SECTION 20 0553
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Equipment Nameplates.
2. Valve Tags.
3. Valve and Equipment Directories.
4. Pipe Identification.
5. Ceiling Markers.
6. Painting of bare and insulated piping systems.
7. Painting of bare and insulated duct systems.

B. Related Sections:

1. 20 0000 – Mechanical General Requirements
2. 23 2113 - Hydronic Piping and Specialties
3. 23 2123 - Hydronic Pumps
4. 23 3400 - HVAC Fans
5. 23 3600 - Air Terminal Units
6. 23 5223 - Cast Iron Boilers and Accessories
7. 23 8200 - Terminal Heating and Cooling Units
8. 23 8318 – Snow Melting Equipment
9. 25 4000 - Variable Speed Drives

1.2 REFERENCES

A. Codes and Standards:

1. ANSI/ASME A13.1-2007 (American Society of Mechanical Engineers) - Scheme for the Identification of Piping Systems.
2. ANSI Z535.1-2006 (R2011) - Safety Color Code.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide equipment nameplates, valve tags and labels for the mechanical systems provided under this contract.
2. Provide labels for piping. Paint exposed piping and pipe insulation in utility and mechanical rooms.
3. Paint exposed new and existing ductwork exposed and visible in the open Library areas.

1.4 SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data:

1. Master Schedule of Equipment:

   a. Submit master schedule of equipment, components, and systems that will be tagged and labeled for the project.

   b. Include the proposed method of labeling to be implemented (nameplate, tag, label/marker, etc.), legend ("Domestic Cold Water," "PMP-1," etc.) and letter/background colors.

   c. Match legend to Contract Document legend, abbreviations, and schedule symbols. Use standard mechanical identification products when available.

2. Valve Directories: Submit separate proposed "Valve Directories" (subset of the master schedule) for each mechanical room that includes the valves located within the applicable space. Include valve designations, a brief description and normal position (open (NO), closed (NC), balanced to X GPM). For Example:

Valve Designator	Description	Normal Position
H-101	BLR-1 Supply Isolation	NO
H-102	BLR-1 Return Isolation	NO
H-103	BLR-1 Flow Balance	150 GPM
P-100	Domestic Water Service Isolation	NO
P-201	Supply Strainer Flush Valve	NC
ETC.		

C. Installation, Operation and Maintenance (IO&M) Manuals:

1. Provide completed, typed "Master Schedule of Equipment."

2. Provide completed, typed "Valve Directories" with balance valve settings obtained from the final balance report.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Marking Services Incorporated (MSI).

B. Seton Identification Products.

C. Craftmark.

D. Approved equal.

2.2 EQUIPMENT NAMEPLATES

A. Plastic Engraved Equipment Nameplates:

1. Minimum letter height: 3/4 inch.

2. Tag size: Minimum 2 inches high, length to fit equipment tag lettering requirements. Provide uniform size for similar types of equipment.
3. Plastic thickness: 1/16 inch minimum.
4. Fastening method:
   a. Mounting holes.
   b. Adhesive backing may be provided for labeling equipment where drilling holes is not feasible, with the pre-approval of the Contracting Agency.
5. Color coding: As designated by the Contracting Agency. If specific direction is not provided, select white letters on black background.
6. Legend: As designated by the Contracting Agency. If specific direction not provided, match scheduled equipment symbols.

2.3 VALVE TAGS

A. General:
1. Small equipment, such as in-line pumps may be identified with tags in lieu of nameplates if inadequate room is available.
2. Provide service indicator on top line of tag, using system abbreviations provided in Part 3 Pipe Identification Table.
3. Provide valve number on bottom line of tag. Start valve numbering with “001” for each legend series/service indicator. Assign valve numbers in a logical sequence from the source (i.e. service water entry point, gas meter service isolation) or heat source (boiler or water heater supply) and continue numbering outward to the most remote terminal connection point.

B. Plastic Engraved Tags:
1. Round, 1-1/2 inches diameter, engraved plastic.
2. Text stamped and filled black:
   a. 1/4 inch service indicator on top.
   b. 1/2 inch valve number below.
3. Beaded chain tag fasteners.
4. Provide tag color coding to match pipe marker coding or as designated by the Contracting Agency.

C. Brass Stamped Tags:
1. Round, 1-1/2 inches diameter, brass with smooth edges.
2. Text stamped and filled black:
   a. 1/4 inch service indicator on top.
   b. 1/2 inch valve number below.
3. Beaded chain tag fasteners.

2.4 VALVE AND EQUIPMENT DIRECTORIES

A. Equipment and Valve Directory Frame:
1. 8-1/2” x 11” aluminum frame with plastic lens.

2. Provide multiple frames as required.

2.5 PIPE IDENTIFICATION, MARKING

A. Identify both service and flow direction.

B. Colors and Lettering: Conform to ANSI/ASME A13.1; see tables under Article 3.2E below.

C. Plastic Pipe Labels:

1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.
2. Larger sizes may have maximum sheet size with plastic nylon ties or straps.

D. Plastic Tape Pipe Labels: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.6 CEILING MARKERS

A. Description:

1. 7/8-inch diameter, color-coded.
2. Metal push tacks or 0.030” rigid vinyl, pressure sensitive stickers.

B. Color code as follows:

1. HVAC equipment: Yellow.
2. Plumbing valves: Green.
3. Non potable water and waste water valves: Orange.
4. Heating/cooling valves: Blue.
5. Fire suppression valves and drains: Red.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to be painted or directly receive adhesive labels. Refer to Division 9 - Finishes.

B. Install identifying devices after completion of coverings and painting.

3.2 INSTALLATION

A. Do not install identifying devices over factory installed equipment labels.

B. Locate identifying devices in clear view for simple identification.

C. Pipe Identification:

1. Identify piping, above the ceiling and exposed in Mechanical rooms, using ANSI A13.1 compliant pipe labels. Identify both service and flow direction in accordance with the following table.

Abbreviation	Legend	Color (Letters/Background)
CW	Domestic Cold Water	White/Green

Abbreviation	Legend	Color (Letters/Background)
HW	Domestic Hot Water	White/Green
HWC	Domestic Hot Water Circulation	White/Green
GHS	Glycol Heating Supply	White/Green
GHR	Glycol Heating Return	White/Green
PG	Propane	Black/Yellow
FOS	Fuel Oil Supply	White/Brown
FOR	Fuel Oil Return	White/Brown
W	Sanitary Drain	White/Green
V	Sanitary Vent	White/Green

2. Pipe label letters shall be a minimum of 1/2" high and increase with pipe diameter as follows:

Pipe Outside Diameter	Letter Height
0.75" to 1.25"	0.5"
1.5" to 2"	0.75"
2.5" to 6"	1.25"
8" to 10"	2.5"
over 10"	3.5"

3. Install labels in unobstructed view and aligned with horizontal or vertical axis of piping as appropriate. For piping located above the normal line of vision, place labels below the horizontal centerline of the pipe for clear unobstructed view from below.
4. Install labels not to exceed 20 foot intervals along straight piping runs (including risers and drops), close to valves, adjacent to changes in direction and branches, on each side of pipe penetrations through walls or floors, and at each access panel.

D. Pipe Painting:

1. Paint new and patched piping insulation exposed in utility areas and mechanical rooms white in accordance with Division 9 - Finishes.
2. Paint new and reworked bare steel piping exposed in utility areas and mechanical rooms black in accordance with Division 9 - Finishes.
3. Paint new and reworked bare steel piping exterior to the building gray in accordance with Division 9 - Finishes.
4. Do not paint non-ferrous piping/tubing, fittings or valves such as copper or bronze.

E. Duct Painting:

1. Paint new and patched duct insulation exposed in utility areas and mechanical rooms white in accordance with Division 9 - Finishes.
2. Paint new and reworked bare duct exposed and visible from below in the Open area of the Library black in accordance with Division 9 - Finishes.

END OF SECTION 20 0553

SECTION 20 0556
INTERIOR TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes general requirements, products, and methods of execution relating to excavation, back-fill, and compaction of inside trenches for mechanical work. Inside trenches are those which occur within an arbitrary, imaginary boundary five feet beyond the outside perimeter of the structure.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 4100 - Mechanical Demolition
3. 22 1300 - Sanitary Waste and Vent Piping and Specialties

1.2 SYSTEM DESCRIPTION

A. Provide trench work for mechanical work of every description and of whatever substance encountered to the depth indicated, or to provide pipe slopes and elevations shown on the Drawings. Excavate and backfill utility trenches. Place and compact bedding material. Compact backfill material.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 TRENCH BACKFILL

A. Obtain trench backfill material from trench excavation. If sufficient suitable trench backfill material is not available from trench excavation, import it from sources approved by the Contracting Agency.

B. Use granular material, free from large stones, boulders debris, and frozen material. Maintain moisture content within a range that will allow specified compaction.

3.2 EXCAVATION

A. Place excavated material suitable for back-fill in an orderly manner, and in conformance with safety codes.

B. Dispose of material not suitable for back filling.

C. Form bell holes so pipelines rest on continuous undisturbed soil. If larger rocks or boulders are encountered, remove them. If trenches are below specified grade, backfill to required depth with select granular materials free from debris, rock, or frozen material, and compact to proper grade before installing piping.

3.3 LOCATION

A. Locate trenches to accommodate utilities shown on the drawings.

B. Excavate trench with adequate width to allow compaction equipment to be used at the sides of pipes.

C. Make trench side slopes conform to prevailing safety code requirements.

3.4 **DEWATERING**

A. Perform whatever work is necessary to prevent the flow and accumulation of surface or ground water in the excavation.

3.5 **TIMING**

A. Do not back-fill until underground mechanical system has been properly tested, inspected and approved.

B. Coordinate with the work of others, and complete trench work in a timely manner.

3.6 **BEDDING MATERIAL**

A. Select bedding material from trench excavation using care to separate it from unsuitable material. If suitable bedding material is not available from trench excavation, import it from sources approved by the Contracting Agency.

B. Use granular material, free from large stones, boulders, debris, and frozen material. Maintain moisture content within a range that will allow specified compaction.

C. Do not use any frost susceptible materials.

3.7 **BEDDING**

A. Place bedding material under, around, and over the pipe in lifts not exceeding six inch in depth.

B. Work material around pipe by hand methods, taking care to keep any oversize or sharp stones out of contact with the pipe, and to provide uniform support for the pipe.

C. Cover pipe with bedding material to building sub-grade or to a minimum 12-inch depth before adding other backfill.

3.8 **BACKFILLING**

A. Continue placing backfill material until trench is completely filled to building sub-grade, or as shown on the Drawings.

B. Place backfill material in lifts not to exceed 6-inches in depth.

3.9 **COMPACTION**

A. Compact bedding material to at least 95 percent of maximum density, taking care not to damage the pipe.

B. Compact backfill under footings, slabs, and other structures to 95 percent of maximum density or more, if required by the Contracting Agency. Where 95 percent compaction cannot be achieved, fill remaining voids with concrete.

C. Compact other areas to preclude future settlement, or at least to 85 percent of maximum density.

3.10 **FINISHING**

A. After completion of backfilling, dispose of excess material and smooth the surface to grade.

B. Do not allow heavy equipment to be used over backfilled work that does not have sufficient cover to prevent pipe damage.

3.11 SPECIAL PRECAUTIONS

A. Avoid unauthorized and unnecessary excavations.

B. Minimize number and size of excavations under footings or bearing walls.

C. Support footings, foundations, and walls with timbers and jacks if there appears to be any possible chance of damage, and keep such precautions in place until work is completed and sufficient backfill is in place to eliminate possible damage.

D. Avoid damage to existing underground services, cables, conduit lines or foundations. Repair any existing underground work damaged at no additional cost to the Owner.

E. Protect excavated materials from moisture during the period prior to reinstallation.

END OF SECTION 20 0556

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SECTION 20 0700
MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Specific requirements, products and methods of execution which relate to the insulation of ducts, fittings, equipment, pipes and other surfaces of the mechanical installation.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 22 1100 - Domestic Water Piping and Specialties
3. 22 1300 - Sanitary Waste and Vent Piping and Specialties
4. 22 4000 - Plumbing Fixtures
5. 23 2113 - Hydronic Piping and Specialties
6. 23 3100 - Ducts and Accessories

1.2 DESCRIPTION

A. Provide thermal insulation for ventilation system ductwork and building service piping.

B. Provide insulation for exposed ADA plumbing fixture piping.

1.3 REFERENCES

A. International Building Code (IBC).

B. International Mechanical Code (IMC).

C. International Energy Conservation Code (IECC)

D. ASHRAE 90.1 - 2010 Energy Standard for Buildings Except Low-Rise Residential Buildings

E. NFPA 90A - 2012 Standard for the Installation of Air Conditioning and Ventilating Systems.

F. NFPA 90B - 2006 Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

1.4 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Qualifications: Submit manufacturer and Applicator qualifications, showing compliance with Article 1.5.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years' experience.

1.6 **ENVIRONMENTAL REQUIREMENTS**

A. Maintain ambient conditions required by manufacturer of each product.

PART 2 - PRODUCTS

2.1 **FIRE RATING OF MATERIALS**

A. Provide insulation products used aboveground in building with burning characteristics in compliance with NFPA Standards 90A and 90B: Flame Spread 25, Fuel Contributed 50, Smoke Developed 50. Tested according to UL 723, ASTM E84, or NFPA 255.

B. Insulation specified for use underground and aboveground away from the building might have other burning characteristics. Use such products only where specifically required.

2.2 **FIBERGLASS INSULATION**

A. Piping: Provide insulation products as follows:

1. Thermal conductivity K equals 0.24 at 100 degrees F. mean temperature, ASTM C335.
2. Factory applied vapor-barrier, flame retardant all service jacket and tape, with permeability rating equal to 0.02 perms, ASTM E 96.
3. Temperature limits for fiberglass pipe insulation: 350 degrees F, unless otherwise indicated.
4. Manufacturers: Johns Manville, Owens Corning, Knauf Fiber Glass, or approved equal.

B. Ductwork: Provide insulation products as follows:

1. Flexible insulation: Average thermal conductivity K equals 0.24 at 75 degrees F. mean temperature at 1.5 pcf density, ASTM C335.
2. Rigid insulation: Average thermal conductivity K equals 0.24 at 75 degrees F. mean temperature at 3.0 pounds per cubic feet (pcf) density, ASTM C518.
3. Factory-applied vapor barrier flame-retardant Foil-Scrim-Kraft (FSK) or all-service jacket and tape, with permeability rating equal to 0.02 perms, ASTM E 96.
4. Temperature limits for fiberglass duct insulation: 250 degrees F. unless otherwise indicated.
5. Manufacturers: Johns Manville, Owens Corning, Certainteed, Knauf Fiber Glass, or approved equal.

2.3 **REMOVEABLE VALVE INSULATION:**

A. 1 inch thick fiberglass insulation with Tyvek cover.

B. Provide for valving.

C. No Sweat Valve Wraps or equal.

2.4 **FIXTURE INSULATION ASSEMBLY**

A. Protective, molded, fire-resistant foam insulation, single piece insulation manufactured specifically for plumbing fixture supplies and drains.

B. 4.5 lbs per cubic foot foam with insulation R factor 2, white fire retardant polyurethane integral skin, twist fasteners.

C. Manufacturer: Skal+Gard, Model SG-100B, TCI Products, or approved equal.

2.5 **CANVAS JACKETING**

A. Insulating Lagging Canvas: Eight ounces per square yard minimum, fire-retardant material complying with fire ratings specified above. Manufacturer: Chas Harmon "Osnaberg", Claremont Company Inc., “Claretex”, or approved equal.

B. Lagging Adhesive: Plastic synthetic resin emulsion adhesive; watertight, mildew resistant, fire retardant. Manufacturer: Childers Chil-Perm CP, Foster® Sealfas® coating 30-36, or approved equal.

2.6 **METAL JACKETING**

A. 27 gauge (U.S. Standard) heavy corrugated aluminum.

B. Preformed fitting covers.

2.7 **PVC JACKETING**

A. 20 mil thick, white, PVC jacketing.

B. Plenum rated; flame spread less than 25 and smoke developed rating less than 50 per ASTM E84.

C. Manufacturer: Speedline 25/50 Smoke-Safe PVC or equal.

2.8 **COATINGS**

A. Coatings: UL labeled.

B. On cold or dual service lines, use vapor barrier type coatings.

2.9 **PREFORMED FITTING COVERS**

A. One piece premolded PVC jacketing and fitting covers specifically designed for the service intended.

B. Install per manufacturer's instructions and secure with manufacturer's color matching PVC tape.

C. Manufacturer: J-M “Zeston”, TeeCee, Proto, Certainteed.

PART 3 - EXECUTION

3.1 **GENERAL**

A. Do not apply insulation materials until surfaces to be covered are clean and dry and foreign material such as rust, dirt, etc. is removed. Keep insulation clean and dry during installation and during the application of any finish.

B. Do not install the insulation on pipe fittings and pipe joints until the piping has been tested and approved.

C. Do not install the insulation on ducts or fittings until the ductwork has been tested and approved.

D. Do not apply under conditions of excessive humidity or at temperatures below 50 degrees F. or above 100 degrees F.

E. Provide insulation support blocks, shields, and transitions for hangers, supports, anchors, and guides. Coordinate insulation requirements through rated assemblies and Listing penetration's requirements.

F. Adjust hangers, guides, anchors, and supports after insulation installation has been approved.

3.2 PIPE INSULATION

A. Cold Piping:

1. Includes domestic cold water, plumbing, and vents through roof.
    a. Insulate plumbing vents from three feet below the under deck of the roof to the termination above the roofline.
2. Insulate with sectional fiberglass and provide a completely sealed vapor barrier. Provide insulation thickness per Insulation Thickness Table.
3. Insulate valves, unions, flanges, fittings, tanks, vessels, air separators, heat exchangers, and similar components, except where indicated otherwise.

B. Hot Piping:

1. Includes domestic hot water supply and recirculation, and hydronic heating.
2. Insulate with sectional fiberglass. Provide insulation thickness per Insulation Thickness Table.
3. Insulate valves, unions, flanges, fittings, tanks, vessels, air separators, heat exchangers, steam and process vents, and similar components, except where indicated otherwise.

C. Buried Piping. Insulate with flexible foam plastic insulation; glue seams with manufacturers recommended cement.

D. In addition to specified jackets, provide PVC jacket on piping insulation anywhere piping is exposed below eight feet zero inches above floor in mechanical rooms.

E. Insulation Thickness Table (units are in inches):

Fluid Design Operating Temperature Range	Less than 1	1 to <1-1/2	1-1/2 to <4	4 to <8	8 and up
Heating Systems (Water and Glycol Solutions) and Domestic (Hot Water and Hot Water Circulation):					
141 °F to 200 °F	1.5	1.5	2	2	2
105 °F to 140 °F	1.5	1.5	2	2	2
Domestic Cold Water:					
All	1	1	1.5	1.5	1.5
Rain leaders, Plumbing vents through roof:					
All	1	1	1.5	1.5	1.5

3.3 TECHNIQUE FOR APPLICATION TO PIPES

A. Close longitudinal joints of pipe insulation firmly and butt insulation sections firmly together. Neatly and smoothly adhere laps and butt strips.

B. Clean the contact area on jacket for adhesive lap strips and butt strips so it is free from fingerprints, oil, construction dust and other contaminants. Clean surfaces with tack rags, methanol, or other suitable agent before attempting to adhere the strip. Apply pressure to adhesive strip with suitable tool immediately after adhering. Remove insulation with inadequately sealed joints and install new sections. Outwardly clinching staples may be used to reinforce joints.

C. Continuously seal vapor barriers. If staples are used at laps, seal the entire length of stapled lap with adhesive jacket tape applied as specified above for laps and butts. Sectionalize vapor barrier by sealing ends of insulation sections at not more than 25 feet intervals, to prevent moisture migrating lengthwise. Apply butt strips over joint as above.

D. Provide double insulation thickness on piping in outside walls and within five feet of vehicle doors or other large openings.

E. Except as indicated, locate pipe hangers and rollers outside insulation. Provide insulation saddles or sheet metal shields around insulation. On pipes two inches and larger, within the area of each insulation shield, use calcium silicate or cellular glass on the lower half of the insulation, equal in thickness to adjacent insulation.

F. Where piping is installed outdoors, provide two-layer glass cloth and four-layer weatherproof vapor barrier adhesive coating, in addition to jacket specified.

3.4 TECHNIQUE FOR APPLICATION TO PIPE FITTINGS, EQUIPMENT, AND VALVES

A. Insulate fittings, valves, and flanges to the same thickness as the pipe insulation.

B. Any of the following methods of insulation are acceptable:

1. Blanket Wrap: Wrap the fitting with compressed glass fiber blanket. Wire the blanket securely in place and cover with a smooth layer of insulating/finishing cement. Cover with glass mesh tape, adhering it with an adhesive coating.

2. Fabricated Segments: Cut mitered segments from pipe insulation that has the same wall thickness as adjacent pipe insulation to form a cover which will fit snugly around the fitting. Wire the segments firmly in place and seal the joints with insulating/finishing cement. Apply adhesive coating and wrap with glass mesh tape, then apply another layer of the same coating over the whole assembly.

3. Cement: Apply insulating or insulating/finishing cement, molding it to the contour of the fitting. When area is large, apply an under layer of cement, wrap this with glass mesh tape, then apply an outer layer of cement. If the insulation is not concealed the exposed surface of insulating/finishing cement shall have a final glass mesh tape wrap embedded in adhesive.

C. In each of the listed methods, to protect the insulation against contact damage, apply an adhesive coating when the cement is completely dry and hard, then wrap with glass mesh tape. Apply another coating of adhesive over the whole assembly.

D. In each of the listed methods, pre-formed fitting covers may be substituted for the tape and adhesive covering specified. Cement and tape fitting covers on cold piping to provide a positive vapor barrier.

E. Removable insulation blankets or covers of comparable insulation value for valves and where equipment require frequent adjustments or maintenance shall be provided; identify and coordinate during submittal process.

F. After insulation has been installed adjust hangers for proper fit, maintain pipe grade and support.

3.5 DUCT THERMAL INSULATION REQUIREMENTS

A. Insulate ductwork as follows:

1. Insulate outside air intake ducts from air intake louver connection to equipment connections (including insulated isolation damper frame) with 1.5-inch rigid or semi-rigid board insulation.
2. Insulate exhaust and relief ducts from point of discharge to and including back draft damper support frame with 1.5 inch rigid or semi-rigid board insulation.
3. Relief air and exhaust air ductwork: Insulate relief air and exhaust air ductwork with 1-1/2” inch fiberglass insulation from exterior wall penetration to a minimum of 6 inches upstream of the isolation damper.

B. Insulation Type and Finish:

1. Rigid or semi-rigid board where canvas or metal jacket is specified. May also be used in place of blanket insulation where practical.
2. Blanket insulation where rigid board is not specified or indicated. Proper installation is critical. Loose joints and sagging insulation shall require reinsulation of entire branch or main duct before acceptance and during warranty period.
3. Fiberglass or canvas jacket over board insulation in mechanical and boiler rooms less than 10 feet above finish floor, where exposed in finished rooms and where indicated. Seal jacket with vapor barrier lagging adhesive.
4. Ductwork insulation to have a completely sealed vapor barrier, except segmental insulation on medium/high velocity trunk ducts and warm air ducts in concealed spaces, where approved.

3.6 DUCT SOUND INSULATION REQUIREMENTS

A. Refer to Section 23 3100 - Ducts.

B. Install where shown.

C. Install in accordance with manufacturers installation instructions. Completed installation shall be fastened tightly to ductwork and free of sags.

3.7 TECHNIQUE FOR APPLICATION TO DUCTWORK

A. Rigid and Semi-rigid Insulation:

1. Impaling Over Pins: Install insulation with edges tightly butted using adhesive and metal pins. Impale insulation on pins welded to the duct and secure with speed clips. Trim off pins close to speed clip. Space pins as required to hold insulation firmly against duct surface but not less than one pin per square foot.
2. Other Method of Securement: If the welded pin method is not feasible, secure the insulation to the duct with adhesive. Cover the entire surface of the metal with adhesive when applying to the underside of horizontal ducts. Application to top and sides may be

in strips with a minimum of 50 percent coverage. Additionally, secure insulation with No. 16 galvanized wire on not more than 12 inches on center. Provide metal angle at corners to protect edges of insulation.

3. Vapor Barrier: Seal joints and speed clips with adhesive tape of similar construction to insulation jacket. Thoroughly clean contact surfaces for adhesive as specified under pipe insulation technique. Glass cloth tape set in adhesive may be used. Provide metal or plastic corner angles within eight feet of floor, walkway, or stairs.

4. Provide fiberglass or canvas jacket where specified. Completely cover with minimum 1/8" lagging adhesive. Cover canvas with two heavy coats of same adhesive and completely fill the weave. Inspect when dry for complete vapor barrier throughout and refinish as required.

B. Blanket Insulation:

1. Position insulation so that longitudinal seam will be underneath and not supporting weight of sheet. Remove a uniform strip of insulation from backing to provide a lap strip. Butt insulation and secure lap strip with outwardly clinching staples.

2. Use pins to secure blanket on large flat areas as specified for rigid insulation. Reinforce jacket at pin penetration where required.

3. Seal laps, staples and butt joints with adhesive tape of similar construction to insulation jack. Seal speed clips if used. Thoroughly clean contact surfaces for adhesive as specified under pipe insulation technique.

4. When system is under pressure, inspect insulation for inflation caused by improperly sealed ducts. Repair duct seal and reinsulate as necessary.

5. The Contracting Agency may inspect completed insulation and test taped joints for adhesion. Seal laps and butt tapes that can be removed with reasonable force shall require that entire branch or trunk duct be reinsulated.

3.8 FIXTURE INSULATION ASSEMBLY

A. Insulate hot water supply and waste piping exposed beneath sink and lavatory fixtures designated on drawings or specified in Section 22 4000 - Plumbing Fixtures, as intended for use by the handicapped. Install in accordance with ANSI A117.1. - 2009.

3.9 PAINTING

A. Paint exposed insulation in utility areas, service areas and mechanical rooms in accordance with Division 9 - Finishes.

B. Color shall be white.

END OF SECTION 20 0700

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SECTION 20 4100
MECHANICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Demolition and removal of selected mechanical systems, equipment and selected components.

B. See Division 1 for general demolition requirements and disposal of demolished materials.

1. Coordinate the demolition and disposal of materials and equipment with Contracting Agency.
2. Provide Contracting Agency with the first right of refusal for the salvage of demolished equipment and materials.

C. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 25 5000 - Building Automation System

1.2 DEFINITIONS

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

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

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

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

1.3 SUBMITTALS

A. Submit a demolition and construction plan for review by the Contracting Agency prior to beginning work. Describe procedures that will be used to protect and maintain cleanliness of the adjacent building areas/systems during construction.

1.4 QUALITY ASSURANCE

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

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

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

D. Pre-demolition Meetings: Conduct coordination meetings prior to demolition as required by Division 1.

1.5 **PROJECT CONDITIONS**

A. Drawings and specifications involving existing conditions are based on building record drawings and limited field observation. Provide field verification. Addition building record drawings are available from the Owner with a written request.

B. Notify Contracting Agency of discrepancies between existing conditions and the Contract Documents before proceeding with demolition.

C. Maintain existing utilities to the maximum extent possible. Coordinate outages, if necessary, in accordance with Division 1.

D. Maintain fire-protection systems in service during mechanical demolition operations.

E. Storage or sale of removed items or materials on-site is not permitted.

1.6 **WARRANTY**

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. Drawings and specifications involving existing conditions are based on building record drawings and limited field observation.

B. Conduct a site inspection prior to submission of Bid to become thoroughly familiarized with the Scope of Work. Review actual site conditions and compare with the Contract Documents mechanical demolition drawings. Obtain direction from Contracting Agency for identified conflicts.

C. Inventory and record the condition of items to be removed, removed and reinstalled or removed and salvaged. Provide Contracting Agency with first right of refusal for the salvage of demolished equipment and materials.

D. Verify field measurements, locations, sizes, and routing arrangements and site conditions.

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

F. Commencement of demolition implies Contractor accepts existing conditions.

3.2 **PREPARATION**

A. Maintain existing utilities in operation to the maximum extent possible during the selective demolition of mechanical systems. When utility outages are necessary, coordinate outages and their duration with Contracting Agency in accordance with Division 1. Arrange to shut off indicated utilities with utility companies.

B. “Tag” equipment and systems to be demolished. Identify the extent to which each system will be demolished.

C. Locate, identify, isolate, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

D. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

E. Coordinate with the Contracting Agency to provide a central staging area for the temporary storage of demolished equipment and systems.

3.3 DEMOLITION - GENERAL

A. General:

1. Demolish and remove existing mechanical equipment and systems only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
2. Terminate ductwork and piping back to branch connections and replace tees and fittings with straight couplings. Terminate electrical circuits back to panel (See Divisions 26, 27 and 28). Remove unused ductwork, piping, conduit and associated hangers and other support devices.
3. Abandonment in place of unused equipment and systems affected by the remodel is not allowed.
4. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
5. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
6. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
7. Promptly transport and dispose of demolished equipment, systems and material at the closed, approved dump site.
8. Heating System: Drain, flush and clean the existing hydronic heating systems throughout the entire building. Dispose of existing circulation solutions in an approved manner.

B. Controls:

1. Sequence limited demolition of the controls system.
2. Limited schedules outages are acceptable for system cross-over.
3. Coordinate outages with Contracting Authority 24 hours in advance of the scheduled outage.

C. Indoor Air Quality:

1. Maintain cleanliness and indoor air quality in areas adjacent to construction areas.
2. Submit a demolition and construction plan for review by the Contracting Agency prior to beginning work.

3. Reference SMACNA IAQ Guidelines for Occupied Buildings Under Construction - First Edition - November 1995.

D. Fire Protection: Notify the Contracting Agency and the Fire Department Agencies at least 24 hours before partially or completely disabling Fire Protection Systems.

E. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Contracting Agency.
4. Transport items to Contracting Agency designated on-site storage area.
5. Protect items from damage during transport and storage.

F. Removed and Reinstalled Items:

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

G. Existing items to Remain:

1. Protect construction indicated to remain against damage and soiling during selective demolition.
2. When permitted by Contracting Agency, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.

3.4 CLEANING AND REPAIRS

A. Plug, patch and repair surfaces, adjacent construction, and finishes damaged during demolition and new work. Restore to original condition or better. Retexture surfaces to match surrounding surfaces. Repaint affected surfaces, with extent of paint to include adjacent surfaces to next wall or other clean break to avoid mismatched finish. Repair fire proofing.

B. Clean construction areas after completion of the project. Wipe down new and existing surfaces including but not limited to walls, floors, ductwork, piping and equipment. Clean adjacent equipment and systems to remain and building surfaces of dust, dirt, and debris caused by demolition operations.

C. Return adjacent areas to the condition existing before demolition operations began.

END OF SECTION 20 4100

SECTION 21 1000
WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes performance requirements, products, and methods of execution relating to fire suppression for the project. The contract documents have performance, materials, and installation requirements which exceed code and standard minimums. This Section is substantially a “performance” specification.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 28 3100 - Addressable Fire Alarm System
3. 28 3113 - Fire Alarm and Detection

1.2 REFERENCES

A. Provide fire suppression in accordance with the provisions of the following codes and standards:

1. International Fire Code - 2012, IFC.
2. International Mechanical Code - 2012, IMC.
3. International Building Code - 2012, IBC.
4. Uniform Plumbing Code - 2015, UPC.
5. NFPA 13 – 2010, Installation of Sprinkler Systems.
6. NFPA 25 - 2011, Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
7. NFPA 70 - 2017, National Electric Code, NEC.
8. NFPA 72 – 2010, National Fire Alarm and Signaling Code.
9. ASCE 7 - 10, Minimum Design Loads for Buildings and Other Structures.
10. Foundation for Cross-Connection Control and Hydraulic Research, 9th edition, University of Southern California.
11. Underwriters Laboratories, UL, Fire Protection Equipment Directory.

A. Standards: Reference to the following standards infers that installation, equipment and material shall be within the limits for which it was designed, tested and approved, in conformance with the current publications and standards of the following organizations:

a. American National Standards Institute - ANSI.
b. American Society of Heating Refrigerating and Air Conditioning Engineers - ASHRAE.
c. American Society of Mechanical Engineers - ASME.
d. American Society for Testing and Materials - ASTM.
e. National Electrical Manufacturers' Association - NEMA.
f. National Fire Protection Association - NFPA.

1.3 SYSTEM DESCRIPTION

A. Provide complete wet and dry pipe automatic fire sprinkler systems, hydraulically calculated using density/area method to protect the entire facility and fully operational.

B. Demolish portions of the dry system piping and heads in the covered entrance walkway to be demolished.

C. Demolish portions of the preaction system piping and heads to accommodate the new floorplan.

D. Coordinate and provide effort to support the new floorplan and ceilings.

E. Extend the existing wet, dry and preaction systems to provide coverage for the building additions and the renovated portions of the building. Existing wet, dry and preaction system risers to be reused, if possible, field verify. Refer to fire suppression reference drawing (1 page) contained in the selected original construction drawing found in the appendices. Field verify existing conditions.

F. Comply with the Contract Documents requirements, applicable codes and standards, as well as the Authority Having Jurisdiction (AHJ) requirements. The contract documents have performance, materials, and installation requirements which exceed code minimums.

G. Provide sprinklers utilizing systems compatible with the specific application throughout the building, including outside covered entry canopies, library stack areas, mechanical and electrical areas, and all building areas as shown and described in the contract documents. Work includes complete installation of sprinkler heads in finished ceilings. Sprinkler head layout to be reviewed and approved by the Architect. Sprinkler head layout to be centered both directions in the ceiling tiles.

H. Provide a complete fire suppression system fully operational in accordance with the contract documents and the applicable codes and standards, as well as the Authority Having Jurisdiction requirements to protect the building.

I. Provide seismic anchoring, bracing, supports, and clearance for equipment, pipes and sprinkler heads per NFPA 13, International Building Code, and ASCE 7; most conservative criteria shall govern.

J. Provide labor, materials, and equipment as required to test sprinkler system as required per NFPA 25. Test shall be coordinated with Contracting Agency for specific systems and areas.

K. Provide listed sprinkler flex hose for sprinkler heads in new or reconfigured suspended ceiling assemblies. Other methods to maintain required clearances are not allowed.

L. Provide 1” clear in horizontal directions from sprinkler heads with a 2” oversized ceiling tile hole with an oversize ring, sleeve, adaptor, or listed sprinkler flex hose for sprinkler heads in suspended ceiling assemblies per ASCE 7-05 requirement in existing ceilings to remain.

M. Provide a test valve at the hydraulic remote area in both dry and wet systems to equal the required flow of one or more sprinklers head.

N. Work includes complete installation of pipes and sprinklers in many types of spaces and finished ceilings, architectural features, and building lines. Route pipes above ceilings where

possible. Exposed pipes shall follow architectural elements/building lines for visual and symmetric appearance. Design and installation of sprinkler systems shall incorporate aesthetic review comments by the Architect including: routing and concealment of lines, exposed pipe, sprinkler head finish and locations, and exterior penetrations.

O. Sprinkler systems shall follow these general requirements:
   1. All areas and spaces shall be protected by the automatic sprinkler systems.

P. Dry pipe and double interlock systems shall be required to provide water delivery per NFPA criteria and in 60 seconds or less, regardless of the system size. Design shall incorporate provisions for testing dry pipe system before substantial completion. Locate inspector's test connection arrangement at the most remote branch line at the highest elevation.

Q. Modify and extend the existing dry pipe, automatic sprinkler system serving the covered entry area is to be removed to provide full coverage for the new covered entry areas.

R. Modify and extend the existing wet pipe, automatic sprinkler system to provide full facility coverage. See architectural drawings for extents of demolition, renovation and addition.

S. Modify and extend the existing preaction wet pipe, automatic sprinkler system serving the book stack storage areas in the open area of the Library to provide full coverage.

T. Provide complete building interface with building smoke and fire alarm and detection systems including fire alarm control panels, pre-action panels, and graphical displays.

1.4 SUBMITTALS

A. Submittals shall be complete for review. Drawings, calculations, and product cutsheets shall be complete and submitted together in one package. See Section 20 0000 - General Mechanical Requirements for additional requirements not covered below.

B. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents.
   1. Submittals will not be checked for quantity, dimension, fit, or for proper technical design of manufactured equipment.
   2. Providing a complete and satisfactory working installation is the responsibility of the Contractor.
   3. Product data, shop drawings, and calculations shall be submitted together for review. Partial submittals will not be reviewed.

C. Electronic Submittals:
   1. Provide electronic submittal in PDF format.
   2. Provide electronic bookmarks within the PDF document in place of tabs and sub-tabs.

D. Product Data:
   1. Submit product data for items specified in Part 2 and those products required by the performance standards of this Section. Identify catalog designation and/or model number and neatly annotate each salient characteristic and design option of the product. Identify operation characteristics, performance curves and rated capacities of products and devices to show compliance with shop drawings and calculations.

2. Provide exterior and interior signage with placement locations indicated on shop drawings.
3. Provide data on firestopped penetrations, including product being submitted, the rating of the assembly it will be used for, and the applicable Through Penetration Firestop System drawing(s) from the UL Fire Resistance Directory.

E. Shop Drawings:

1. Submit Authority Having Jurisdiction approved sets of shop drawings and calculations. Drawings and calculations shall include the NICET certification and State of Alaska Permit IIC or IIC-DO number and signature, or signed seal of a licensed professional engineer, and the fire suppression Contractor's Alaska specialty license number.
2. Shop drawings shall be submitted with information in compliance with NFPA 13 and other performance standards of this Section. Shop drawings shall include but not limited to the following:
    a. Name of Contracting Agency, Occupant and Building Permit number.
    b. Location, including street address and legal description.
    c. Point of compass.
    d. Fire Department connections.
    e. Necessary controlling equipment.
    f. Location of water source, type, routing, depth of bury, and size of supply pipes. Identify location and size of city main and whether it is dead-end or circulating loop and distance to the flow data test hydrant.
    g. Distribution system pipes and outlets. Include pipe and fitting types.
    h. Sprinkler connection, drop, details including supports required for flex pipe.
    i. Supports, brackets, restraints, and seismic attachments details and schedules.
    j. Reflected ceiling plan showing ceiling heights, construction type, proposed location and type of sprinkler heads, and other ceiling devices such as HVAC diffusers, loud speakers, type and location of light fixtures, etc.
    k. Interference control between sprinkler system and other trades.
    l. Full height cross section, indicating basic building construction system, sprinkler piping arrangement, and elevation of the highest sprinkler head.
    m. Location of partitions. Identification of full height walls and draft stops.
    n. Location and size of unprotected concealed spaces.
    o. Identification of unheated areas and areas that cannot be reliably maintained above 40 degrees F.
    p. Water flow test results: Include testing agency, time, date, and location of test.
    q. Make, model, type, orifice, finish, color, and temperature rating of sprinklers and their respective locations.
    r. Sprinklers with sprinkler guards.
    s. Extended coverage sprinklers.
    t. Corrosion resistant sprinklers.

u. Ceiling slopes greater than 2 to 12 shall be identified.

v. Clearly identify each hydraulic remote area and associated calculations with hazard type and density.

w. Hydraulic node points.

x. The square footage area protected by each system.

y. Make, model, and size of valves and equipment, including: control valves, pre-action, deluge, alarm valves, check valves, hose valves, and related appurtenances.

z. Identify drum drip drains, main drain, low point drains, drain receptors, and inspector test stations.

aa. Indicate the type and location of pipe hangers, equipment supports, seismic movement, and seismic restraints.

bb. Make, model, size, and locations of pipe couplings, fittings, and flanges.

cc. Make, model, size, power requirement, and location of alarm bells, buzzers, detectors, switches, air compressors, and panels.

dd. Provisions for flushing and backflow device system demand forward flow test and test discharge to safe location.

ee. Name, address, and telephone number of the fire protection specialty Contractor. If design is by a separate firm, include the name address, telephone and fax numbers, and email of the design firm.

ff. Complete legend of abbreviations and symbols indicated.

gg. Complete schedule of room occupancies.

hh. Location of structural penetrations and verification that structural penetrations have been coordinated and approved.

ii. Note the size, location, and extent of “exposed” pipes. Identify exposed piping visible from below on the shop drawings by highlight the piping in a green color.

jj. Location of fire rated assemblies.

kk. Total number of sprinklers on each dry-pipe or pre-action system.

F. Design Data:

1. Submit Authority Having Jurisdiction approved sets of calculations. Drawings and calculations shall include the NICET certification and State of Alaska Permit IIC or IIC-DO number and signature or stamp of a licensed professional engineer and the fire suppression Contractor’s Alaska specialty license number. Submit complete hydraulic calculations which were used to prepare the final design drawings. One set will be retained by the Engineer.

2. Product data, shop drawings, and calculations shall be submitted together for review; partial submittals not allowed.

3. Systems shall be limited to a maximum of 175 psig, unless otherwise approved. Systems requiring pressures 175 psig and higher shall have pressure reducing valves, controls, and related equipment incorporated.

4. Submit water flow information used for hydraulic calculations:

a. If the Contractor conducts the flow test, a representative of the AHJ and Contracting Agency shall witness the test. Submit a written procedure and certification for the test, which shall be in compliance with NFPA 13 and NFPA 291 for flow testing water supplies and approved by the AHJ.

b. Hydraulic calculations shall be accomplished in compliance with the procedures established in NFPA 13.

c. For each zone hydraulic calculations shall be accomplished in compliance with the procedures established in NFPA 13.

d. Hydraulic calculations accomplished by computer program for submittal shall be accompanied by a complete legend of the abbreviations, nodes, and symbols utilized on the computer printout.

e. Hydraulic calculations shall follow NFPA 13 requirements and shall clearly identify the following:

1). Sprinkler type and “K” factor.

2). Pipe and fittings type, size, and inside diameter.

3). Fitting equivalent length chart that complies with the “C” factor and pipe type.

4). NFPA hazard designation, design density, and size of the design remote area.

5). The elevation of the “highest” sprinkler.

6). Extended coverage sprinklers shall include design pressure and coverage identified on the drawings and manufacturer's product information to confirm usage. Hydraulic calculations shall identify extended coverage sprinklers and operating pressure.

7). The available water supply and system demand at the point of connection to the water supply, indicated on a logarithmic graph and required safety factors. Include hose demands.

f. Equipment, pipe, fittings, and sprinklers used in calculations shall match installed system. Variances shall require redesign and installation by contractor.

G. Quality Assurance/Control Submittals:

1. Design Data: Provide hydrant flow test reports or other information used for design.

2. Certificates Initial Submittal:

a. Submit Contractor's qualifications, proof of three years’ experience under this Contractor’s firm name, and references for at least five projects in Alaska of similar type, size, or complexity.

b. Submit a copy of designer's NICET certification and resume', Alaska Permit number and level or Alaska P.E. license number.

c. Submit a copy of backflow assembly tester qualifications and certificate.

d. Submit a copy of Contractor's State of Alaska Fire Protection Permit and Administrator's License for the appropriate type of systems provided.

e. Welding materials, procedures, welder qualifications, quality control and quality assurance, and records shall meet NFPA 13 as minimum requirements. Provide the following submittals:

1). Welder qualifications.

2). Welding procedures to be used for specific pipe and fittings.

3. Certificates Post Construction:
   a. Submit a letter of certification for backflow assembly installation and testing, signed by the installer/tester.
   b. Provide copy completed of the Contractor's Material and Test Certificate for Above Ground Piping.
   c. Provide test report for hydrostatic test of piping.
   d. Provide test report confirming proper operation of tamper, supervisory, and flow, switches and system alarms.
   e. Provide test report for trip test of dry pipe system.
   f. Provide a letter of certification stating that testing and flushing has been performed in accordance with the applicable codes and standards. Itemize codes and standards complied with.
4. Provide Manufacturer's Installation Instructions, and Manufacturer's field reports.
5. Fire suppression system shall be installed, tested, as-builts completed and installation approved by the Authority Having Jurisdiction, AHJ, before substantial completion request or notification is made.
6. Significant changes in piping due to on site coordination with other trades and existing conditions shall require hydraulic recalculation to confirm adequate pipe sizing and be resubmitted to AHJ and Contracting Agency's Insurance agency.

H. Review, Approvals, and Permits Required
1. Obtain written review and/or approval of the entire fire suppression system design and arrangement from the following authorities:
   a. Contracting Agency - (Approval).
   b. Authority Having Jurisdiction, AHJ - (Approval).
   c. Architect - (Review).
   d. Mechanical Engineer - (Review).
2. Comply with the above review comments, revising the system design as required, and resubmitting in a timely manner, so as not to hinder the construction schedule.
3. Obtain and pay for required permits, inspections, tests, and approvals as required by Authority Having Jurisdiction.

I. Operation and Maintenance Manual Submittal:
1. Include manufacturers' descriptive literature, operating instructions, installation instructions, testing certificates, maintenance and repair data, parts listings, and spare parts list.
2. Electronic copy of the Authority Having Jurisdiction approved hydraulic calculations, drawings, and their review letter.
3. Table showing NFPA 25 maintenance requirements.

4. Provide an electronic copy of operations and maintenance manual in PDF format with bookmarks matching table of contents, including as-built shop drawings with each required paper copy.

J. Closeout Submittals:

1. Refer to Division 1 for general procedures for submittals.
2. Project Record Documents: Record actual locations of components and locations of access doors required for access or valving.
3. Warranty: Submit manufacturer warranty and ensure forms have been completed in Contracting Agency's name and registered with the manufacturer.
4. Submit a written affidavit at the completion of the system, stating that the fire suppression system as installed complies with referenced Codes and Standards, Authority Having Jurisdiction requirements.
5. Provide written warranty as specified in Division 1. Furnish written guarantee to the Contracting Agency, that materials installations are free from mechanical defects and guaranteeing to replace and repair any and all unsatisfactory and defective work and items, to the satisfaction of the Contracting Agency, in a timely manner for a period of one year after final acceptance of the Contracting Agency, and to be responsible for any damage caused to the premises for any such unsatisfactory work.
6. Issue a minimum one set of full size as-built drawings and maintenance data to the Contracting Agency's designated maintenance personnel, in addition to required submittals.
7. Train the Contracting Agency's designated maintenance personnel in the operation and maintenance of the fire suppression system. Minimum 4 hours of training is required.

K. Maintenance Information and Framed Building Plan:

1. Coordinate with Section 28 3100 - Addressable Fire Alarm for fire alarm graphical displays and maps.
2. Provide information for a complete 1/16" scale building floor plan showing system control valves, drain stations, alarm and control panels, test valves, and other primary fire suppression devices. Indicate sprinkler zones, boundaries, and types of systems. Each zone shall be assigned a unique sequential identifier number. Submit this plan prior to substantial completion for review by the Contracting Agency.
3. Orient the floor plan in a manner that is consistent with the building. Rotate graphic layout as required to show North, South, East, and West, as it applies to the building.
4. Enclose the plan in a professionally fabricated metal picture frame with 1/8 inch rigid clear plastic cover. Minimum 1 inch frame width. Locate the framed plan in the fire suppression control valve room on the wall with the spare sprinkler cabinet.
5. Include step by step instructions to place the fire suppression system in service as well as to take it out of service. Provide complete maintenance information of primary fire suppression equipment, valves, fittings, sprinklers. Identify equipment indicating whether devices are replacement items or repairable. Provide parts list and suppliers for repairable items.
6. Include step by step procedures for required operational weekly/monthly/annual service and testing as required by NFPA 25. Provide a complete report of field test operations and results prior to substantial completion.

L. Record Drawings:

1. Maintain current and up-to-date As-Built prints of the fire suppression system at the job site.

2. Approved full size As-Built drawings and electronic copy of as-built drawing files in PDF and DWG formats shall be submitted with IO&M manuals.

1.5 QUALITY ASSURANCE

A. Furnish the services of a qualified and approved fire suppression subcontractor to provide the work of this specification section. Unless otherwise noted, this is substantially a "performance" specification.

B. Minimum qualifications of the Contractor/subcontractor shall include the following:

1. Specialist Firm: Company specializing in automatic fire suppression/sprinkler systems, possessing a minimum of three years of experience with systems similar in nature to the type specified herein. Demonstrate satisfactory completion of five projects of similar size and scope in the State of Alaska; provide references.

2. Design Certification: Drawings and calculations shall be prepared by a Level III or IV Fire Sprinkler Designer, certified by the National Institute for Certification in Engineering Technologies (NICET), in Fire Protection Engineering Technology Automatic Fire Sprinkler System Layout who also have their State of Alaska Permit IIC or IIC-DO license, or an Alaskan Licensed Professional Engineer.

3. Maintain a complete stock of replacement parts.

4. Remain on 24 hour call for emergency service.

5. Maintain an office and telephone, with authorized representatives of the fire suppression contractor's firm, including the Designated Project Administrator, with a physical presence and address in Alaska.

6. Bids by wholesalers, contractors, or any firm whose principal business is not that of manufacturing and/or installing fire suppression systems are not acceptable.

C. Material:

1. Equipment and components: Bear the "UL" label or the "FM" approval marking.

2. Grooved joint couplings, fittings, valves, and specialties shall be from the same manufacturer, including grooving tools.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to the site under provisions of Division 1.

B. Deliver and store valves in manufacturer's packaging with labeling in place.

C. Prior to installation, pipes shall be wrapped with protective wrapping.

1.7 PROJECT/SITE CONDITIONS

A. Work shall be scheduled to minimize disruption of automatic fire suppression service, coordinate with Contracting Agency for shut down.

B. Check dimensions indicated on the Architectural and Structural Drawings, and verify dimensions at the site before fabricating any portion of the system. Any discrepancies in

piping and head locations resulting from failure to do so shall be corrected expeditiously to provide proper coordination of trades.

C. Coordinate work with that of other trades to make sure that adequate space is provided, including requirements for accessibility and serviceability. Locate sprinkler heads a minimum 6 inches distance from ceiling T-Bar, structural elements, devices, and other installed equipment. Adjust final location of piping and heads in field to accomplish these requirements for coordination.

D. Identify structural penetrations for pipes, and submit details of those penetrations to the Structural Engineer for approval. Replace structural members that are damaged, cut, or penetrated without approval at no additional expense to the Contracting Agency.

E. In addition to 20 0000 Mechanical General Requirements Part 3 demolition requirements, review the contract documents and any Contracting Agency furnished equipment and determine if any portion of the existing fire suppression system will be affected by the temporary or permanent implementation of any portion of this work. Provide Contracting Agency a list of the specific fire suppression and detection systems affected before proceeding with design or demolition.

1.8 ANNUAL MAINTENANCE AGREEMENT PROPOSAL

A. Provide upon request a cost proposal for performing annual maintenance recommended by NFPA 25.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide only products that are a standard product of a manufacturer regularly engaged in the manufacture of fire suppression equipment.

B. Products and materials shall have a minimum working pressure of 175 psig and capable of withstanding a hydrostatic test pressure of 200 psig at 2 hours test pressure without damage, unless noted otherwise for higher pressure ratings or basis of design includes higher pressure ratings.

1. Exception for approved ancillary devices that are normally isolated from the fire water and sprinkler lines shall have a minimum rated 150 psig working pressure.

C. Submittals are required for all equipment, materials, and products.

D. Glycol systems for fire suppression shall not be used.

E. Exterior items shall be chrome finish or stainless steel.

2.2 LABELS, TAGS, AND APPROVALS FOR PRODUCTS

A. Products UL or FM listed, labeled, and specifically approved for the fire suppression application where they are used.

B. Label pipes, riser assemblies, pre-action systems, and alarm valves, including zone designation; enamel on metal for valves.

C. Tag equipment for maintenance and operations. Include in shop drawings and O&M manual.

2.3 MANUFACTURERS

A. Sprinkler System and Components:

1. AGF.
2. Central.
3. Croker.
4. Gem Sprinkler.
5. Grinnell.
6. Kennedy.
7. Metraflex.
8. Milwaukee.
9. Notifier Company.
10. Potter-Roemer.
11. Potter Electric.
12. Reliable.
13. Star.
14. System-Sensor.
15. Tyco.
16. Tolco.
17. Victaulic.
18. Viking.

2.4 PIPE

A. Plastic pipe is not allowed.

B. The use of pipe nipples less than 1-inch in diameter and less than schedule 40 wall thickness is not allowed.

C. Pipe shall be identified including manufacturer's name, model designation or schedule.

D. Wet Pipe Sprinkler Systems:

1. Metallic pipes shall be listed for the intended service by UL or FM.
2. Whenever pipes other than steel schedule 40 is utilized, submit a statement that the pipe complies with NFPA 13 standards, the pipe strength is adequate for the application, and the pipe corrosion resistance ratio (CRR) shall be equal or greater than 1.0, equivalent to schedule 40 pipe for the installed system. Include this CRR data in product submittal.

E. Dry Pipe Sprinkler Systems:

1. Schedule 40 hot dipped galvanized steel pipe in accordance with NFPA 13. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.5 FLEXIBLE SPRINKLER HOSE WITH THREADED END FITTINGS

A. Flexible one-inch 304 stainless steel flexible sprinkler hose products shall be FM Global or UL tested and approved and submitted for the specific application. The drop system shall include required mounting brackets and appurtenances.

B. Equivalent length of 1" schedule 40 steel pipe and pressure drop information shall be included in product submittal and hydraulic calculations.

2.6 FITTINGS, ABOVE GROUND

A. Grooved Fittings, Couplings, and Mechanical Tees:

1. Grooved Fittings: ductile iron fittings with flow equal to standard pattern. Fabricated or segmented fittings are not acceptable. Couplings and mechanical tees shall be standard painted, unless indicated otherwise.

2. Grooved joint couplings shall consist of two ductile iron housing segments with pressure responsive gaskets and zinc plated, hot dipped galvanized or stainless steel hardware as required for application.

   a. Rigid type: Couplings shall provide joint rigidity, support and hanging in accordance with NFPA 13.

   b. Flexible type: For use in locations where vibration attenuation and stress relief or flexible connectors are required.

3. Mechanical Tee Clamp-on. Ductile iron with pressure responsive gaskets and zinc plated, hot dipped galvanized or stainless steel hardware as required for application. Threaded or grooved outlets.

B. Threaded fittings shall be compatible with piping system and include cast iron Class 125 and 250 , and malleable iron Class 150 and 300 steel..

C. Pipe Flanges shall be compatible with piping system and include: cast iron Class 125 and 250, and malleable iron Class 150 and 300 steel.

D. Welded Pipe Fittings for Wet Pipe Sprinkler Only: Limited to Weld-o-lets, Thread-o-lets, Gruv-o-lets, Tees, and Welded Flanges. Welding limited to shop fabrication work with approved quality control process, welding procedures, and welders for specific application.

E. Welded pipe joints and fittings shall not be used on galvanized pipe or on pipes with wall thickness less than schedule 10.

F. Clamp-on, saddle type, or mechanical tee are not allowed for new work.

G. Other means of joining pipe are not permitted.

2.7 VALVES AND ALARM ASSEMBLIES

A. Valves: UL or FM listed and labeled and specifically approved for the fire suppression application where they are used. Minimum working pressure 175 psi non-shock cold water. Higher pressure rating as required.

1. Control Valves: Fire suppression system control valves shall be supervised with switches compatible with the fire alarm system or other methods in compliance with NFPA 13.

   a. OS&Y Gate Valves: Rated working pressure 250 psi non-shock cold water.

b. Butterfly Valves: Rated working pressure 300 psi non-shock cold water with pressure responsive seat, 360-degree circumferential seating. Weatherproof handwheel actuator housing and two integrated supervisory switches. Grooved, threaded, or wafer type acceptable.

c. NRS Gate Valves: Rated working pressure 250 psi non-shock cold water.

2. Swing Check Valves, Spring-Assisted: Rated working pressure 250 psi non-shock grooved end, flanged, or wafer type, listed for vertical or horizontal installation.

B. Test and Drain Valves:

1. Test orifices shall be clearly identified and selected for smallest sprinkler orifice on system riser.

2. Drain valve position clearly identified and valve accessible.

3. Sight glass for visual confirmation of water flow.

4. Valve assembly shall be bronze body.

C. Wet Pipe Automatic Sprinkler Systems:

1. Alarm Check Valve Assemblies: Existing to remain. Field verify condition and adequacy.

2. Water Flow Detectors: Existing to remain. Field verify condition and adequacy.

D. Dry Pipe Sprinkler Systems:

1. Dry Pipe Valve: Existing to remain. Field verify condition and adequacy.

E. Pre-action Automatic Sprinkler Systems.

1. Pre-action Valve: Existing to remain. Field verify condition and adequacy.

F. Provide electrical alarm and control wiring in accordance with NFPA 72 and Division 26 requirements.

G. Provide identification sign (enamel on metal) for valves per NFPA requirements.

H. Valves in galvanized piping systems shall be bronze.

2.8 SPRINKLER HEADS

A. Provide sprinklers as required by NFPA 13 standards and in compliance with the IBC Chapter 9. Sprinkler heads using O-ring water seals are not allowed. Sprinkler finish and style as follows:

1. In areas with surface mounted light fixtures attached to finished suspended ceilings, provide standard spray pendant sprinklers, and escutcheons to position the sprinkler deflector below the light fixture. Sprinklers and escutcheons to be chrome finish.

2. In areas with recessed lighting flush to the suspended ceiling finish, provide recessed standard spray pendant sprinklers. Sprinklers and escutcheons to be chrome finish.

3. Sprinklers above ceilings and exposed ceiling areas shall be bronze finish, standard spray, upright or pendant type.

4. Sidewall sprinklers shall be bronze finish in service areas, and chrome throughout public areas.
5. Dry pendant and dry sidewall sprinklers protecting entry vestibules and other public areas susceptible to temperatures below 40 degrees F. shall be chrome **##**bronze**##** finish recessed.
6. Dry pendant and dry sidewall sprinklers protecting unheated areas and piped from wet pipe systems shall have an "A Length" dimension of not less than 18 inches.
7. Sprinklers with orifices less than K-4.2 shall be noted during submittal for specific application for approval and have an independent strainer with access for maintenance.
8. Sprinklers of correct temperature rating shall be installed according to NFPA 13. Coordinate sprinkler location and temperature rating near the fireplace.
9. Provide a minimum of 2 spare sprinkler heads of each type and temperature rating, minimum of 6 total, and a minimum of one sprinkler wrench for each type of installed sprinkler. Wrenches shall directly engage the wrench boss cast into the sprinkler. Provide plugs where dry type sprinklers are used. Spare sprinkler cabinet shall be red sheet steel manufactured by the sprinkler manufacturer. Mount cabinet on the wall within 60 inches of the main sprinkler control riser.

B. Sprinkler heads on dry pipe and pre-action systems shall be listed for the application and shall be upright or pendent, installed on a return bend.

2.9 PIPE AND EQUIPMENT ANCHORS, BRACING, HANGERS, AND SUPPORTS

A. Provide seismic anchoring, bracing, supports, and clearance for equipment, piping and sprinkler heads per NFPA 13, International Building Code, and ASCE 7. Most conservative criteria shall govern.

B. Provide flexible couplings, bracing, and other components required and compatible with the piping materials and fittings.

C. Hangers, bracing, and seismic details and locations shall be included on the shop drawings.

2.10 INSPECTORS TEST CONNECTIONS

A. Provide inspectors test connections for complete system testing, as indicated, and as required by Authority Having Jurisdiction.

B. Chrome plate pipe and fittings exposed outside building. Provide chrome plated set screw escutcheon.

2.11 ELECTRICAL WORK

A. Provide electrical components, equipment, wire, conduit, connections, devices, and services as required by NFPA 72 and Division 26 requirements.

2.12 VALVE SUPERVISION, TAMPER, SWITCHES

A. Provide supervision of valves on water supplies, sectional control and isolation valves, floor control valves, and other valves in supply pipes to sprinklers and other fixed water-based fire suppression systems.

B. Provide valve supervision switches compatible with fire alarm system in NEMA 4 enclosure.

C. Coordinate with Division 26 requirements.

D. Refer to Section 28 3100 - Addressable Fire Alarm System.

2.13 WATER FLOW DETECTORS

A. Refer to Section 28 3100 - Addressable Fire Alarm System.

B. Provide vane-type water flow detectors installed at each system or zone control and for the main system header for multiple zone systems.

C. Provide test connection at each flow detector.

D. Provide water flow detectors compatible with fire alarm system in NEMA 4 enclosure.

E. Coordinate with Division 26 requirements.

2.14 PRESSURE GAUGES

A. Pressure gauges shall be 3-1/2" corrosion resistant moving parts, polycarbonate window with connection not smaller than 1/4" NPT, and maximum limit not less than twice the normal system working pressure at the point where installed.

B. Provide 3-way globe shutoff valve with provisions for removal and draining on each pressure gauge.

2.15 COMPRESSED AIR SYSTEM MAINTENANCE AND APPURTENANCES

A. Existing to remain. Field verify adequacy and condition.

2.16 DRY SYSTEM LOW PRESSURE ALARM

A. Provide UL approved low pressure alarm switches on each dry system, compatible with fire alarm system.

PART 3 - EXECUTION

3.1 GENERAL

A. The contract documents have performance, materials, and installation requirements which exceed code minimums.

3.2 COORDINATION

A. The fire suppression contractor shall coordinate their work with the work of other trades to assure timely installation and efficient use of mechanical areas including, but not limited to, boiler rooms, fan rooms, and ceiling spaces.

B. Promptly remove any work installed without proper coordination and reinstall in a manor to allow for a good practical arrangement of items which need to be installed by other trades involved.

C. In case of coordination dispute, consult the Contracting Agency and its decision shall be binding.

D. Costs associated with coordination, arranging or rearranging of the fire suppression system shall be borne by the affected contractor, without causing any additional expense or delay to the Contracting Agency.

E. Installation, testing, O&M manuals, record drawings, and AHJ approvals shall be completed, submitted, and approved by the Contracting Agency before beneficial occupancy.

F. Work shall be scheduled to minimize disruption of existing fire service. Coordinate with Contracting Agency for shut down and maintain a fire watch when system is inoperable.

G. Coordinate with architectural requirements for prepping and painting of pipes, hangers, brackets, restraints, and appurtenances in public exposed areas.

3.3 PIPING INSTALLATION

A. Install pipes, fittings, and appurtenances in accordance with codes and recommended practices. Follow manufacturers' installation instructions.

B. Installed system to have a corrosion resistance ratio (CRR) equal or greater than 1.0.

C. Pipes and equipment not directly serving exit enclosures or exit passageways shall not be routed through them. Only pipes and equipment directly serving exit enclosures or exit passageways shall be allowed in these spaces. There shall be no penetrations whether protected or not between adjacent exit enclosures or exit passageways.

D. Sprinkler pipe and fittings shall be installed to flush and drain system. Drains shall be accessible. Discharge test pipes, backflow system demand flow tests, and system main drain to safe location outside. Coordinate discharge point with Contracting Agency.

1. Arrange pipes to drain to the main drain valve where practicable. Where connection to the main drain or other exterior drainage is impractical, as shown on shop drawings, install low point drain stations in accordance with NFPA 13.
2. Identify the location of drain and test stations with signs on access panels, ceiling panels, or walls adjacent to the station, visible from the floor.
3. Riser main drains shall have hose bibb connections for maintenance drainage where drainage to exterior safe location is not allowed or impractical.
4. Coordinate routing of drain lines to waste receptors. Direct connection shall not be made between sprinkler drain lines and sewers.

E. Sprinkler system to be installed to flushed and drained system. Drains shall be accessible.

F. Pipes shall be arranged to drain to the main drain valve where practicable. Where connection to the main drain or other exterior drainage is impractical, as shown on shop drawings, install low point drain stations in accordance with NFPA 13. Route drain lines to nearest waste receptor where possible.

G. Seismic protection for the piping system shall be in accordance with NFPA 13 standards and ASCE 7. Include seismic restraint details with installation shop drawings.

H. Provide clearance around pipes extending through walls, floors, ceilings, platforms, and foundations, including drains, fire department connections, and other auxiliary pipes. Holes shall be sized 2" larger than the pipe for pipe 1" to 3-1/2" and 4" larger for pipe 4" and larger,

unless flexible couplings are located within 1 foot of each side of item penetrated, and excluding frangible construction that is not required to have a fire resistance rating.

I. Install pipes to conserve building space and route pipes around roof hatches, electrical panels, access panels, and maintenance accesses.

J. Minimum 3 inches clearance from structure not used to support pipes.

K. Provide service access around equipment per manufacturer's requirements, minimum of 18 inches.

L. Sprinkler pipes shall be substantially supported from the building structure, which shall support the water loaded pipe plus a minimum 250 pounds temporary point load applied at the point of hanging. Pipe hangers shall include 250 pounds and weight of 5 time pipe filled with water.

M. Dry system pipes shall be installed to allow full service and complete drainage of the entire system. Dry pipes shall be sloped to accomplish this requirement. Discharge dry pipe drains to the outside. Drum drips shall be provided on exterior pipes and interior areas subject to moisture accumulation.

N. Pipes shall be concealed, except at ceilings exposed to structure, or as noted. Conceal pipes in areas with finished ceilings. Coordinate with the other trades to take timely advantage of available space above ceilings, below raised floor, in pipe and duct spaces and elsewhere.

O. Pipes shall not be concealed in walls.

P. Piping to sprinklers below ceilings with minimum 1-inch outlets.

Q. Pipes in exposed ceiling areas shall be limited to branches serving heads in the area. Pipe routing shall be coordinated to minimize visual impact and approved prior to installation.

R. Connection to existing systems shall be configured and installed for flushing and draining of all pipes including, but not limited to, system supplies and risers, risers, cross and feed mains, and branches.

S. Provide penetrations where pipes pass through walls, floors, or ceilings. Penetrations shall be in accordance with UL Fire Resistance Directory for "Through Penetration Firestop Systems (XHEZ)".

T. Pipes supported from manufactured structural members shall comply with truss manufacturer's installation recommendations for hanger attachments and loading of pipe hangers.

U. Pipes passing pre-drilled structural elements to be shown on approved shop drawings.

V. Fasten trapeze members to truss chords or structural members.

W. Install "beam clamp" type fasteners with retainer straps and locking nuts. Retainer strap shall be tight to beam.

X. Pipe hangers: "rod and ring" type hangers throughout for dry pipe system. Minimum 1/2" of adjustment on each side of the hanger ring nut, to allow for piping grade adjustment in the future.

Y. Pipe size reductions by one-piece reducing fittings; bushing shall not be used.

Z. Provide test connection for each flow switch and supervisory switch on each shutoff valve.

AA. Install a test valve at the remote area in dry and wet pipe systems to equal the required flow of one sprinkler head.

BB. Welded pipe shall be shop fabricated by certified welders and procedures. No field welding is allowed. Welding of galvanized pipe is not allowed.

3.4 GROOVED AND ROLLED FITTINGS

A. Follow the manufacturer's suggested methods to prepare gaskets, pipes, and fittings to prevent leakage, system breakdown, and designed pipe and fitting movement.

B. Cut grooved pipe shall be limited to schedule 40 pipe.

C. Welding fittings shall not be used on galvanized pipe.

D. Installers to have been trained by the coupling manufacturer in the use of grooving tools and installation of product. The manufacturer’s representative shall periodically visit the job site to ensure best practices are being followed.

3.5 SPRINKLER HEAD INSTALLATION

A. Sprinkler heads to be centered per approved shop drawings. Changes due to field conditions shall be pre-approved.

B. Sprinkler heads to be centered on acoustical lay-in panels and symmetrically 4-way on architectural drawings laid out in each separate room or space with GWB type ceiling regardless of finishes and minimum Code requirements.

C. Sprinkler heads to be centered on acoustical lay-in panels and symmetrically 4-way on architectural drawings laid out in each separate room or space with GWB type ceiling regardless of finishes and minimum Code requirements.

D. Sprinkler heads shall be connected to system via minimum 1-inch diameter flexible stainless steel sprinkler hose in new suspended ceiling areas. Ceiling systems with listed flex hose connections shall be identified on shop drawings.

E. Escutcheons and cover plates shall be metallic and listed for the assembly.

F. Provide guards where sprinklers may be subject to mechanical damage.

G. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or a cracked bulb.

H. The sprinkler bulb protector shall be removable by hand, without tools or devices that may damage the bulb.

I. Sprinkler head temperature ratings shall be selected based upon installed distance from heat source.

J. Provide clearance for removal of sprinkler heads and minimum 1-inch clearance from structure. Exclude concealed, recessed, and flush types, which have clearances above the ceiling.

K. Identify sprinklers with less than 8 feet between them and include listing and NFPA 13 criteria.

3.6 DRY SPRINKLER HEADS

A. Provide dry sprinkler heads in areas potentially subject to freezing including, but not limited to ceilings of entry vestibules, overhangs requiring fire suppression, rooms with combustion air openings, walk-in freezers and refrigerators, and under over-head garage type doors, combustible space formed above existing roofing where new roof and structure is over-laid and other areas where temperatures may drop below 40 degrees F.

1. Provide insulating boot for vapor tight and thermally insulated assembly. Coordinate with architectural requirements.
2. Coordinate “A Length” dimension with each assembly penetrated when piped from wet pipe system. Include information in submittals.

B. Review work of Divisions 26, 27 and 28 and determine which areas are not heated during times of primary power failure.

3.7 SPRINKLER PIPES AT ELECTRICAL, TRANSFORMER, TELECOM/DATA, AND COMPUTER ROOMS

A. Route no pipes through rooms except branch piping supplying sprinklers protecting the room. Branch pipes shall not exit electrical room to supply additional sprinklers outside the room.

B. No pipes shall be routed above electrical panels or telecommunication racks.

C. Maintain a minimum of 42 inches clear in front of electrical panels, coordinate with electrical requirements.

3.8 PRE-ACTION SYSTEM

A. Coordinate with Section 28 3100 - Addressable Fire Alarm System for:

1. Installation of detection devices and manual override.
2. Connection to fire alarm system the following points:
    a. Pneumatic pressure trouble contacts.
    b. Zone detector inputs.
    c. Manual override inputs.
    d. Fire alarm.
    e. Electrical Equipment shutdown relay.

B. Provide inspector test point at hydraulic remote end of line with drum drip and threaded hose connection.

C. Sequence of Operation:

1. Maintain compressed air pressure of 20 to 80 psig in piping system.
2. On loss of air pressure activate pneumatic pressure trouble contacts.
3. On activation of fire suppression system the fire suppression panel shall signal the pre-action panel.
4. On activation of one of the smoke detectors in the open area of the Library the fire alarm panel shall signal the pre-action panel to open deluge solenoid to permit water flow on loss of piping pressure.
5. When sprinkler head fusible link melts, piping system pressure drops and water flows.
6. On system shutdown and detecting devices are restored, close solenoid.
7. On activation of manual override, signal fire alarm, open valve solenoid.

3.9 IDENTIFICATION

A. Valves: Control, auxiliary control, drain, and test connection valve shall have permanently secured weatherproof metal identification signs.

1. Systems with more than one control valve that must be closed to work on an area shall have a sign referring to existence and location of other valves.
2. Control valve identification to include its function and what it controls.

B. Coordinate with valve, zones, and pipe identification with Framed Building Plan and fire alarm nomenclature.

C. Rooms containing control valve, fire pump, and similar equipment requiring fire department identification or access shall have signage.

D. Coordinate exterior and interior signage with architect and AHJ requirements.

E. Sprinkler system hydraulic design and relevant general information. Information shall meet NFPA 13 and NFPA 25 requirements for inspection, testing, and maintenance.

3.10 ELECTRICAL WORK

A. Provide electrical work, connections, routings, signals, power, and services as required by NFPA 72 and Division 26 requirements.

B. Coordinate switches, connections, alarms, and number and type of devices with electrical work. Devices shall be compatible with Division 26 requirements.

3.11 PAINTING

A. In areas exposed to public viewing, exposed sprinkler system and elements shall be painted, excluding sprinkler head assemblies.

B. Clean and prepare pipe, fittings, hangers, restraints, supports, and miscellaneous items for areas to be painted.

C. Refer to the requirements specified in Division 9 - Finishes.

3.12 ACCESS DOORS

A. Provide access doors where “Fire Suppression” valves, switches, drain valves, or other controlling or monitoring devices are concealed. Label doors for quick location and recognition of concealed devices. For rated assemblies provide rated access door to match assembly's rating.

3.13 INSPECTORS TEST PIPING

A. Discharge inspectors test pipes to approved floor drains in non-public areas, or outside building, but not on main walkways or over architectural surfaces easily stained or difficult to clean. Do not terminate discharge more than 48 inches above grade.

B. Dry pipe and double interlock inspector’s test connection arrangement to be located at the most remote branch line at the highest elevation.

3.14 FLUSHING

A. New and existing Systems in or serving area of work shall be arranged for flushing. Cross main ends shall be provided with readily removable fittings and shall terminate with 1-1/4" or larger pipe.

B. Flush pipes before pressure testing.

3.15 FIELD QUALITY CONTROL

A. Arrange for proper witnessing of tests, as required by Authority Having Jurisdiction and as specified elsewhere. Contracting Agency's representative may witness tests. Notify Contracting Agency a minimum of 3 days in advance of test.

B. Arrange new and existing systems in or serving the area of work for testing. Limits and criteria for testing existing systems impacted by work under this contract to be coordinated with Contracting Agency and AHJ.

C. Conduct tests in accordance with applicable codes for new and existing systems. Test above ground pipes at minimum 200 psig hydrostatic for two hours.

D. Trip test dry pipe system to confirm system discharge time and submit test report. Dry pipe systems shall produce water at inspector test per NFPA 13 criteria and less than 60 seconds regardless of system volume. Provide a quick-opening device, accelerator, if required to meet discharge time requirements, independent of system volume.

E. Test tamper, supervisory, flow, and system alarm actuations and alarm monitoring systems.

F. Pipe shall not be concealed until satisfactorily pressure tested.

G. Log of test shall be kept at the job site and shall identify:

1. Who performed the test,
2. Time and date of test,
3. Section of system tested,
4. Results of test,

5. Completed Contractor's Material and Test Certification forms.

H. Verify permanently marked weatherproof metal “Hydraulic Design Information Sign” is secured with corrosion resistant fastener at each alarm valve and information matches approved shop drawings and hydraulic calculations.

I. Provide a letter of certification stating that testing and flushing has been performed in accordance with the applicable codes and standards. Itemize codes and standards complied with.

3.16 TRAINING AND DEMONSTRATION

A. Provide annual operational test including flow performance in accordance with NFPA 13 and NFPA 25 with Contracting Agency's representative and Owner's maintenance personnel.

B. Train the Owner's designated maintenance manager in the operation and maintenance of the entire fire suppression system, minimum of 4 hours on-site training.

C. Training materials shall include approved O&M manual and as-built drawings.

D. Provide documentation stating date and length of training with list of attendees, instructor, and sign-off by Contracting Agency's representative stating that training and demonstration has been completed.

END OF SECTION 21 1000

SECTION 22 1100
DOMESTIC WATER PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, fittings, and connections for domestic potable water system.
2. Piping accessories.
3. Valves.
4. Water hammer arresters.
5. Trap primer valves.
6. Access doors.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 20 0556 - Interior Trench Excavation and Backfill
5. 20 0700 - Mechanical Insulation

1.2 REFERENCES

A. Codes and Standards:

1. International Building Code (IBC).
2. Uniform Plumbing Code (UPC).
3. ANSI A117.1, Accessible and Usable Buildings and Facilities.
4. Foundation for Cross-Connection Control and Hydraulic Research, 9th edition, University of Southern California.
5. 2011 Reduction of Lead in Drinking Water Act.
6. NSF/ANSI 61 - Drinking Water System Components - Health Effects.

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for interrelated systems necessary for the various plumbing systems and equipment.
2. Wetted surfaces of pipes, fittings, valves, and equipment in potable water systems shall be lead free as defined by the 2011 Reduction of Lead in Drinking Water Act.

B. Performance Requirements:

1. Potable water systems shall perform quietly, with no objectionable vibration transmitted to the surrounding construction.

2. Replace piping and equipment that does not perform as intended with properly operating equipment.

1.4 PRE-INSTALLATION MEETINGS

A. Coordinate and sequence installation of plumbing systems and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any plumbing components

1.5 SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:

B. Product Data:

1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Literature clearly annotated to indicate specified salient features and performance criteria.

2. Indicate valve data and ratings.

3. Provide plumbing specialty component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings:

1. This Section shop drawings to be submitted under Section 20 0000 - Mechanical General Requirements.

2. Show placement of fixtures and plumbing equipment.

D. Certificates: Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation of cross contamination protection devices.

E. Manufacturer's Installation, Operation, and Maintenance (IO&M) Manuals.

F. Test and Evaluation Reports:

1. Submit hydrostatic pressure test report.

2. Submit sterilization of system report.

1.6 CLOSEOUT SUBMITTALS:

A. Refer to Section 20 0000 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:

B. Warranty Documentation.

C. Record Documentation:

1. Record actual locations of valves, backflow preventers, water hammer arresters, and other components.

2. Record locations of access doors required for access or valves.

1.7 **QUALITY ASSURANCE**

A. Qualifications:

1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
2. Installers: Minimum three years' experience in the installation and start-up of plumbing systems and equipment.

1.8 **DELIVERY, STORAGE, AND HANDLING**

A. Delivery and Acceptance Requirements:

1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.

B. Storage and Handling Requirements:

1. Store products in covered storage area protected from the elements, outside the general construction zone until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

1.9 **WARRANTY**

A. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 **WATER SERVICE PIPING (ABOVE GRADE INSIDE BUILDING)**

A. Copper (Hard drawn):

1. Tubing: Type L (ASTM B88).
2. Fittings:
   a. Cast copper alloy (ASME B16.18).
   b. Wrought copper and bronze (ASME B16.22).
3. Joints: Solder, Grade 95TA (ASTM B32).

B. Copper Press Fitting System:

1. Limited to tubing sizes 4 inch and smaller.
2. Cast or wrought copper fittings, ASME B16.18 or ASME B16.22. Pre-formed grooves with pre-lubricated EPDM O-rings designed to seal fitting to copper tubing water tight with the use of manufacturer's crimping tool. Fittings shall be rated for 250 Degrees F., and 200 psi.
3. IAPMO UPC listing.
4. Manufacturer: Viega ProPress, NIBCO Press System, no substitutions.

2.2 UNIONS (STANDARD)

A. Steel Piping (Threaded):

1. Class 150 malleable iron, ground joint, copper or copper alloy seat. AnvilStar Figure 463. (150 psig steam, 300 wog).
2. Where indicated: Class 250 malleable iron ground joint, copper or copper alloy seat. AnvilStar Figure 554.

B. Copper Piping (Sweat and Threaded): Cast bronze, ground joint, copper to copper, or copper to threaded joint. Nibco 733-LF series.

2.3 DIELECTRIC ISOLATORS (ELECTRICALLY INSULATING)

A. Provide dielectric unions for 2 inch pipe and smaller.

B. Provide dielectric flanges for 2-1/2 inch pipe and larger.

C. Insulating gaskets, all types, shall be suitable for fluid type, temperature and pressure.

D. Galvanized pipe to copper: Brass threaded end and sweat copper end.

E. Black steel to copper: Zinc plated steel threaded end and sweat copper end.

F. Manufacturers: Capitol, Epco, Control Plastics, Watts, or approved equal.

2.4 VALVES

A. General:

1. Select valves of the best quality and type suited for the specific service and piping system used. Minimum working pressure rating 125 psig saturated steam or 200 psig W.O.G. Packing material or seals shall not contain asbestos.

B. Ball Valves:

1. Two (2) inch and smaller: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, blowout proof stem, 150 psig pressure/temperature rating (steam).

C. Drain Valves:

1. Full port ball valve with threaded hose adapter with bronze end cap.
2. Do not use sillcocks or butterfly valves as drain valves.

2.5 BALANCING VALVES

A. Provide a balancing valve at each point shown on the domestic hot water recirculation branches. Except as indicated, balancing valves shall be full line size. Wide open pressure drop selected at one psi (2.3 feet) (nominal).

B. Provide calibrated plug or ball valve type balancing valves with self-sealing quick connect pressure taps, scale and locking device. Include schedule with submittal.

C. Manufacturer: Bell & Gossett, or equal.

D. Provide test kit with gauge and hoses to match balancing valves.

2.6 WATER HAMMER ARRESTERS

A. Manufacturers:
   1. Sioux Chief
   2. Precision Plumbing Products
   3. Mifab
   4. Zurn
   5. Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.

B. Pressurized Piston Type:
   1. Description: ASSE 1010 certified water hammer arrester.
   2. Performance:
      a. Maximum working temperature of 250 degrees F.
      b. Maximum working pressure of 350 PSIG.
   3. Materials:
      a. Seamless copper body.
      b. EPDM o-rings lubricated with FDA approved compound.

C. Expansion Bellows Type:
   1. Description:
   2. Performance:
      a. Maximum working temperature of 250 degrees F.
      b. Maximum working pressure of 350 PSIG.
   3. Materials:
      a. Stainless steel body and bellows.

2.7 TRAP PRIMER VALVES

A. Manufacturers:
   1. Precision Plumbing Products.
   2. Mifab.
   3. ProFlo.

B. Non-Electronic Type:
   1. Description: Valve designed to deliver a metered amount of water to floor drain traps upon pressure drop of 10 psi in the cold water line.
   2. Performance: Factory set for proper operation with water pressure of 20 to 80 PSI.
   3. Materials:
      a. Lead-free brass body.
      b. EPDM o-rings.

c. Stainless steel mesh screen.

C. Accessories: Distribution unit to serve multiple floor drains from a single trap primer.

2.8 **ACCESS DOORS**

A. Provide access doors for mechanical systems in accordance with Section 08 3100 - Access Doors and Panels.

B. Provide UL labeled access doors and panels when required for fire resistance of surrounding construction.

C. Provide key locks on access doors located in public areas below eight feet above finished floor.

D. Prime coat steel.

E. Coordinate location and size of access doors in walls, partitions, floors, and ceilings to correspond with valves, trap primers, cleanouts, and other devices requiring service or adjustment. Maintain any fire rating of the surrounding construction.

F. Manufacturers: Elmdor, KARP, Milcor, MIFAB.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. Field verify existing conditions.

3.2 **PREPARATION**

A. Protection of In-Place Conditions: Cover equipment and plug piping connections to protect components from construction dirt and debris.

B. Surface Preparation:

1. Verify that excavations are to required grade, dry, and not over-excavated.

2. Refer to Section 20 0556 - Interior Trench Excavation and Backfill.

3.3 **INSTALLATION**

A. Interface with Other Work:

1. Review architectural drawings. Coordinate locations of access panels prior to piping installation.

2. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related work shall be completed at no additional expense to the Owner.

4. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 for instructions on painting and coordination.

B. Water Service Piping:

1. Install piping and plumbing products in accordance with UPC and manufacturer's instructions. Provide seismic anchoring, bracing, supports, and clearance for equipment,

piping and sprinkler heads per UPC, IBC, and ASCE-07; most conservative criteria shall govern.

2. Install piping to maintain headroom, conserve space, and not interfere with use of space.
3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
4. At fixtures, install and connect hot water on left and cold water on right, as viewed when facing the fixture.

C. Valves:

1. Provide accessible ball type isolation valves at major piping branches, and on main lines as shown, and at all terminal devices.
2. Install balancing valves for hot water recirculation system to be accessible and adjustable.

D. Provide finished products with protective covers during balance of construction.

E. Access Doors: Provide appropriate size and install such that plumbing features are readily accessible and maintainable.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.4 REPAIR/RESTORATION

A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.

B. Substitute replacement parts from other manufacturers are not acceptable.

3.5 SITE QUALITY CONTROL

A. Site Tests:

1. Test water piping hydrostatically at 100 psig or 150 percent of working pressure, whichever is greater, for a period of four hours. Observe piping during this period and repair leaks and retest.
2. Air Test:
   a. In general, air testing is not acceptable. In the event of low temperature conditions that would subject system piping to freezing, an equivalent air pressure test may be conducted in accordance with the Uniform Plumbing Code with prior Contracting Agency approval.
   b. Test with clean air at 150 percent of system working pressure but not less than 75 psig or more than 150 psig. System shall hold pressure for not less than four hours. Inspect joints using leak detecting fluid or soapy water. Repair leaks and retest.
   c. Observe necessary safety procedures when testing with air including, but not limited to, use of protective goggles or face shields. Only persons directly involved in testing procedure shall be within 20 feet of a pipe under pressure.
3. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.

B. Inspection:

1. Arrange for inspections and provide notice to the Contracting Agency when the entire work or logical portions thereof, is ready for inspection.
2. The Victaulic Company's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).

3.6 SYSTEM STARTUP

A. Start-up and operate plumbing systems and equipment in accordance with the manufacturer's written installation and operation manual checklist.

B. Document start-up and operational checks using the checklist and submit in accordance with submittal requirements.

C. Operationally test control and safety devices and record settings.

D. Submit a copy of start-up report that includes final settings and that indicates that the start-up of each piece of equipment has been completed.

3.7 CLEANING

A. Sterilization of Domestic Water Systems:

1. Sterilize each unit of completed supply line and distribution system with chlorine before acceptance for domestic operation.
2. Sterilization as described below or by the system prescribed by the American Water Works Association Standard C-651. Apply the amount of chlorine to provide a dosage of not less than 50 parts per million. Provide chlorine manufactured in conformance to the following standards:
    a. Liquid Chlorine: Federal Specification BB-C-120.
    b. Hypochlorite: General Specification O-C-114a, type 11, Grade B or Federal Specification O-X-602.
3. Introduce the chlorinating material to the water lines and distribution system after piping system has been thoroughly flushed. Maintain a contact period of not less than 24 hours. Flush the system with clean water until the residual chlorine content is not greater than 1.0 part per million.
4. Open and close valves in the lines being sterilized several times during above chlorination.
5. Certify in writing that sterilization has been completed in accordance with these requirements.

B. After construction is completed, clean and wipe down exposed surfaces of pumps, piping and appurtenances.

END OF SECTION 22 1100

SECTION 22 1300
SANITARY WASTE AND VENT PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary waste and vent pipe and fittings.
2. Cleanouts.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 20 0556 - Interior Trench Excavation and Backfill
5. 20 0700 - Mechanical Insulation

1.2 REFERENCES

A. Codes and Standards:

1. International Building Code (IBC).
2. Uniform Plumbing Code (UPC).

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.
4. ASA - American Supply Association.
5. CISPI - Cast Iron Soil Pipe Institute.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: This section describes specific requirements, products and methods of execution for sanitary waste systems and equipment.

B. Performance Requirements:

1. Sanitary waste systems shall perform quietly, with no objectionable vibration transmitted to the surrounding construction.
2. Replace piping that does not perform as intended with properly operating equipment.
3. Provide products with performance, output or salient features indicated or scheduled on the drawings.

1.4 PREINSTALLATION MEETINGS

A. Coordinate and sequence installation of sanitary waste and vent piping and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any plumbing components.

1.5 SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:

B. Product Data:

1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Clearly annotate literature to indicate specified salient features and performance criteria.
2. Provide plumbing specialty component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings:

1. This Section shop drawings to be submitted under Section 20 0000 - Mechanical General Requirements.
2. Indicate pipe grade and direction of slope. Indicate elevation of piping at the beginning and end of each main, and at branch connections.
3. Coordinate exact locations of drains, floor penetrations and structural penetrations with applicable trades.

D. Test and Evaluation Reports:

1. Submit pressure test report.
2. Submit system flushing report.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:

B. Warranty Documentation.

C. Record Documentation:

1. Record actual dimensioned locations for buried or inaccessible piping.
2. Show actual cleanout locations and types.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Work shall be performed by workmen usually employed and experienced with the trade.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
2. Remove damaged or otherwise unacceptable products from the project site when directed by the Contracting Agency.

B. Storage and Handling Requirements:

1. Store products in covered storage area protected from the elements, outside the general construction zone until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

1.9 **WARRANTY**

A. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 **DRAINAGE PIPING, BURIED BENEATH AND WITHIN FIVE FEET OF BUILDING**

A. Hub-less Cast Iron Pipe and Fittings:
1. Manufacturers:
a. Charlotte Pipe and Foundry.
b. Tyler Pipe and Coupling.
c. AB&I Foundry.
d. Equal.
2. Pipe: CISPI 301, ASA group 022.
3. Fittings: Cast iron.
4. Couplings:
a. Manufacturers:
1). Husky Series 4000.
2). Approved equal.
b. Materials:
1). Heavy-duty 304-type stainless steel couplings and screws.
2). Minimum shield thickness: 0.015 inch.
3). Gaskets conforming to ASTM C564.

2.2 **DRAINAGE PIPING, ABOVE GRADE**

A. Hub-less Cast Iron Pipe and Fittings:
1. Manufacturers:
a. Charlotte Pipe and Foundry.
b. Tyler Pipe and Coupling.
c. AB&I Foundry.
d. Equal.
2. Pipe: CISPI 301, ASA group 022.
3. Fittings: Cast iron.
4. Couplings:
a. Manufacturers:

1). Husky Series 2000

2). MG Coupling

3). Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.

b. Description: No-hub cast iron pipe couplings conforming to standard CISPI 310.

c. Materials:

1). Gaskets conforming to ASTM C564.

2). Stainless steel clamp-and-shield assemblies.

B. Copper Pipe, DWV: ASTM B75, ASTM B251, ASTM B302, ASTM B306.

1. Fittings: ASME B16.23 cast bronze, or ASME B16.29 wrought copper.

2. Joints: ASTM B32, lead-free solder, Grade 50B.

2.3 CLEANOUTS

A. Manufacturers:

1. Zurn.

2. Mifab.

3. J.R. Smith.

4. Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.

B. Floor Cleanouts:

1. Cast iron body, bronze plug with neoprene gasket.

2. Adjustable head to match finished floor elevation.

3. Round, scoriated bronze top.

4. Where indicated, provide cleanout tops with tile-terrazzo insert or carpet insert to match surrounding floor finish.

C. Wall Cleanouts:

1. Cast iron body, recessed bronze plug.

2. Wall access panel or access cover with center screw.

PART 3 - EXECUTION

3.1 PREPARATION

A. Interface with Other Work:

1. Review architectural and millwork shop drawings. Confirm location of cleanouts and access panels prior to installation.

2. Coordinate and sequence installation of roof drains and piping with trades responsible for portions of this and other related sections of the Project Manual.

B. Protection: Cover equipment and plug piping connections to protect components from construction dirt and debris.

C. Surface Preparation:

1. Verify that excavations are to required grade, dry, and not over-excavated.
2. See Section 20 0556 - Interior Trench Excavation and Backfill.

3.2 **INSTALLATION**

A. Install plumbing systems in accordance with manufacturer's instructions and listing.

B. Provide finished products with protective covers during balance of construction.

C. Access Doors: Provide appropriate size and install such that plumbing features are readily accessible and maintainable.

D. Piping:

1. Grading: Minimum 1/4 inch per foot unless indicated otherwise on drawings and approved by AHJ for shallower slopes.
2. Install piping to maintain headroom, conserve space, and not interfere with use of space.
3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
4. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
5. Where pipe support members are welded to structural building framing; scrape, brush clean, and apply one coat of zinc rich primer to welding.
6. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 - Finishes.
7. Connections:
   a. Hubless piping joints as specified above for underground or above ground piping.
   b. Thread Joints: Assemble with TFE tape or approved non-hardening joint compound.
   c. Solder Joints: Assemble with lead free solder.

E. Vents:

1. Install vents as indicated and as required by plumbing code. Add vents when field conditions increase the length of a trap arm or cause other changes in venting requirements.
2. Unless otherwise indicated, the portion of the vent extending through roof shall be increased in size from one foot below roof assembly to termination as defined below. Increase as follows:
   a. Vent size two-inch and under; vent thru roof three-inch.
   b. Vent size three-inch; vent thru roof four-inch.
   c. Vent size four-inch; vent thru roof six-inch.
   d. Vent size six inch & larger; vent thru roof same size.
3. Termination of Vent: As required by the Uniform Plumbing Code.

F. Cleanouts:

1. Provide as indicated on drawings.
2. If field conditions create additional offsets or increase length of piping shown, provide additional cleanouts as required by the Uniform Plumbing Code and AHJ.
3. Where practical or as indicated provide cleanouts on vertical rainwater piping immediately above grade.

3.3 REPAIR/RESTORATION

A. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

B. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.

C. Substitute replacement parts from other manufacturers are not acceptable.

3.4 FIELD QUALITY CONTROL

A. Inspections: Arrange for inspections and provide notice to the Contracting Agency when the entire Work, or logical portions thereof, is ready for inspection.

B. Maintain current as-built drawings on-site recording including invert elevations, connections to fixtures, cleanouts, slopes, pipe sizes, and routing of pipes. Annotate sections of lines with dates when pressure tests have been approved by AHJ.

C. Pressure Tests:

1. Water Test: Test waste and vent system with water in accordance with the Uniform Plumbing Code.
2. Air Test:
    a. In general, air testing is not acceptable. In the event of low temperature conditions that would subject system piping to freezing, an equivalent air pressure test may be conducted in accordance with the Uniform Plumbing Code with prior Contracting Agency approval.
    b. Observe necessary safety procedures when testing with air including, but not limited to, use of protective goggles or face shields. Only persons directly involved in testing procedure shall be with 20 feet of a pipe under pressure.
3. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.

3.5 ADJUSTING

A. Adjust functional components for proper operation in accordance with manufacturer's recommendations, or as otherwise directed.

3.6 CLEANING

A. Flush drain piping to remove dirt and foreign debris from all systems.

B. Clean all exposed pipes, fittings, and materials.

C. Provide written certification which documents that the complete storm drain and sanitary sewer systems have been flushed of foreign debris. Include date and printed names and signatures of person(s) performing the flush and Contracting Agency witnessing the flush.

3.7 CLOSEOUT ACTIVITIES

A. Start-up and operate plumbing systems and equipment in accordance with the manufacturer's written installation and operation manual checklist.

B. Document start-up and operational checks using the checklist and submit in accordance with submittal requirements.

END OF SECTION 22 1300

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SECTION 22 4000
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water closets.
2. Lavatories.
3. Sinks.
4. Drinking fountains.
5. Tempering valves.
6. Hose bibbs and hydrants.
7. Floor drains.
8. ADA plumbing fixture piping insulation.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0700 - Mechanical Insulation
3. 22 1100 - Domestic Water Piping and Specialties
4. 22 1300 - Sanitary Waste and Vent Piping and Specialties

1.2 REFERENCES

A. Codes and Standards:

1. Uniform Plumbing Code (UPC)
2. International Building Code (IBC)
3. American Society of Safety Engineers (ASSE)
4. Standard for Accessible and Usable Buildings and Facilities (ANSI A117.1). ASCE 07-05, Minimum Design Loads for Buildings and Other Structures.

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.
4. GPF - Gallons Per Flush.
5. PSI - Pounds per Square Inch.
6. PSIG - Pounds per Square Inch Gauge.
7. “Handicap”, “handicapped”, or “ADA compliant”: Refers to fixtures that comply with the requirements of ANSI A117.1.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for plumbing fixtures.
2. Plumbing fixtures in potable water systems shall be lead free as defined by the 2011 Reduction of Lead in Drinking Water Act.

B. Performance Requirements:

1. Potable water systems shall perform quietly, with no objectionable vibration transmitted to the surrounding construction.
2. Replace piping and fixtures that do not perform as intended with properly operating piping and fixtures.

1.4 PRE-INSTALLATION MEETINGS

A. Coordinate and sequence installation of plumbing fixtures with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any plumbing components.

1.5 SUBMITTALS

A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:

B. Product Data:

1. Provide plumbing specialty component sizes, rough-in requirements, service sizes, and finishes.
2. Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Shop Drawings:

1. This Section shop drawings to be submitted under Section 20 0000 - Mechanical General Requirements.
2. Indicate dimensions and weights of fixtures and equipment, and placement of openings and holes.

D. Test and Evaluation Reports:

E. Manufacturer’s Installation, Operation, and Maintenance (IO&M) Manual.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:

B. Warranty Documentation.

C. Record Documentation.

1.7 **MAINTENANCE MATERIAL SUBMITTALS**

A. Refer to Section 20 0000 - Mechanical General Requirements for general maintenance material submittal requirements for the following:

1.8 **QUALITY ASSURANCE**

A. Qualifications:

1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
2. Installers: Work shall be performed by workmen usually employed and experienced with the trade.

1.9 **DELIVERY, STORAGE, AND HANDLING**

A. Delivery and Acceptance Requirements:

1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.

B. Storage and Handling Requirements:

1. Store products in covered storage area protected from the elements, outside the general construction zone until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
4. Replace damaged items with same item in new condition.

1.10 **WARRANTY**

A. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 **FIXTURES**

A. Traps, Stops and Supplies:

1. Provide traps, stops and supplies for fixtures.
2. Sink/lavatory P-Traps: 17 gauge chrome-plated tubular brass or cast brass.
3. Supplies: Flexible, stainless steel.
4. Stops: Quarter-turn, removable key type. Commercial quality metal components only; no plastic parts.

B. Escutcheons: Provide chrome plated wall escutcheons for pipe penetrations into walls.

C. Flush Valve Manufacturers: Sloan, Zurn, no substitutions.

D. Lavatory Faucets Manufacturers: Delta, Chicago Faucets, no substitutions.

E. Carriers:

1. Manufacturer: J.R. Smith, Josam, Zurn, MIFAB.
2. Provide carriers for wall mounted fixtures.

F. Fixtures specified elsewhere, or otherwise furnished:

1. Provide appropriate strainer, tailpiece, trap, waste and supplies.
2. Rough in and connect only.

G. Handicapped Fixtures:

1. Provide fixtures in compliance with the appropriate standard listed in Part 1.
2. Provide fixtures operable with one hand without grasping, pinching or twisting of the wrist, and requiring not more than five pounds of operating force.
3. Handicap accessible lavatories and sinks: Where piping is exposed, provide fixture insulation assembly. Refer to Section 20 0700 - Mechanical Insulation.

2.2 WATER CLOSETS

A. P-1 - Water Closet:

1. Fixture: Wall hung, siphon jet, elongated bowl, low consumption (1.6 gpf), 1-1/2 inch top spud. American Standard model Afwall Millennium Flowise 1.6.
2. Flush Valve: Zurn Aquaflush Z6000-1-WS.
3. Seat: Open front, commercial weight, heavy duty, solid plastic, stainless steel check hinge, without cover, white.
4. Carrier: Floor mounted. Extra heavy duty (rated for 750 lbs.). Jay R. Smith model 0240Y or equal.

B. P-1H - Water Closet:

1. Fixture: Wall hung, siphon jet, elongated bowl, low consumption (1.6 gpf), 1-1/2 inch top spud. American Standard model Afwall Millennium Flowise 1.6.
2. Flush Valve: Zurn Aquaflush Z6000-1-WS1.
3. Seat: Open front, commercial weight, heavy duty, solid plastic, stainless steel check hinge, without cover, white.
4. Carrier: Floor mounted. Extra heavy duty (rated for 750 lbs.). Jay R. Smith model 0240Y or equal.
5. ADA: ADA compliant. Handicapped mounting height.

2.3 URINALS

A. P-2H – Urinal:

1. Fixture: Siphon jet, vitreous china, low consumption (1.0 gpf). Integral flush rim, wall hangers, 3/4 inch top spud. American Standard model Trimbrook 1.0.
2. Flush valve: Zurn Aqualflush Z6001-WS1.
3. Carrier: Floor mounted. No residential.
4. ADA: ADA compliant. Handicapped mounting height.

2.4 LAVATORIES

A. P-3H – Counter Lavatory:

1. Fixture: Counter mounted, vitreous china, self-rimming, 18 inch by 14 inch oval, front overflow. Fixture to be provided by others.
2. Faucet: Sensor actuated, battery powered, counter mounted, thermostatic mixing valve, ASSE 1070 listed. Bobrick model B-8878.
3. Drain: Metal grid strainer.
4. ADA: ADA compliant. Pipe drain for handicapped access.

B. P-4H - Wall Lavatory:

1. Fixture: Wall mounted, vitreous china, 20 inch by 18 inch, rear overflow, faucet holes on four inch centers. American Standard model Comrade.
2. Faucet: Single lever, deck mounted. Delta model 523LF.
3. Mixing valve: Thermostatic, ASSE 1070 listed. Powers model LFLM495.
4. Drain: Metal grid strainer.
5. Floor mounted carrier. No residential.
6. ADA: ADA compliant. Handicapped mounting height.

2.5 SINKS

A. P-5H - Single Compartment Sink:

1. Fixture: Under mounted, single compartment, 18 gauge, type 304 stainless steel, 22 inch by 31 inch by 5-1/2 inch deep, self rimming, sound deadened, with grid strainer. Elkay ELUHAD281655.
2. Faucet: 5-1/4” Swing gooseneck spout, 4” centers, deck mounted. Chicago Faucets 895-317GN2AE35ABCP.

2.6 DRINKING FOUNTAINS

A. DF-1H - Drinking Fountain/Bottle Fill:

1. Fixture: Wall mounted, dual station with bottle filling station, polished stainless steel, push-button controls, visual filter monitor, refrigerated, filtered, 1.0 GPM laminar fill rate. Elkay LZWS-LRPBM28K.
2. Carrier: Floor mounted. No residential.
3. Options: Elkay Cane Apron, LKAPR1.
4. ADA: ADA compliant. Handicapped mounting height.

2.7 TEMPERING VALVES

A. TV-1 - Thermostatic Tempering Valve:

2.8 HOSE BIBBS AND HYDRANTS

A. HB-1 - Wall hydrant:

1. Automatic draining, freezeless, with integral vacuum breaker.
2. Flush mounted, with key operated hinged cover.
3. 3/4 inch hose connection.

4. Woodford model B65.

2.9 **FLOOR DRAINS**

A. FD-1 - Floor Drain:

1. Fixture: Cast iron body with adjustable, polished nickel bronze top. Dome bottom strainer. No-hub outlet,
2. Grate: 6-inch round top except where 6-inch square top indicated (-B). Free area (minimum) 6-inch round = 9 square inches, 6-inch square = 12.5 square inches. Secured by vandal-proof screws.
3. Trap primer connection.
4. J.R. Smith No. 2010-A (-B) PBU, (caulk or thread); No. 2005-A (-B) PBU, (No-Hub).

2.10 **ADA PLUMBING FIXTURE PIPING INSULATION ASSEMBLY**

A. Manufacturer: Skal+Gard, Model SG-100B, TCI Products, or approved equal.

B. Description: Protective, molded, fire-resistant foam, single piece insulation manufactured specifically for plumbing fixture supplies and drains.

C. Performance/Design Criteria: Insulation R factor 2.

D. Materials:

1. Foam: 4.5 pounds per cubic foot.
2. Skin: White fire retardant polyurethane.
3. Twist fasteners.

PART 3 - EXECUTION

3.1 **INSTALLERS**

A. Installer: Perform work by experienced personnel previously engaged in plumbing system construction and fixture installation, and under the supervision of a qualified installation supervisor.

3.2 **PREPARATION**

A. Confirm location and size of fixtures and openings before piping rough-in and installation.

B. Verify that rough-ins have been provided, are correctly sized and are located within dimensional tolerances for fixtures to be installed prior to installation of fixtures.

C. Interface with other Work: Review Architectural drawings and millwork shop drawings to verify correct fixture locations.

3.3 **INSTALLATION**

A. Install piping and plumbing products in accordance with UPC and manufacturer's instructions. Provide seismic anchoring, bracing, supports, and clearance for equipment, piping, and sprinkler heads per UPC, IBC, and ASCE-07; most conservative criteria shall govern.

B. Provide permanent metal and wire positioners, supports, and carriers to secure fixtures and piping rigidly in proper alignment without sway or sideplay.

C. Anchor fixtures securely to withstand applied vertical load of not less than 250 pounds on the front of the fixture, without noticeable movement.

D. Install fixtures plumb, level and to the finished architectural surface, so that the maximum gap between the fixture and the surface does not exceed 3/16 inch. Caulk the edge of the joint between fixture and surface with silicone or butyl type waterproof caulking compound.

E. Install and connect hot water on left and cold water on right, as viewed when facing the fixture.

F. Locate flush valve handles on handicapped accessible water closets on the wide side of the stall. Mount Accessible fixtures shown in the ADA guidelines to the heights indicated.

G. ADA Plumbing Fixture Insulation Assembly:

1. Insulate hot water supply and waste piping exposed beneath sink and lavatory fixtures designated on drawings or specified in this section, as intended for use by the handicapped.

2. Install in accordance with ANSI A117.1. - 2009.

3.4 REPAIR/RESTORATION

A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.

B. Substitute replacement parts from other manufacturers are not acceptable.

3.5 SITE QUALITY CONTROL

A. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

3.6 ADJUSTING

A. Adjust functional components for proper operation in accordance with manufacturers' recommendations, or as otherwise directed.

3.7 CLEANING

A. Clean fixtures and trim to a clean condition. Obtain a written certification from the Owner that this has been accomplished and accepted.

END OF SECTION 22 4000

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SECTION 23 0593
TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: General requirements and methods of execution relating to the testing and balancing of the mechanical systems provided on this project.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 23 2113 - Hydronic Piping and Specialties
3. 23 2123 - Hydronic Pumps
4. 23 3400 - HVAC Fans
5. 23 3600 - Air Terminal Units
6. 23 3700 - Air Outlets and Inlets
7. 23 5223 - Cast Iron Boilers and Accessories
8. 23 8200 - Terminal Heating and Cooling Units
9. 23 8318 - Snow Melting Equipment

1.2 REFERENCES

A. Codes and Standards:

1. National Environmental Balancing Bureau - Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
2. National Environmental Balancing Bureau - Testing, Adjusting, Balancing Manual for Technicians.
3. SMACNA - HVAC SYSTEMS Testing, Adjusting, and Balancing.

B. Abbreviations and Acronyms:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.
3. TAB: Testing, Adjusting, and Balancing.
4. NEBB: National Environmental Balancing Bureau

C. Definitions:

1. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
2. Accuracy: Capability of an instrument to indicate the true value of a measured quantity.
3. Adjusting: Varying of system flows by partially closing balancing devices, such as dampers, and valves, and varying fan speeds to achieve optimum system operating conditions within design and installation limitations.

4. Balancing: Methodical proportioning of air and hydronic flows through the system main, branches, and terminal devices using acceptable procedures to achieve the specified air or hydronic flow with testing and design limitations.
5. Calibrate: The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.
6. NEBB Certified TAB Firm: A Firm that has met and maintains all the requirements of the NEBB for Firm certification in TAB and is currently certified by NEBB. A NEBB Certified Firm shall employ at least on NEBB Qualified TAB Supervisor in the full time management position.
7. NEBB Certified TAB Report: Data presented in a NEBB Certified TAB Report accurately represents system measurements obtained in accordance with the current edition of the *NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems*. Variances from design quantities that exceed NEBB or contract document tolerances are to be noted in the TAB report project summary.
8. NEBB Qualified TAB Supervisor: Full time employee of the TAB Firm in a management position who has successfully passed the supervisor level written and practical qualification examinations and maintains the Supervisor re-qualification requirements of NEBB.
9. NEBB Qualified Technician: Full time employee of the TAB Firm who has met the technician level experience requirements of NEBB and has successfully passed the technician level written and practical qualification examinations. A NEBB Qualified TAB Technician shall be supervised by a NEBB Qualified TAB Supervisor. Supervision does not infer constant oversight; a NEBB Qualified Technician is capable of performing assigned tasks with periodic supervision.
10. Precision: Ability of an instrument to produce repeatable readings of the same quantity, or a tightly grouped set of values, under the same conditions.
11. Range: Upper and lower limits on an instrument's ability to measure the value of a quantity for which the instrument is calibrated.
12. Resolution: Smallest change in a measured variable that an instrument can detect.
13. Testing: Use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristics, velocities, and air and hydronic quantities for an evaluation of flow conditions.
14. Testing and Balancing: As used in these specifications, testing and balancing refers to testing, adjusting, and balancing (TAB) as described in the above references.
15. TAB: A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in this document.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: This section describes specific requirements, products and methods of execution for the testing, adjusting and balancing of the project.

B. Performance Requirements: Furnish the services of a qualified and approved TAB Firm to perform the work of this specification section.

C. The work of this section includes but is not necessarily limited to:

1. TAB reports from the original library construction are not available. Perform testing and provide an initial air and hydronic systems TAB report prior to any demolition to document air flowrates of the AHU supply and return fans, including fan RPM, fan powered and non fan powered terminal unit CFMs and air inlet/outlet CFMs, and hydronic pump and coil water flowrates.
2. Test and balance fans and supply, exhaust and relief ventilating systems.
3. Test and balance hydronic heating systems.
4. Test and balance domestic hot water recirculation flow rate.
5. Work directly with the control subcontractor to obtain proper system adjustments. This includes, but is not limited to:
   a. VAV box controller airflow coefficient adjustments.
   b. Fluid flow measuring device calibration adjustments.
6. Measure sound power levels if so directed.
7. Provide a final report.

D. The work of this section does not include:

1. Adjusting burners for proper combustion operation.

1.4 PRE-BALANCING MEETING

A. Coordinate TAB work with other trades and requirements of other related sections of the Project Manual prior to commencing work.

B. Schedule a pre-balancing meeting one week prior to commencing work of this Section. Refer to Section 20 0000 - Mechanical General Requirements.

1.5 SUBMITTALS

A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data: Sample report forms and outlines indicating adjusting, balancing, and equipment data required prior to commencing work.

C. Certificates:

1. Submit the name and qualifications of TAB Firm for approval with general product submittals. Submit copy of TAB Firm's NEBB certification.

2. Submit the names and certifications of the Firm's NEBB Qualified TAB Supervisor and NEBB Certified Technician.

D. Balancing Report:

1. Submit a complete report of the testing and balancing of all devices in a format equivalent to that shown in the SMACNA HVAC Systems Testing, Adjusting and Balancing manual. Compile the test data and submit eight copies of the complete test data for acceptance and/or analysis and recommendations.
2. Provide report in soft cover, letter size, comb bound binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include drawings within report.
3. Report Cover Sheet. Include the following data:
    a. Project Name.
    b. Project Address.
    c. Names of Architect and Engineer.
    d. Names of General Contractor and HVAC Contractor.
    e. Report date.
    f. Names of TAB technicians responsible for the measurements and report.
4. System Review Sheet:
    a. List air and hydronic systems balanced, with systems highlighted that were found to be performing outside design tolerances.
    b. Include a summary of problems encountered, deviations from design, deficiencies in performance, remaining problems, recommendations, and comments.
5. Instrument Calibration Report:
    a. Include a complete list of test equipment used, including apparatus manufacturer's name, model number, serial number, and date last calibrated.
    b. List the instruments used on the project during the balancing work, on an NEBB "Instrument Calibration Report" form, or equivalent form. This includes flow measuring hoods and other related devices.
6. Air Systems Report. Prepare a report for each air system balanced. Tabulate data separately for each system. Describe balancing method used for each system. At minimum, include the following:
    a. System Diagram: Include locations of air terminal units and pitot tube traverses. Include appropriate notes, static pressure reading locations, etc., taken during testing and balancing.
    b. Air Apparatus or Fan Test Report: Include pertinent data on the test report forms. If test data could not be measured, or is not applicable, indicate such on report forms. List how each actual cfm measurement was obtained (duct traverse, total of outlet airflows, or a combination).
    c. Duct Pitot Tube Traverse Reports: Include actual temperature and pressure readings recorded at the time of testing and balancing.
    d. Air Outlet Test Reports: Include applicable A_k factors and terminal device sizes. If flow measuring hoods are used, indicate their use in the remarks column.

e. Include complete identification of elements. Identify by box number, room name and number, air outlet symbol, orientation in room, etc., as necessary to clearly and positively identify the location of each element.

7. Hydronic Heating and Cooling System Reports. Prepare a report for each hydronic system balanced. Tabulate data separately for each system. Describe balancing method used for each system. At minimum, include the following:

   a. Schematic Diagram: Include heat exchange equipment and locations of flow measuring devices.

   b. Pump Test Report: Confirm test data was recorded and properly entered on form. Attach manufacturer's pump capacity curves, with the actual pump operating point plotted, to the test report form. List how the actual pump flow rate was determined (flow meter, pump curve, etc.).

   c. Primary Heat Exchange Equipment: Confirm that appropriate test data has been recorded for the boilers, heat exchangers, chillers, and other primary heat exchange equipment. List how the actual flow rate(s) of each item was determined.

   d. Terminal Heat Exchange Equipment: Confirm that heating coil and terminal unit temperatures and pressures were recorded and properly entered on form. List how each terminal unit flow rate was determined.

   e. Include complete identification of elements. Identify by equipment tag number, room name and number, baseboard symbol, orientation in room, etc., as necessary to clearly and positively identify the location of each element.

8. Reduced Size Drawings: Provide with air outlets and equipment identified to correspond with data sheets. Record actual locations of thermostats, and balancing valves with settings.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. The work described in this section shall be performed by a Firm certified by the National Environmental Balancing Bureau for air and hydronic balancing.

2. The Firm shall have a record of operation within Alaska for at least three years prior to bid date of this project and shall have demonstrated satisfactory completion of five projects of similar size and scope in the State of Alaska. Provide references if requested.

3. The Firm's Technician and Supervisor for this project shall be NEBB certified for their respective positions.

4. Bids by suppliers, contractors or any Firm whose principal business is not that of testing, adjusting, and balancing HVAC systems are not acceptable.

B. Balancing Standards:

1. Perform total system balance in accordance with NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

2. Maintain one (1) copy of balancing procedural document on site.

3. Use standard NEBB forms.

C. Timing of Work:

1. Sequence work to commence after completion of systems. Do not begin balancing and testing until the systems are complete and in full working order.

2. Schedule the testing and balancing work in cooperation with other trades.
3. Schedule completion of testing and balancing before Substantial Completion of Project.

D. Construction team responsibility to TAB Agency: Refer to 20 0000 - Mechanical General Conditions.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. Verify systems are complete and operable before commencing work.

B. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

C. Report defects and deficiencies that may preclude proper TAB of systems and equipment.

3.2 **PREPARATION**

A. Schedule work under the provisions of Section 20 0000 - Mechanical General Conditions.

B. Provide calibrated instruments required for testing, adjusting, and balancing operations.

C. Prior to starting work, review drawings and actual field conditions for additional balancing devices or components required for correct balance. Coordinate provision of additional balancing devices as required elsewhere in these specifications. Refer to Related Sections above.

D. Preliminarily adjust grille, register, and diffuser blades or pattern controllers per drawings. If airflow blow patterns are not shown on drawings, adjust for uniform diffusion pattern(s) or diffusion into long dimension of room.

3.3 **SPECIAL TECHNIQUES:**

A. Use instrumentation in accordance with NEBB requirements, calibrated to the accuracy standards specified by this organization.

B. Flow measuring hoods are acceptable for measurement of ceiling diffuser performance if used in a manner as recommended by the manufacturer and calibration and accuracy data is provided with the balancing report.

C. Upon request, make available to the Contracting Agency copies of current calibration certificates.

3.4 **ACCEPTABLE CRITERIA**

A. Systems will be considered balanced in accordance with NEBB *Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems* when the following conditions are satisfied:

1. Air Handling Systems:

a. Measured airflow quantities are within plus or minus 10 percent of design quantities. Deficiencies shall be noted in the TAB report.

b. There is at least one direct path with fully open dampers from the fan or terminal unit device to an air inlet or outlet. Additionally, if a system contains branch dampers,

there will be at least one wide open path downstream of every adjusted branch damper.

2. Air Outlets and Inlets:

   a. Measured airflow quantities total to within plus or minus 10 percent of design to space and individual outlets and inlets in space to within plus or minus 10 percent of design.

   b. Grilles, registers, and diffusers blades or pattern controllers are adjusted for uniform diffusion in the space. Re-adjust airflow patterns that result in airflow velocities greater than 50 FPM at 5 feet AFF.

3. Hydronic Systems:

   a. Manually balanced systems:

      1). Measured fluid flow quantities are within plus or minus 10 percent of design.

      2). There is at least on direct path with fully open balancing valves from the pump discharge balancing valve (if present) to a terminal device. Additionally, if a system contains branch balancing valves, there will be at least one wide open path downstream of every adjusted branch balancing valve.

   b. Automatically balanced systems: Pressure drops across a sample of system's automatic balance valves are within the manufacturer's recommended operating range for the device.

B. If systems or components cannot be adjusted to within specified tolerances:

1. Coordinate the replacement of sheaves, belts, or other components or devices needed for correct balance as required elsewhere in these specifications.

2. Note deficiencies in the TAB report.

3.5 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on equipment sheaves, belts, dampers, valves, air outlets and inlets and each system according to the procedures contained in the current edition of the NEBB *Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems* and this section.

B. Adjustments shall be made with air handler filters blanked off to create a filter pressure drop of 60 percent of the manufacturer's recommended filter final pressure. Where multiple filters are encountered each set shall be individually blanked off, for a cumulated pressure drop of 60 percent of each filters final pressure.

C. Ensure recorded data represents actual measured or observed conditions.

D. Permanently mark final settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Contracting Agency.

H. Schedule and provide assistance in final adjustment and test of fire alarm system with Authority Having Jurisdiction.

3.6 **SITE QUALITY CONTROL**

A. Make calibrated test instruments available to Contracting Agency to facilitate spot checks during testing and commissioning as appropriate.

B. Re-balance components or systems found to be out of tolerance at no additional expense to the Owner.

END OF SECTION 23 0593

SECTION 23 1113
FUEL OIL PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fuel Piping, Fittings and Accessories.

B. Related Sections: 20 0000 - Mechanical General Requirements.

1.2 SYSTEM DESCRIPTION

A. The work includes connection of the existing fuel oil piping system to the new fuel oil burning boiler connections. In general, oil burning equipment is specified elsewhere.

1.3 SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements.

PART 2 - PRODUCTS

2.1 FUEL PIPING AND FITTINGS

A. Above grade:

1. Carbon Steel Product Line Pipe and Fittings:
   a. Schedule 40 black steel. Threaded fittings,
2. Copper Product Line Pipe and Fittings:
   a. Type “K” hard drawn copper with brazed fittings (1,000 degrees F minimum filler metal melting point).
   b. Type “K” annealed tubing with Swagelok® "Flare" fittings or approved equal.

2.2 THREAD SEALANT

A. Threaded connections are to be sealed with a UPC listed, lead-free, paste thread sealant compatible with the product and piping materials specified.

B. Threaded connections which must be disassembled for periodic maintenance shall be sealed with a UPC listed, lead-free, non-seizing type, paste thread sealant compatible with the product and piping materials specified.

C. Manufacturer: Real-Tuff™, Grrip™, or approved equal.

2.3 VALVES

A. Isolation Valves:

1. Size: 1/2 inch to 2 inch pipe size.
2. Ball type, Bronze body, regular port, WOG rated.
3. Chrome plated ball.
4. Blow-out proof, grounded stem.
5. PTFE resilient seats and seals.
6. Zinc plated handle with rubber handle cover.

7. Manufacturer: Crane Tork-Seal No. 930, threaded, 600CWP/150SWP, or approved equal.

B. Fusible Valves:

1. UL listed.
2. Brass body.
3. Automatic shutting at 165 degrees F.
4. Self-adjusting stuffing box.
5. Backseat feature.
6. Threaded, flared or combination fittings.
7. Manufacturer: Firomatic, or approved equal.

2.4 FILTERS

A. Suitable for pressure type burners, UL listed.

B. 12 psig working pressure.

C. 60 GPH firing rate.

D. Filter capacity: 25 microns.

E. Manufacturers: General Filter, Firomatic, or approved equal.

2.5 GAUGES

A. 2-1/2 inch diameter gauge, suitable for oil service.

B. Accuracy at two percent of range.

C. Select pressure range for normal; indicate in the middle third of range.

D. Manufacturer: Trerice or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Connections:

1. Provide the final operating connection to fuel oil burning equipment in accordance with the specific equipment manufacturer's installation instructions.
2. Provide leak tight, sheetmetal drip pans with 2 inch raised and rolled rims under each fuel oil burner, filter assembly, and at any additional location susceptible to fuel oil leakage.
3. Provide a new fuel oil filter, new fusible valve and isolation valve at the new boiler.

3.2 DEMONSTRATION AND STARTUP

A. Demonstrate proper operation of the systems to the satisfaction of the Contracting Agency.

B. Provide written documentation that demonstration and start-up of the systems and equipment has been satisfactorily completed.

END OF SECTION 23 1113

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SECTION 23 1123
FUEL GAS PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Specific requirements, products, and methods of execution relating to the provision of fuel gas systems for the project.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification

1.2 REFERENCES

A. Codes and Standards:

1. 2012 International Fuel Gas Code (IFGC).
2. 2012 NFPA 54 - National Fuel Gas Code.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for interrelated systems necessary for the distribution of propane to the propane fired fireplace and fireplace venting for this project.
2. Provide products including above ground piping, connections to propane burning apparatus, and work at the gas source to provide complete fuel gas systems.
3. The local propane supplier will provide and install the tank and the pressure regulators. Coordinate installation requirements and products.

B. Performance Requirements:

1. Provide the connection at the gas pressure regulator outlet using appropriate materials, compatible joints, supports, and other products for proper interface.

1.4 PREINSTALLATION MEETINGS

A. Coordinate installation of gas piping and equipment with trades responsible for portions of this and any other related specification sections prior to installation of any components.

1.5 SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data: Provide manufacturers' product literature for items specified in Part 2 and those products required by the performance standards of this section, clearly annotated to indicate specified salient features and performance criteria.

C. Shop Drawings: Submit dimensioned shop drawings of gas piping size and routing as part of the plumbing shop drawings, with callouts indicating deviations from layout shown.

D. Test and Evaluation Reports:

1. Obtain a certificate of final inspection from the Contracting Agency.
2. Submit a letter of certification with copy of certificate of final inspection, indicating that the gas piping has been completed, tested, and inspected.

E. Quality Control Submittals: Provide a certified test report showing the system has been tested in accordance with Code requirements and is in compliance.

1.6 CLOSEOUT SUBMITTALS:

A. Record Documentation: Record actual locations of equipment, piping, and components, and areas required for maintenance access.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
2. Installers: Minimum three years' experience in the installation of gas piping and equipment.

B. Regulatory Requirements: NFPA 54.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 20 0000 - Mechanical General Requirements for general delivery, storage and handling requirements.

1.9 WARRANTY

A. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 PROPANE GAS PIPING

A. Below grade, pressure less than 10 psig:

1. Exterior to the building only: Medium-density polyethylene tubing per ASTM D 2513, IPS SDR-11, listed for LP-Gas service, yellow pipe color complying with APWA/ULCC color code.
2. Manufacturer: JM Eagle or equal.

B. Above ground, pressure less than 14 inches water column:

1. Interior or exterior to the building: Schedule 40 black steel pipe per ASTM A53.
   a. Welded or threaded black malleable iron fittings.
2. Interior to the building: Corrugated Stainless Steel Tubing (CSST):
   a. CSST complying with ASTM A 240, 125 PSIG maximum operating pressure and 200 degrees F maximum operating temperature.
   b. Fittings and appurtenances by same manufacturer as CSST product.

c. Manufacturer: OmegaFlex TracPipe PS-II, or approved equal.

2.2 PRESSURE REGULATORS

A. Pressure regulators provided by local propane supplier.

2.3 PROPANE TANK

A. Provided by local propane supplier.

B. Tank: Above ground.

C. Capacity: 500 gallons.

D. Construction: U.S. DOT compliant.

2.4 FIREPLACE VENTING

A. Listed concentric direct vent type (5X8) as recommended by the fireplace manufacturer. Coordinate with Architechural.

B. Vertical high wind termination with high wind guard.

C. Type 430 stainless steel inner flue, 0.016 inch ; Steel outer casing, 0.022 inch.

D. ICC EXCELDirect or equal.

2.5 SEISMIC GAS SHUT-OFF VAVLE

A. Vertical orientation, bottom in flow, 60 psig pressure rating, -22 to 150 deg F operating temperature.

B. Rated for propane gas, ANSIZ21.21 and ASCE 25 compliant.

C. Manufacturer: Pacific Seismic or equal.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Installer: Perform work by experienced personnel under the supervision of a qualified installation supervisor.

3.2 PREPARATION

A. Protection of In-Place Conditions: Plug piping connections for protection from construction dirt and debris.

B. Surface Preparation: Prior to installation of stacks, verify that shop drawings are approved and stack locations and routing have been coordinated with other trades.

3.3 INSTALLATION

A. Special Techniques:

1. Install equipment in accordance with manufacturer’s instructions and requirements of the codes specified herein.
2. Arrange products to be readily accessible for inspection, testing, and shutting off gas supply.
3. Install pipe and fittings clean and free from cuttings, burrs, and defects in structure of threading, and thoroughly brushed and scale blown.
4. Do not install any piping in concrete, in masonry, or below grade inside the building.
5. Provide connection to gas consuming appliances. Connect gas appliances and fixtures with flexible connectors in accordance with the requirements of the appliance listing and manufacturer’s instructions.

6. Provide independent gas pressure relief pipes to outside the building from each fuel gas train. Size and install reliefs in accordance with the written UL listing installation instructions. Gang piping to penetrate exterior building skin at a common location. Terminate relief vents not less than 10 feet from openings to the building and not less than 25 feet from building outside air intakes.

B. Interface with Other Work: Coordinate and sequence installation of gas piping and equipment with trades responsible for portions of this and other related sections of the Project Manual.

3.4 REPAIR/RESTORATION

A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.

B. Substitute replacement parts from other manufacturers are not acceptable.

3.5 RE-INSTALLATION

A. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

3.6 SITE QUALITY CONTROL

A. Site Test and Inspections:

1. Test gas piping before connection to the gas source. Do not enclose or conceal any untested portion of the gas system.

2. Test piping in accordance with IFGC requirements.

B. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

3.7 CLEANING

A. Clean gas piping, fittings, valves, etc., of grease, rust, dust and dirt.

B. Paint exterior piping with one coat of a suitable rust-inhibiting primer and one final coat of enamel paint to provide a uniform appearance. Color: By Architect; to match exterior siding.

C. Provide metal escutcheon at piping exterior wall penetration.

END OF SECTION 23 1123

SECTION 23 2113
HYDRONIC PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for:
    a. Hydronic heating piping.
    b. Equipment drains and overflows.
2. Piping accessories.
3. Flexible pipe connectors.
4. Hydronic Specialties:
    a. Expansion tanks.
    b. Air vents.
    c. Strainers.
    d. Brazed plate heat exchangers.
    e. Flushing agents.
    f. Water treatment chemicals.
    g. Glycol specialties.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 20 0700 - Mechanical Insulation
5. 20 4100 - Mechanical Demolition
6. 23 0593 - Testing, Adjusting and Balancing
7. 23 2123 - Hydronic Pumps
8. 23 5223 - Cast Iron Boilers and Accessories
9. 23 8200 - Terminal Heating and Cooling Units
10. 23 8318 - Snow Melting Equipment
11. 25 3000 - Building Automation System Field Devices
12. 25 5000 - Building Automation System
13. 25 9000 - Sequence of Operations

1.2 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products, and methods of execution for the system of liquid heat transfer throughout the project. The system of heat generation is specified elsewhere.

1.3 PRE-INSTALLATION MEETINGS

A. Coordinate installation of hydronic systems and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any hydronic components.

1.4 SUBMITTALS

A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data:

1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Literature clearly annotated to indicate specified salient features and performance criteria.

C. Shop Drawings:

1. Submit shop drawings for piping systems to demonstrate proper layout and coordination.
2. Drawings of boiler room, fan rooms, and other areas with high-density piping, shall be shown at 1/4-inch scale or larger.
3. Indicate elevation of piping above finish floor.
4. Indicate dimensions and weights of equipment, and placement of openings and holes.
5. Include reference to ductwork and other equipment where space coordination is necessary to avoid conflicts.
6. Indicate mechanical and electrical service locations and requirements.

D. Manufacturer Reports:

1. Certificates, Manufacturer's Instructions, and Manufacturer's Field Reports:
   a. Provide a complete manufacturer's written installation, operation and maintenance manual for each type of installed equipment. Annotate the manual to indicate applicable information for the specific equipment model(s) installed.
   b. Included with the manual one copy of the completed start-up and operation checklist. The checklist shall include:
      1). Printed names and signatures of the installers.
      2). Documentation from Manufacturer's representative and Contracting Agency that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.
2. Test reports:
   a. Provide certificate that cleaning of hydronic systems has been accomplished.
   b. Provide certificate listing satisfactory results for the hydrostatic pressure tests.

c. Provide certificate listing satisfactory results for the operational tests.

3. Submit a letter to document that the training was conducted. Include in the letter the date, start/stop times for the training, list of attendees and signature/title of the person(s) providing the training.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance (IO&M) Manuals:

1. Refer to Section 20 0000 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.

2. Include the following:

a. Copies of approved submittal information.

b. Manufacturer's installation, operating and maintenance/repair instructions, parts listings, and spare parts list for each product. Annotate the manual to indicate applicable information for the specific equipment model(s) installed.

c. Completed start-up and operational test report as required to validate equipment warranty.

d. Start-up and operational test reports for each piece of equipment. Report shall include printed names and signatures of the installers and documentation that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.

B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.

C. Record Documentation: Record actual locations of equipment, valves, strainers, air vents, flexible pipe connectors, expansion joints, other components, and locations of access doors required for maintenance access in accordance with Section 20 0000 - Mechanical General Requirements.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.

2. Installers: Minimum 3 years' experience in the installation and start-up of hydronic systems and equipment.

3. Testing Agencies: Products requiring electrical connection shall be listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and as indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site:

1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.

2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.

3. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

B. Storage and Protection:

1. Store products outside the general construction zone in covered storage area protected from the elements, until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

1.8 WARRANTY

A. Manufacturer Warranty:

1. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.
2. Provide 1 year manufacturer's warranty.
3. Submit necessary documentation to the Manufacturer's Representative to validate manufacturer's warranty.
4. Provide to the Contracting Agency 1 copy of warranty documentation and confirmation receipt from the Manufacturer's Representative.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Glycol Systems:

1. Copper pipe three inches and smaller:
   a. Type L copper, wrought copper fittings.
   b. Fit joints using 430 silver solder, 95-5 tin-antimony or other approved lead-free solder. Solder type must be compatible with pipe and fittings. Solder containing lead shall not be allowed on the job site.
   c. Soldering flux: Water flushable, low corrosivity type meeting the requirements of ASTM B813. Flux shall have label indicating it meets these requirements.
   d. Extracted branch joints (T-Drill) may be approved when Contractor can demonstrate satisfactory experience with this method. All joints shall be brazed in accordance with the Copper Development Association Copper Tube Handbook using B-Cup series filler metal.
2. Copper Press Fitting System:
   a. Limited to tubing sizes 4 inch and smaller.
   b. Cast or wrought copper fittings, ASME B16.18 or ASME B16.22. Pre-formed grooves with pre-lubricated EPDM O-rings designed to seal fitting to copper tubing water tight with the use of manufacturer's crimping tool. Fittings shall be rated for 250 Degrees F., and 200 psi.
   c. IAPMO UPC listing.
   d. Elastomeric gaskets suitable for glycol.
   e. Manufacturer: Viega ProPress, NIBCO Press System, no substitutions.
3. Victaulic mechanical joint-type pipe systems are not permitted.
4. Galvanized piping is not permitted.

B. Equipment drains and overflows: Type L copper pipe, wrought copper fittings.

2.2 **VALVES**

A. Select valves of the best quality and type suited for the specific service and piping system used. Minimum working pressure rating 125 psig saturated steam or 200 psig W.O.G. Packing material or seals shall not contain asbestos.

B. Manufacturers: Crane, Nibco, Hammond, Jenkins, Grinnell, Milwaukee, Stockham, Victaulic .

C. Ball Valves, two inch and smaller: Two piece type, full port, bronze or stainless steel body and ball, TFE seats, blowout proof stem, 150 psig pressure/temperature rating (steam).

D. Swing Check Valves two inch and smaller: Bronze body, horizontal swing, Y-pattern, Buna-N-disc for water, oil and gas. TFE disc for steam.

E. Drain Valves: Full port ball valve with threaded hose adapter with bronze end cap. Do not use sillcocks or butterfly valves as drain valves.

F. Valves Specified Elsewhere: Provide special valves such as motor-operated valves, relief valves, temperature regulating valves, etc., as specified under the individual system or as indicated on the drawings.

2.3 **UNIONS (STANDARD)**

A. Copper Piping (Sweat and Threaded): Cast brass, ground joint, copper to copper, or copper to threaded joint. Grinnell No. 9730 - 9739.

2.4 **PRESSURE GAUGES**

A. Provide where shown on drawings, specified in Part 3, or as required.

B. Bourdon tube type with 4-1/2-inch dial (minimum) accuracy plus or minus one-percent span, recalibratable. Normal operating pressure near midpoint of range. Industrial quality.

C. Gauge cock on gauges and pulsation damper (snubber). Steam gauges shall have siphon to isolate gauge from steam, except where remotely mounted and connected by looped tubing.

D. Differential pressure gauges shall be piston or diaphragm type with range suitable for application and static pressure capability suitable for system pressure. Orange Research.

2.5 **THERMOMETERS**

A. Provide where shown on drawings, specified in Part 3, or as required.

B. Digital, self powered type.

C. Normal operating temperature at scale midpoint and sufficient range to cover operating conditions.

D. Provide separable wells of suitable material for piping and mounting hardware for ducts. Set probe in heat transfer paste recommended by thermometer manufacturer.

E. Manufacturers: Weiss DVU or equal.

2.6 **PRESSURE AND TEMPERATURE TEST PLUGS**

A. Provide where shown on drawings, specified in Part 3 or as required.

B. Standard type for 1/8-inch diameter pressure or temperature probes. Self seal when probe removed and complete with threaded cap. Minimum continuous rating 125 PSIG and 220 degrees F coincident. Sealing element suitable for fluid in pipe.

C. Provide one thermometer and one pressure gauge for each range required by system parameters.

D. Manufacturers: Sisco, Peterson Equipment, or approved equal.

2.7 FLEXIBLE PIPE CONNECTORS

A. General:

1. System Application: Hot water heating or 50 percent propylene glycol solution (heating) or 30 percent propylene glycol solution (cooling).
2. System Maximum Operating Temperature: 210 degrees F.
3. Pressure: Internal.
4. Installation: Straight or Offset as shown.
5. Movement: Constant or Intermittent.
6. Maximum offset: Not to exceed 25 percent of the centerline bend radius.
7. Determine appropriate minimum “live hose length” (flexible portion of assembly) based on the centerline bend radius for each application in accordance with manufacturer’s sizing tables.

B. Copper Pipe Flexible Connectors - Small Diameter (Sweat):

1. Size: 3/4 inch through 2-1/2 inch nominal pipe size (NPS).
2. Pipe Ends: Copper tube sweat.
3. Corrugated Hose: Bronze.
4. Outer Braid: Single braided bronze.
5. Minimum Working Pressure Rating: 120 PSIG at 250 degrees F.
6. Maximum Temperature Rating: 250 degrees F.

C. Copper Pipe Flexible Connectors - Small Diameter (Removable):

1. Size: 3/4 inch through 2-1/2 inch nominal pipe size (NPS).
2. Pipe Ends: Female pipe coupling, Female union, Male Hex Nipple, Male Pipe with Hex Nut.
3. Corrugated Hose: Bronze.
4. Outer Braid: Single braided bronze.
5. Minimum Working Pressure Rating: 120 PSIG at 250 degrees F.
6. Maximum Temperature Rating: 250 degrees F.

D. Manufacturers: Metraflex, Keflex, or equal.

2.8 EXPANSION TANKS

A. General:

1. Performance as scheduled.
2. Flexible heavy duty butyl diaphragm sealed into tank, as scheduled.

B. Construction:

1. Designed, tested and stamped in accordance with ASME SEC 8-D standards; supplied with National Board Form U-1.
2. Welded steel shell and base.
3. Forged steel system connections.
4. Steel support stand.

C. Ratings:

1. Working pressure: 125 PSIG.
2. Working Temperature: 240 degrees F.
3. Precharge: As Scheduled.

D. Accessories:

1. Pressure gage.
2. Air charging fitting.
3. Tank drain isolation valve.
4. System connection isolation valve.

E. Model and size: As scheduled.

F. Manufacturers: Amtrol, Armstrong, Bell & Gossett, Taco, or equal.

2.9 AIR VENTS

A. Coin operated vent: Manual low profile vent for use in baseboard and other enclosures where automatic vent will not fit. 150 PSIG working pressure, 212 degrees F. operating temperature. Bell & Gossett No. 4V or approved equal.

B. Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
2. Iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.
3. Operating pressure 75 psig, hydrostatic pressure 200 PSI maximum, intended for use in hot or cold lines. Provide ball type isolation valves for air vents that do not have integral shut off valves.
4. Manufacturers: Spirotherm Spirotop, Honeywell EA791004, or equal.

2.10 STRAINERS

A. Size two inch and under:

1. Screwed brass or iron body for 175 PSIG working pressure.
2. Y pattern with 1/32-inch stainless steel perforated screen.

B. Manufacturers: Metraflex, Armstrong, Crane, Hayward, Watts Regulator, Hoffman, Sarco, Victaulic.

2.11 AUTOMATIC FLOW LIMITING AND ISOLATION VALVES

A. Supply pipe side: Brass alloy body with stainless steel flow cartridge assembly, integral ball valve, 20 mesh strainer element, two pressure/temperature test valves and drain valve with hose bibb adapter and end cap. Body design allows removal of flow cartridge without disturbing piping connections. Threaded sweat adapter inlet. Union with sweat adapter outlet.

B. Return pipe side: Forged brass body with integral ball valve, pressure/temperature test valve and manual air vent. Union with sweat adapter inlet. Threaded sweat adapter outlet.

C. Calibration: Control flow within five percent of selected rating, over operating pressure range of at least 10 times minimum pressure required for control. Provide three operating pressure ranges with a minimum range requiring less than 3.5 PSID to actuate flow control cartridge.

D. Flow Control Cartridge: Stainless steel one piece cartridge with segmented port design and full travel linear coil spring.

E. Provide supply and return components packaged as a system and labeled in accordance with the equipment schedule tag to match terminal heating unit served.

F. Manufacturer: Griswold Controls, Bell & Gossett, Victaulic or approved equal.

2.12 BALANCING VALVES

A. Provide calibrated plug or ball valve type balancing valves with self-sealing quick connect pressure taps, scale and locking device. Include schedule with submittal.

B. Manufacturers: Bell & Gossett, Taco, Victaulic or equal.

2.13 BRAZED PLATE HEAT EXCHANGERS

A. Provide brazed plate type heat exchanger(s) with the heat transfer and hydraulic performance characteristics as scheduled.

B. Heat exchangers to include the following:

1. Cover plates: Stainless steel ASTM 316L.
2. Channel Plates: Corrugated stainless steel ASTM 316L, vacuum brazed together.
3. Brazing material: Copper.
4. Connections: Stainless steel ASTM 316L.
5. Design pressure: 435 PSIG.
6. Design temperature: -310 degrees F (minimum) and 450 degrees F (maximum).

C. Manufacturers: Bell & Gossett, Trantor, or equal.

2.14 **FLUSHING AGENT**

A. Synthetic organic dispersant manufacturer: CH2O, Product 6149 or approved equal.

2.15 **WATER TREATMENT**

A. Hydronic loop treatment manufacturer: CH2O, Product 6439 or approved equal.

2.16 **GLYCOL SYSTEMS**

A. Provide equipment and products specifically designed and approved for continuous operation with the glycol solution specified.

B. Glycol Solution:

1. Inhibited propylene glycol solution premixed to 50 percent by volume for use with hydronic heating systems.
2. Fluid analysis test kit.
3. Manufacturer: Dow Chemical Company Dowfrost HD dyed. No substitutes.

PART 3 - EXECUTION

3.1 **INSTALLERS**

A. Installer: Perform work by experienced personnel previously engaged in hydronic system construction and under the supervision of a qualified installation supervisor.

3.2 **PREPARATION**

A. Protection of In-Place Conditions: Cover equipment and plug piping connections to protect components from construction dirt and debris.

B. Surface Preparation:

1. Prior to installation of equipment, verify concrete housekeeping pads are complete and properly sized for equipment mounting.
2. Prior to installation of piping and equipment, verify that shop drawings are approved and locations and routing have been coordinated with the work of other trades.

3.3 **INSTALLATION**

A. Special Techniques:

1. Install equipment in accordance with manufacturer's instructions and requirements of the codes specified herein.
2. Provide finished products with protective covers during balance of construction.
3. Provide accessible ball type isolation valves at major piping branches, and on main lines as shown, and at terminal devices. Provide drains and manual vents at main line and branch line valves to facilitate draining and filling piping sections. Provide caps on drain outlets.
4. Access Doors: Provide appropriate size and install such that hydronic system features are readily accessible and maintainable.
5. Install balancing valves and automatic flow limiting valves to be accessible and adjustable.
6. Install piping to maintain headroom, conserve space, and not interfere with use of space.
7. Use of bullhead tee with opposed flow, double inlet configuration not allowed.

8. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
9. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
10. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 - Finishes.
11. Thermal Expansion:
    a. Install piping to allow for normal thermal expansion and contraction without stressing pipe, joints, or connected equipment.
    b. Provide anchors where necessary and as shown.
12. Provide test plugs on both inlet and outlet sides of heat transfer elements to allow measurement of both fluid pressure drop and differential temperature.
13. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
14. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
15. Flushing:
    a. Where hydronic piping installed under this project is connected to an existing hydronic system, provide branch isolation valves and provision for cleaning and flushing consisting of tees with valve, hose fittings and caps immediately adjacent to the branch isolation valves.
    b. Flush and clean all existing to remain hydronic heating supply and return piping as part of filling and commissioning the system expansion. Provide new glycol solution meeting these specifications. The Contractor is responsible for proper disposal of the used glycol solution.
    c. Clean internal surfaces of the completed heating system as follows:
        1). Flush hydronic piping to remove black magnetic iron oxide and mill scale from the system.
        2). Flush system piping with synthetic organic dispersant to remove grease. Circulate solution through system at 150 degrees F. or greater for 12 to 24 hours.
        3). Repeat process until the system is clean to the satisfaction of the Contracting Agency.
        4). Flush system with fresh water as necessary to remove residual cleaning agent.
        5). Exercise proper care during flushing and cleaning of systems to make sure no damage is done to equipment, valves, fittings, or Work of other trades. Restore damaged system components or Work of other trades to new or original condition at no additional cost to Owner.

B. Interface with Other Work: Coordinate and sequence installation of hydronic products with trades responsible for portions of this and other related sections of the Project Manual.

3.4 REPAIR/RESTORATION

A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.

B. Substitute replacement parts from other manufacturers are not acceptable.

C. Touch-up finished surfaces with touch-up paint provided by the equipment manufacturer.

3.5 SITE QUALITY CONTROL

A. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

B. Manufacturer Services:

1. Verify units are installed and operational in accordance with the manufacturer's written installation instructions.
2. Provide samples of the inhibited propylene glycol solution to the manufacturer for testing using the fluid analysis test kit provided.
3. The manufacturer of the inhibited propylene glycol solution shall provide free testing of the solution 24 hours after system startup and again 90 days later to verify proper fluid performance for both tests.
4. Provide one copy of manufacturer's test reports to the Owner. Adjust fluid concentration and/or correct deficiencies as addressed in the report.

C. Hydronic System Cleaning and Treatment Coordination Meeting:

1. Conduct a meeting prior to flush cleaning and treatment of the hydronic heating system to discuss cleaning agents, treatment chemicals and procedures to be used. Discuss system fill procedures with inhibited propylene glycol solution.
2. Participants shall include the Contractor, Subcontractor directly performing the work and the Owner's Maintenance Staff personnel.
3. Provide one week notice prior to the meeting.
4. Cleaning, filling and treatment of the hydronic heating system is not permitted until this coordination meeting has been conducted and the Contracting Agency's concerns have been adequately addressed.

D. System fill:

1. After flush cleaning the hydronic heating system, fill the primary system with water and add treatment chemicals to the concentration recommended by the manufacturer. Fill the secondary loop system with inhibited propylene glycol solution as specified.
2. Thoroughly vent the systems to include piping high points and equipment vents (pump casings, air separators, etc.).

E. Site Tests:

1. Hydrostatic Pressure Test:

a. Make sure hydronic heating system is filled with clean operating fluid. Hydrostatically test system to 100 psig. System must hold test pressure for a two hour period with no pressure drop to pass test.

b. Inspect system during test and repair leaks.

c. Provide written report indicating that the pressure test has been satisfactorily completed.

2. Operational Test:

a. Inspect system for proper fluid circulation, sufficient clearance for expansion and contraction of piping and proper system pressure control.

b. Note and correct discrepancies and deficiencies.

c. Provide written report indicating that the operational test has been satisfactorily completed.

3. Final Glycol Fluid Percentage Test:

a. Test final fluid glycol percentage to verify final solution is mixed to 50% propylene glycol by volume throughout entire hydronic system.

b. Provide written report indicating that the final glycol fluid percentage test has been satisfactorily completed.

4. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.

F. Inspection:

1. Arrange for inspections and provide notice to the Contracting Agency when the entire work or logical portions thereof, is ready for inspection.

2. The Victaulic Company's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).

G. Verify penetrations are installed to maintain assembly integrity.

3.6 SYSTEM STARTUP

A. Start-up and operate hydronic heating systems and equipment in accordance with the manufacturer's written installation and operation manual checklist.

B. Document start-up and operational checks using the checklist and submit in accordance with submittal requirements.

3.7 ADJUSTING

A. Adjust functional components for proper operation in accordance with manufacturer's recommendations, or as otherwise directed.

B. Coordinate and work directly with the Balancing and Testing Agency and the requirements of Section 23 0593 - Testing, Adjusting and Balancing, to provide systems in proper operating order.

C. Make corrections and adjustments as required by the Testing, Adjusting and Balancing (TAB) Agency in a timely manner.

3.8 **CLEANING**

A. Waste Management: After construction is completed, clean and wipe down exposed surfaces of pumps, piping and appurtenances.

3.9 **CLOSEOUT ACTIVITIES**

A. Demonstration: Provide 2 hours of demonstration conducted by authorized factory start-up personnel to the Contracting Agencies authorized maintenance personnel.

B. Training: Provide 4 hours of operational instruction conducted by authorized factory start-up personnel to the Contracting Agencies authorized maintenance personnel.

END OF SECTION 23 2113

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SECTION 23 2123
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. In-line circulators.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0513 - Common Motor Requirements
3. 20 0529 - Mechanical Hangers and Supports
4. 20 0553 - Mechanical Identification
5. 23 0593 - Testing, Adjusting and Balancing
6. 23 2113 - Hydronic Piping and Specialties
7. 23 8318 - Snow Melting Equipment
8. 25 9000 - Sequence of Operations

1.2 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for interrelated systems necessary for the pumping of heating fluid, which will be distributed to the locations shown.
2. The method of generation of, and distribution of, this heat is specified elsewhere.

B. Performance Requirements:

1. Select pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
2. Provide performance and output shown or scheduled on drawings.

1.3 SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements.

B. Product Data:

1. Provide manufacturers' product literature, clearly annotated to indicate specified salient features and performance criteria.
2. Include the following:
   a. Catalog data sheets for each pump scheduled. Indicate which model is being submitted.
   b. Certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   c. Dimensional data.

d. Features and appurtenances being provided.

e. Electrical characteristics and connection requirements.

C. Shop Drawings:

1. Submit fully dimensioned shop drawings of boiler room showing major equipment and housekeeping pads, with clear callouts indicating deviations from layout shown.

2. Indicate mechanical and electrical service locations and requirements.

D. Quality Assurance/Control Submittals:

1. Design Data and Test Reports: Provide design data and test reports for each pump.

2. Certificates, Manufacturer's Instructions, and Manufacturer's Field Reports:

a. Provide a complete manufacturer's written installation, operation and maintenance manual for each installed pump. Clearly annotate the manual to indicate applicable information for the specific equipment model(s) installed.

b. Included with the manual one copy of the completed start-up and operation checklist. The checklist shall include:

1). Printed names and signatures of the installers.

2). Documentation from Manufacturer's representative and Contracting Agency that the pumps have been properly installed and is fully operational, thus validating the equipment warranty.

E. Closeout Submittals:

1. Project Record Documents: Record actual locations of pumps and associated valves, and areas required for maintenance access.

2. Operation and Maintenance (IO&M) Manuals:

a. Refer to Section 20 0000 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.

b. Provide copies of approved submittal information for inclusion within the project IO&M Manual. Include manufacturer's descriptive literature, operating instructions, installation instructions, assembly views, lubrication instructions, maintenance and repair data, parts listings, and spare parts list.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

2. Acceptable Installers: Minimum three years experience in the installation and start-up of pumps.

B. Pre-Installation Meetings: Coordinate installation of pumps and associated piping and valves with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any components.

C. Regulatory Requirements: Products Requiring Electrical Connection - Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site:

1. Verify that products are delivered in original factory packaging and are free from damage and corrosion:
2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.

B. Storage and Protection:

1. Outside the general construction zone, store products in covered storage area protected from the elements until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

1.6 WARRANTY

A. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.

B. Submit necessary documentation to the Manufacturer's Representative to validate manufacturer's warranty.

C. Provide to the Contracting Agency one copy of warranty documentation and confirmation receipt from the Manufacturer's Representative.

PART 2 - PRODUCTS

2.1 INLINE CIRCULATORS (PMP-3, PMP-4, PMP-5/5A)

A. Type: Horizontal shaft, single-stage, in-line.

B. Materials:

1. Pump: Cast iron, with flanged pump connections.
2. Impeller: Noryl thermoplastic. Stainless steel shaft.
3. Mechanical Seal Assembly: Carbon/Silicon-Carbide.
4. Motor bearings: Permanently lubricated ball bearing.

C. Performance:

1. As scheduled.
2. Maximum working temperature: 225 degrees F.
3. Maximum working pressure: 150 psig.

D. Electrical Characteristics:

1. As scheduled.

E. Manufacturers: Taco 2400 series (Basis of Design), Grundfos, Bell and Gossett.

2.2 **IN-LINE CLOSE COUPLED CIRCULATORS (PMP-1, PMP-1A)**

A. Type: Horizontal shaft, single stage, close coupled, in-line.

B. Materials:

1. Pump Volute: Cast iron, with 125 pound ANSI flanged pump connections.
2. Impeller: Stainless Steel.
3. Shaft: Alloy steel copper sleeve.
4. Mechanical Seal Assembly: Silicon carbide element, carbide seat.

C. Performance:

1. As scheduled.
2. Maximum working temperature: 230 degrees F.
3. Maximum working pressure: 175 psig.

D. Electrical Characteristics:

1. As scheduled.

E. Manufacturers: Taco 1900 series (Basis of Design), Grundfos, Bell and Gossett.

PART 3 - EXECUTION

3.1 **PREPARATION**

A. Protection: Cover pumps and plug piping connections to protect pumps from construction dirt and debris.

B. Preparation: Prior to installation of pumps, verify that electrical power is available and of the same voltage and phase characteristics as the pump being installed.

3.2 **INSTALLATION**

A. Install pumps, pump supports, pressure gauges and other pump appurtenances in accordance with the manufacturer's written installation instructions.

B. Provide access space around pumps for service. Provide no less than the minimum as recommended by manufacturer.

C. Provide line sized shut-off valve on pump suction, and line sized soft seat check valve.

D. Provide gauges with connections to suction and discharge.

E. Lubricate pumps before start-up.

3.3 **CONSTRUCTION**

A. Interface with Other Work:

1. Coordinate and sequence installation of pumps and appurtenances with trades responsible for portions of this and other related sections of the Project Manual.

2. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

3.4 **REPAIR/RESTORATION**

A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.

B. Substitute replacement parts from other manufacturers are not acceptable.

3.5 **FIELD QUALITY CONTROL**

A. Start-up and adjust the system to within the tolerances as specified by the equipment manufacturer. Verify pump impellers rotate in the correct direction.

B. Provide two hours operating instruction to authorized Owner's Representative.

C. Test pump operation and sequencing in accordance with the manufacturer's written installation and testing instructions and Section 25 9000 - Sequence of Operations.

D. Submit a letter of certification indicating that the pump installation and start-up has been completed, that the pumps are properly adjusted and operating within the tolerances as specified by the manufacturer, and that the sequence of operation is fulfilled.

3.6 **ADJUSTING**

A. Coordinate and work directly with the Testing, Adjusting and Balancing Agency to provide systems in proper operating order. Make corrections and adjustments as required by the Balancing and Testing Agency in a timely manner.

3.7 **CLEANING**

A. After construction is completed, clean and wipe down exposed surfaces of pumps, piping and appurtenances.

B. Touch up marred or scratched factory finished surfaces using finish materials furnished by manufacturer.

3.8 **DEMONSTRATION & START-UP**

A. Start-up and operate hydronic pumps in accordance with the manufacturer's written installation and operation manual checklist.

B. Document start-up and operational checks using the checklist and submit in accordance with submittal requirements.

END OF SECTION 23 2123

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SECTION 23 3100
DUCTS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

1. Section Includes: Metal Ductwork and Fittings.
2. Flexible Ductwork.
3. Acoustical Linings.
4. Volume Dampers.
5. Control Dampers.
6. Flexible Duct Connectors.
7. Access Panels and Doors.
8. Filters

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0700 - Mechanical Insulation
4. 23 0593 - Testing, Adjusting and Balancing
5. 23 3400 - HVAC Fans
6. 23 3600 - Air Terminal Units
7. 23 3700 - Air Outlets and Inlets

1.2 REFERENCES

A. Codes and Standards:

1. SMACNA HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005.
2. SMACNA HVAC Air Duct Leakage Test Manual, Second Edition 2012.
3. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

1.3 PREINSTALLATION MEETINGS

A. Coordinate installation of ductwork and accessories with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of ductwork and accessories.

1.4 SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data: Include manufacturer's detailed fire, smoke, and combination fire/smoke damper installation instructions for each specific wall, ceiling, and floor construction type(s) for the project.

C. Shop Drawings:

1. Include the following information in the scaled ventilation system shop drawings:

a. Label duct sizes using the same labeling method as the Contract Documents.

b. Show terminal equipment ductwork connections.

c. Volume, control, backdraft, fire, smoke, and combination fire/smoke damper locations as applicable.

d. Flexible connection locations.

e. Access panels and doors with sizes and swing directions shown.

D. Installation, Operation and Maintenance (IO&M) Manuals.

1.5 **CLOSEOUT SUBMITTALS**

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.

C. Record Documentation: Record actual locations of ductwork and areas required for maintenance access in accordance with Section 20 0000 - Mechanical General Requirements.

1.6 **QUALITY ASSURANCE**

A. Qualifications:

1. Manufacturers: Minimum five (5) years of documented experience manufacturing commercial HVAC duct work and accessories in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

2. Installers: Minimum five (5) years of experience in the installation of commercial HVAC ductwork and accessories in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

1.7 **DELIVERY, STORAGE, AND HANDLING**

A. Refer to Section 20 0000 - Mechanical General Requirements for general delivery, storage and handling requirements.

1.8 **WARRANTY**

A. Refer to Section 20 0000 - Mechanical General Requirements for general warranty requirements.

PART 2 - PRODUCTS

2.1 **METAL DUCTWORK AND FITTINGS**

A. General: Provide metal ductwork and fittings fabricated in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, G90 zinc coated unless otherwise noted.

B. Medium Pressure/Velocity Ductwork:

1. Duct Pressure Class: 4 inches WC.

2. Seal Class: A.

3. Maximum Velocity: 2,200 FPM.

C. Low Pressure/Velocity Ductwork:

1. Duct Pressure Class: 2 inches WC.
2. Seal Class: A.
3. Maximum Velocity: 1,500 FPM.

2.2 FLEXIBLE DUCTWORK

A. Manufacturers:

1. Thermaflex, Model M-KE.
2. Hart & Cooley.
3. JPL.
4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Description: UL listed, Class 1 flexible ductwork in compliance with NFPA 90A and 90B.

C. Performance/Design Criteria:

1. Positive Pressure Rating:

Ten inches WC	(4”-12” ID).
Six inches WC	(14”-16” ID).
Four inches WC	(18”-20” ID).

2. Negative Pressure Rating:

One inch WC	(4”-12” ID).
One half inch WC	(14”-20” ID).

3. Maximum Velocity: 5000 FPM.
4. Operating Temperature Range:
   a. 0 degrees F to 140 degrees F (continuous).
   b. Minus 20 degrees F to 250 degrees F (intermittent).
5. Insulating Value: R-4.2.

D. Materials:

1. Acoustically rated black polyester core permanently bonded to coated spring steel wire helix.
2. Fiberglass insulation.
3. Tear resistant, reinforced metalized vapor barrier.

2.3 ACOUSTICAL LININGS

A. Manufacturers:

1. Knauf.
2. Johns Manville.
3. Owens-Corning.
4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Description:

1. UL listed.
2. NFPA 90A and 90B compliant.
3. One inch thick, 1.5 PCF, flexible, edge-coated, mat-faced glass fiber insulation bonded with thermosetting resin.
4. Does not promote growth of fungi or bacteria.

C. Performance/Design Criteria:

1. Maximum Velocity: 6000 FPM.
2. Operating Temperature Range: Up to 250 degrees F.
3. Maximum Water Vapor Sorption: Three (3) percent by weight.

2.4 VOLUME / BALANCING DAMPERS

A. Manufacturers:

1. Ruskin.
2. Greenheck.
3. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Materials:

1. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for fabricated volume damper construction requirements.
2. Round ducts to 12 inch diameter and rectangular to 18 inch width:
   a. Flat sheet, galvanized steel, single blade damper.
   b. Damper blade two gauges thicker than the duct gauge at the location installed (24 gauge minimum for round, 22 gauge minimum for rectangular).
   c. Manual hand quadrant.
3. Round ducts over 12 inch diameter:
   a. Flat sheet, galvanized steel, single blade damper.
   b. Damper blade two gauges thicker than the duct gauge at the location installed (22 gauge minimum).
   c. Manual hand quadrant with continuous steel rod.
4. Rectangular ducts over 18 inch width:
   a. Flat sheet, galvanized steel, single blade damper.
   b. Damper blade 18 gauge minimum.
   c. Manual hand quadrant with continuous steel rod.
5. Accessible and lockable damper operators.

C. Extractors: Not Permitted.

D. Splitter Dampers: Not Permitted.

2.5 REMOTE VOLUME DAMPER OPERATORS

A. Manufacturers:

1. Duro-dyne.
2. Young Regulator.
3. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Provide flush mounted chrome plated remote operators with tamperproof cover, extension rod, and not more than one 90 degree angle gear drive.

C. Regulator: Duro-dyne Series SRC-380 or Young Regulator 301.

D. Angle Drive: Duro-dyne Model AD-38 or Young Regulator 927.

2.6 CONTROL DAMPERS

A. Manufacturers:

1. Ruskin, Model CD50 (rectangular) or CDR25 (round).
2. Greenheck, Model VCD-43 (rectangular).
3. Air Balance.
4. Pottorff.
5. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Rectangular:

1. Performance/Design Criteria:
   a. Temperature Limits: Minus 72 degrees F. to plus 275 degrees F.
   b. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
      1). Closed Position: Maximum pressure of 13 inches W.C. at a 12-inch blade length.
      2). Open Position: Maximum air velocity of 6,000 feet per minute.
   c. Leakage: Maximum 3.0 cubic feet per minute per square foot at 1.0 inch W.C. for sizes 24 inches wide and above.
   d. Pressure Drop: Maximum 0.05 inches W.C. at 1,500 feet per minute across 24 inch by 24 inch damper.
2. Material:
   a. Frame: Five inches by one inch by minimum 0.125 inch 6063T5 extruded aluminum hat channel, mounting flanges on both sides of frame, reinforced at corners.
   b. Blades: Airfoil-shaped, single-piece blades made of heavy-duty 6063T5 extruded aluminum. Maximum 6 inches blade depth.
   c. Bearings: Non-corrosive, molded synthetic sleeve, turning in hole in frame.
   d. Seals:

1). Blade: Extruded vinyl type for ultra-low leakage. Mechanically attached to blade edge.

2). Jamb: Flexible metal compressible.

e. Linkage: Concealed in frame.

f. Axles: Minimum 1/2-inch diameter plated steel hex, mechanically attached to blade.

3. Finishes: Mill aluminum.

2.7 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:

1. Duro-dyne Corporation.
2. Vent Fabrics.
3. Ductmate
4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Performance/Design Criteria: Provide fan connectors with static pressure ratings suitable for each specific application. Minimum pressure ratings must be greater than, or equal to, the fan's shut-off static pressure, as indicated by the submitted fan curve, with a fifty (50) percent safety factor.

C. Materials:

1. Metal edging: 24 gauge galvanized steel.
2. Fabric: UL Listed, polyester blend with vinyl coating. Double folded seams. Four (4) inch width.

2.8 ACCESS PANELS AND DOORS FOR DUCTS AND PLENUMS

A. Manufacturers:

1. Air Balance Inc. model FSA-100 (Basis of Design).
2. Ruskin.
3. Ductmate.
4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Material:

1. Frame and Door: Minimum 24 gauge galvanized steel.
2. Reinforced doors with cross-bracing and/or otherwise stiffened to prevent rattling and vibration.
3. Seals: Rubber gaskets, secured to door or frame.
4. Where ductwork is insulated or lined, provide double-walled access door panels with one (1) inch of internal insulation to match duct or plenum insulating and/or sound attenuating characteristics.

C. Hinges and Latches:

1. Low velocity system access panels:

a. Sizes 12 inches by 12 inches through 24 inches by 24 inches.

b. Continuous steel hinge mechanically fastened to frame and quarter turn cam latches.

2. Medium velocity system access panels:

a. Sizes 12 inches by 12 inches through 24 inches by 24 inches.

b. Continuous steel hinge mechanically fastened to frame.

c. Provide a minimum of two latches for rolled plate doors.

d. Cement sheet rubber gasket to door.

2.9 FILTERS

A. Provide a new set of filters for the existing air handling unit at the completion of the project. Field verify type and number of filters prior to ordering. Assume 20 SF of UL listed, 2 inch MERV8 24x24, Farr 30/30 or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify location, size and type (i.e. fire resistive construction) of wall, floor and ceiling/roof penetrations.

3.2 PREPARATION

A. Protection on In-Place Conditions: During construction, install temporary closures of sheet metal, cardboard or polyethylene taped over ductwork openings to prevent construction dust and debris from entering duct systems.

3.3 INSTALLATION

A. Metal Ductwork and Fittings:

1. Install, seal and support ductwork and fittings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible for the duct pressure class and seal class specified. The use of “duct tape” as a duct seal method is prohibited.

2. Provide medium pressure/velocity ductwork at the following locations: VAV ventilation systems from air handler cabinet discharge plenum connection to VAV terminal unit inlet neck connection.

3. Provide low pressure/velocity ductwork at the following locations:

a. VAV terminal unit discharge connections to air outlet connections.

b. Outside air intake ductwork.

c. Exhaust and relief air ductwork.

d. Constant volume ventilating systems.

4. Proprietary or other joint systems may be substituted for SMACNA details when submitted and approved in writing before starting work.

5. Where ducts penetrate through walls exposed in occupied spaces, provide sheet metal escutcheons at each penetration to provide a clean, finished appearance.

6. Duct penetrations: See Section 20 0529 – Mechanical Hangers and Supports.

7. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoffs, use 90-degree conical tee or low-loss tee connections.

8. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream of equipment.
9. Provide orifice plates or balance dampers at branch connections as required for proper ventilation system balancing. Select balancing device and installation method to limit noise from mechanical vibration or air bypass.
10. Do not use turning vanes in medium velocity duct systems.
11. Support duct mounted equipment equal to or greater than 40 pounds, such as heating coils, independently from ductwork.
12. Support duct mounted equipment less than 40 pounds using standard duct supports and sway bracing located within 12 inches of equipment.
13. Where offsetting ductwork is not possible, ducts may be reduced a maximum of 20 percent to clear obstacles with Contracting Agency's permission.
14. Where steel ductwork is visible through air outlets or inlets, paint visible interior ductwork flat black.

B. Flexible Ductwork:

1. Install, connect and support flexible ductwork in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
2. Connection to air outlets in suspended grid ceiling systems: Provide a flexible duct length of 8 to 10 feet with one 90-degree bend or large radius 180-degree curve in addition to outlet connection. Support flexible duct at connections to air outlets to maintain minimum recommended bend radius.
3. Seal flexible duct connections to rigid ductwork with draw bands to the pressure class of the rigid duct system.
4. Flexible duct connections between medium pressure ductwork and air terminal units are prohibited.
5. Flexible ductwork is prohibited in inaccessible locations, such as above "hard" ceilings.
6. Flexible ductwork is prohibited at penetrations through walls.

C. Acoustical Lined Ductwork:

1. Provide standard one inch thick acoustically lined ductwork as indicated using the acoustical liner material specified. Attach the lining material to the ductwork in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide thicker acoustical lining where specifically noted.
2. Duct dimensions indicated are net free-area duct dimensions. Add twice the liner thickness to obtain outside duct dimensions.
3. Sleeve acoustical duct penetrations through full height walls perpendicular to wall surface. Provide 1/2" minimum gap between sleeve and duct. Fill gap with mineral wool backer and seal each side of penetration with acoustical sealant.

D. Volume Dampers:

1. Provide air volume dampers at each low-pressure duct main and branch take-off for proper air balancing.
2. Locate dampers a minimum of 10 feet from diffusers except where shown otherwise.

3. Volume dampers are not to be installed in medium pressure, variable air volume systems.

E. Control Dampers:

1. Provide opposed blade type dampers for the following applications:
   a. Exhaust fan discharge dampers.
   b. Outside air intake dampers.
   c. Isolation dampers.
2. Provide parallel dampers for the following application: Air handling unit mixing box.

F. Flexible Duct Connectors:

1. Install duct connectors in accordance with the manufacturers written installation instructions.
2. Provide a flexible airtight joint between fans and other vibrating equipment and the air distribution ductwork systems.
3. Externally isolated air handling units and fans: Provide flexible connections where ducts attach to unit inlet and outlet(s) of unit.

G. Penetrations:

1. Coordinate mechanical penetrations with architectural and structural construction details prior to installation. Set sleeves in position in concrete formwork. Provide reinforcement around sleeves as required.
2. Provide compatible materials, fasteners, adhesives, sealants, and other products required for proper installation.
3. Penetrations through roof, exterior walls and floors to be weather and water tight.
4. Penetrations through fire rated assemblies to be UL listed.
5. Penetrations through smoke partitions and barriers to resist passage of smoke.
6. Other penetrations to have acoustical seals.

H. Access Panels and Doors:

1. Locate access doors to enable in-duct equipment to be easily inspected, cleaned, maintained and tested and/or reset.
2. Provide access doors at the following locations:
   a. Fire, smoke and combination fire/smoke dampers.
   b. Motor operated dampers.
   c. Each side of duct mounted coils.
   d. Each side of duct mounted humidification dispersion panels.
   e. As necessary for duct cleaning in accordance with NADCA Industry Standard for Mechanical Cleaning of Non-Porous Air Conveyance System Components.
   f. As necessary for maintenance access to serviceable instrumentation and control equipment.
3. Coordinate location and size of access doors in walls, partitions and ceilings to correspond with duct access doors, dampers and automatic control devices and instruments.

4. Coordinate with supplier of component air handlers, package units and similar equipment to ensure that access doors and panels will not be obstructed when the equipment is installed.

I. Interface with Other Work:

1. Assist electrical and controls trades in mounting instrumentation devices and safety controls in ductwork and air handling units.

2. Make penetrations through exterior building walls watertight. Detail ductwork connections to prevent condensation or leakage from entering into surrounding building construction. Provide sleeves, special connections and sealant as required to accomplish this performance requirement.

3.4 SITE QUALITY CONTROL

A. Site Tests and Inspections:

B. Verify accessibility to ventilation system components for maintenance, adjustment and cleaning.

3.5 ADJUSTING

A. Adjust and balance dampers in accordance with Section 23 0593 - Testing. Adjusting and Balancing.

3.6 CLEANING

A. Prior to building occupancy and after ventilating systems are complete and functional, verify cleanliness of ventilating system ductwork. Verification shall comply with the inspection method(s) outlined in the National Air Duct Cleaners Association (NADCA) Standard for Assessment, Cleaning, and Restoration of HVAC Systems 2013. Conduct inspection in the presence of a Contracting Agency representative.

B. If the ductwork does not comply with the standard for cleanliness, clean the affected ductwork as follows:

1. Small systems: Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient airflow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

2. Large systems: Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning.

END OF SECTION 23 3100

SECTION 23 3400
HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. In-line centrifugal fans.
2. Modular small cabinet fans.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0513 - Common Motor Requirements
3. 20 0529 - Mechanical Hangers and Supports
4. 20 0553 - Mechanical Identification
5. 23 0593 - Testing, Adjusting and Balancing
6. 23 3100 - Ducts and Accessories
7. 23 3700 - Air Outlets and Inlets
8. 25 9000 - Sequence of Operations

1.2 REFERENCES

A. Codes and Standards:

1. Air Movement and Control Association (AMCA) 99 - Standards Handbook.
2. AMCA Publication 261 Directory of Products Licensed to Bear the AMCA Certified Rating Seal.

1.3 PREINSTALLATION MEETINGS

A. Coordinate installation of fans with trades responsible for portions of this and other related sections of the Project Manual prior to installation of fans.

1.4 SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data:

1. Provide fan curves with scheduled operating point clearly plotted.
2. Provide sound power levels (in decibels) for each octave band for inlet, discharge, and radiated sound power for the assembled fan unit. Obtain sound level data by one of the following methods:
    a. Actual measurements from tests performed in accordance with AMCA Standards in an AMCA registered test chamber.
    b. Documented calculations that start with AMCA tested fan sound data and are modified in accordance with ASHRAE procedures identified in Chapter 48 of the 2011 ASHRAE HVAC Applications Handbook to accurately predict the sound power levels for the configuration shown.

3. Provide electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Operation and Maintenance (IO&M) Manuals.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.

C. Record Documentation: Record actual locations of fans and components and areas required for maintenance access in accordance with Section 20 0000 - Mechanical General Requirements.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: Minimum five (5) years of documented experience manufacturing commercial HVAC fans and related equipment in accordance with AMCA standards.
2. Installers: Minimum five (5) years of experience in the installation of commercial HVAC fan systems.

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 20 0000 - Mechanical General Requirements for general delivery, storage and handling requirements.

B. Storage and Handling Requirements:

1. Maintain fan covers and shrouds in place.
2. Cover fan inlets and outlets to protect components from construction dirt and debris.

1.8 WARRANTY

A. Refer to Section 20 0000 - Mechanical General Requirements for general warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers:

1. Greenheck (Basis of Design).
2. Cook.
3. PennBarry.
4. Acme.
5. Substitution request required.

B. Description:

1. Regulatory Requirements:
   a. AMCA Certified Ratings seal for sound and air performance.

b. Products Requiring Electrical Connection - Listed and classified by Underwriters Laboratories Inc., or by a testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

C. Performance/Design Criteria: As scheduled.

D. Manufacturer's Nameplate: Permanently affixed, embossed metal containing model number and individual serial number for future identification, located on a permanent part of the fan.

2.2 IN-LINE CENTRIFUGAL FANS (EF-1)

A. Duct mounted, direct drive, in-line centrifugal type fans. Rectangular fan housing design constructed of heavy gauge galvanized steel with rectangular duct mounting collars.

B. Removable panel in fan cabinet of sufficient size to permit access for service to internal components without dismantling the cabinet.

C. Centrifugal backward inclined fan wheel, constructed of aluminum and matched wheel and inlet cones for precise running tolerances. Dynamically and statically balanced at the factory.

D. Heavy duty ball bearing type fan motors, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives readily accessible for maintenance.

E. AMCA Certified Ratings. Seal for both sound and air performance.

F. Greenheck SQ or equal.

2.3 MODULAR SMALL CABINET FAN (SCF-1)

A. Cabinet:

1. Materials: Formed double wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections gasketed.
2. Outside Casing: 18 gauge, galvanized steel (G90).
3. Inside Casing: 18 gauge, galvanized steel (G90).
4. Floor Plate: 18 gauge, galvanized steel (G90).
5. Utility Lugs: For lifting unit and fastening to permanent structure, 8 gauge, galvanized steel (G90).

B. Cabinet Insulation. Comply with NFPA 90A or NFPA 90B:

1. Materials: Fiber glass insulation.
2. Thickness: 1 inch.
3. Density: 1-1/2 pounds per cubic foot.
4. Thermal Conductivity (k-Value): 0.26 at 75 degrees F (0.037 at 24 degrees C) mean temperature.
5. Fire-Hazard Classification: Maximum flame spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.

C. Tool less hinged gasketed access doors with latch.

D. Fan Section:

1. Fan Section Construction: Belt driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor drive assembly, and support structure and equipped with formed

steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with interior spring vibration isolation.

2. Fan statically and dynamically balanced. Forward Curved Fan Wheels: Galvanized steel and/or aluminum/painted steel construction with inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.
3. AMCA Certified Ratings Seal for air performance.
4. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
5. Turned, ground, and polished (hot rolled) (stainless) steel with keyway. Ship with a protective coating of lubricating oil.
6. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
7. Pre-lubricated and Sealed Shaft Bearings: Self-aligning, pillow block type ball bearings.
8. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.
9. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation and with 1.5 service factor based on fan motor.
10. Pulleys: Mechanical cast iron with split, tapered bushing dynamically balanced at factory.
11. Motor Pulleys: Adjustable pitch. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
12. Belts: Oil resistant, static free.
13. Motor Mount: Adjustable for belt tensioning.

E. Mixing box with opposed blade low leakage dampers with vinyl edge seals in configuration shown.
F. Filter section with 2 inch filters, maximum face velocity of 350 Feet per minute.
G. Corrosion resistant fasteners.
H. Coil Section:

1. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.
2. Water Coils: Continuous circuit coil fabricated according to ARI 410.
3. Tubes: Copper, .016 inch tube thickness.
4. Fins: Aluminum, fins per inch as scheduled.
5. Fin and Tube Joint: Mechanical bond.
6. Headers: Seamless copper tube with brazed joints.
7. Frames: Galvanized steel channel frame.
8. Ratings: Design tested and rated according to ARI 410.
9. Working Pressure Ratings: 250 psig, 300 degrees F.
10. Source Quality Control: Test to 500 psig underwater (2000 psig ultimate strength)

I. Greenheck MSCF or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install fans in compliance with manufacturer's written installation instructions.
2. Provide flexible connections at fan duct connections. See Section 23 3100 - Ducts and Accessories for flexible duct connectors.
3. Support fans independently from ductwork. Provide fan support in accordance with 20 0529 - Mechanical Hangers and Supports.
4. Provide vibration isolation and seismic restraint for fans in accordance with 20 0529 - Mechanical Hangers and Supports.
5. Ensure that fan access doors and panels are not obstructed when the equipment is installed.
6. Extend lubrication points so each is easily reached for maintenance.

B. Interface with Other Work:

1. Coordinate and sequence installation of fans with trades responsible for portions of this and other related sections of the Project Manual.
2. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate the installation with related work shall be completed at no additional expense to the Owner.

3.2 REPAIR/RESTORATION

A. Refer to Section 20 0000 - Mechanical General Requirements for general repair/restoration requirements.

3.3 SITE QUALITY CONTROL

A. Manufacturer Services: Verify fans are installed and operational in accordance with the manufacturer's written installation instructions.

3.4 SYSTEM STARTUP

A. Start-up and operate fans in accordance with the manufacturer's written installation and operation manual check list.

3.5 ADJUSTING

A. Adjust and balance fans in accordance with Section 23 0593 - Testing, Adjusting and Balancing.

3.6 CLEANING

A. Upon completion of installation and prior to initial start-up, vacuum clean and wipe down external system components and internal shrouded areas.

3.7 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper system operation in accordance with Section 25 9000 – Sequence of Operations, utilizing the building automation system.

END OF SECTION 23 3400

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SECTION 23 3600
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single duct variable air volume terminal units
2. Fan Powered Terminal Units.

B. Products Installed But Not Supplied Under This Section: Coordinate installation of damper control actuators and application specific controllers, furnished under Section 25 5000 - Building Automation System. Control enclosure shall be factory mounted by the air terminal unit manufacturer.

C. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 23 0593 - Testing, Adjusting and Balancing
5. 25 9000 - Sequence of Operations

1.2 REFERENCES

A. Codes and Standards:

1. SMACNA - HVAC Duct Construction Standards, Metal and Flexible, Third Edition 2005.
2. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
3. ANSI/AHRI 880-2011 - Performance Rating of Air Terminals.

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for the single duct, variable air volume, direct digital control terminal units and fan powered terminal units.
2. The method of distribution of air is specified elsewhere.

B. Performance Requirements:

1. Provide product performance characteristics as specified or scheduled on drawings.
2. Operate ventilation system in accordance with Section 25 9000 - Sequence of Operations.

1.4 **PRE-INSTALLATION MEETINGS**

A. Coordinate and sequence installation of air terminal units with trades responsible for portions of this and other related sections of the Project Manual prior to installation of air terminal units.

1.5 **SUBMITTALS**

A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data.

C. Installation, Operation and Maintenance (IO&M) Manuals.

1.6 **CLOSEOUT SUBMITTALS:**

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.

1.7 **QUALITY ASSURANCE:**

A. Qualifications:

1. Manufacturers: Minimum five (5) years of documented experience manufacturing the products specified.
2. Installers: Minimum five (5) years of experience in the installation of products specified.

B. Certifications: Air terminal units shall be certified under AHRI Standard 880 Certification Program and carry the AHRI seal.

1.8 **DELIVERY, STORAGE AND HANDLING**

A. Refer to Section 20 0000 - Mechanical General Requirements for general delivery, storage and handling requirements.

1.9 **WARRANTY**

A. Refer to Section 20 0000 - Mechanical General Requirements for general warranty requirements.

PART 2 - PRODUCTS

2.1 **SINGLE DUCT VARIABLE AIR VOLUME TERMINAL UNITS**

A. Manufacturers:

1. Titus, Model: DESV.
2. Price.
3. Nailor Industries.
4. Substitution request required.

B. Performance/Design Criteria:

1. Capacities: Provide terminal units of the sizes and performance capacities as scheduled.
2. Sound Rating:

a. Sound data certified by AHRI.

b. Sound ratings for basic air terminal units with inlet diameters less than or equal to 16 inches shall not exceed NC-20 at maximum rated flow (CFM) with a differential static pressure drop of 1.0 inch water column.

c. Sound ratings for basic air terminal units with inlet diameters larger than 16 inches shall not exceed NC-30 at maximum rated flow (CFM) with a differential static pressure drop of 1.0 inch water column.

d. Radiated and discharge sound power levels at maximum air flow operating conditions shall be submitted with product information.

3. Casing Leakage: Less than 2 percent of nominal CFM at 1.5 inches WC differential pressure.

C. Operation:

1. Control Actuator and Application Specific Controller: NEMA 1 control enclosures/digital control packages furnished by Section 25 5000 - Building Automation System to the air terminal unit manufacturer for factory mounting on side of casing.

D. Materials:

1. Casing:

a. Minimum 22 gauge galvanized steel.

b. Mechanically sealed and gasketed, leak resistant construction.

c. Beaded inlet for low leakage construction, sized to fit standard round duct.

d. Rectangular discharge opening designed for slip and drive cleat connection to low pressure ductwork or reheat coil.

e. Multi-port, center averaging inlet velocity sensor with sensor tubing. Flow measurement taps provided for connection to application specific controller.

f. Internally line casing with sound liner specified below.

2. Control Damper:

a. Heavy gauge galvanized steel, butterfly type damper.

b. One-piece, 1/2-inch diameter damper shaft with self-lubricating Delrin® or bronze oilite bearings. Notched shaft end, to indicate damper position.

c. Synthetic damper seal to limit close-off leakage to less than 1% of terminal rated airflow at 3.0 inches water column differential pressure.

d. Mechanical stop to prevent damper over-stroking.

3. Duct Transitions:

a. Provide rectangular reheat coil discharge plenum:

1). Minimum width to match reheat coil width.

2). Minimum height to match reheat coil height or maximum downstream branch duct spin-in connection diameter plus 4 inches, whichever is greater.

3). Minimum length 36 inches or longer to accommodate branch ducts, as indicated on drawings.

b. Provide field fabricated duct transitions between terminal unit outlet and reheat coil inlet.

1). Contractor's Option: Provide oversized terminal unit casing to match reheat coil dimensions, with neck/damper size as scheduled, to eliminate the requirement for field fabricated duct transitions between terminal unit outlets and reheat coil inlets.

c. Sound line duct transitions and plenums to match terminal unit casing liner.

E. Accessories:

1. Sound Liner:

a. UL Listed and in conformance with NFPA Standard 90A. Liners shall be fungi and bacterial resistant.

b. 1" thick fiber-free closed cell foam insulation, minimum 1-1/2 pound per cubic foot density, mechanically fastened to unit casing.

c. Cut liner edges and seal to prevent erosion with discharge edges secured with metal barrier strips for fiberglass or similar insulation.

2. Hydronic Reheat Coils:

a. Performance characteristics as scheduled.

b. Constructed from seamless copper tubing (minimum 0.016-inch wall thickness) with aluminum fins, enclosed in 20 gauge (minimum) galvanized steel casing with slip and drive connections. Provide extended copper sweat connections.

3. Access Doors: Provide access doors upstream and downstream of reheat coils for coil cleaning. Refer to Section 23 3100 - Ducts and Accessories.

2.2 FAN POWERED TERMINAL UNITS

A. Manufacturers:

1. Titus, Model: DTQP (Basis of Design).
2. Substitution request required.

B. Performance/Design Criteria:

1. Capacities: Provide terminal units of the sizes and performance capacities as scheduled.
2. Sound Rating:

a. Sound data certified by AHRI.

C. Fan Construction:

1. Fan shall be steel and have a forward curved wheel with direct drive motor.
2. Integral thermal overload protection and permanently lubricated bearings.
3. Gasketed backdraft damper at fan discharge to prevent primary air from flowing back through fan section into return air plenum.
4. Fan performance and electrical input as scheduled.

D. Materials:

1. Casing:

a. Minimum 20 gauge galvanized steel.

b. Mechanically sealed and gasketed, leak resistant construction.

c. Bottom access panel.

2. Control Damper:

a. Heavy gauge galvanized steel, butterfly type damper.

b. One-piece, 1/2-inch diameter damper shaft with self-lubricating Delrin® or bronze oilite bearings. Notched shaft end, to indicate damper position.

c. Synthetic damper seal to limit close-off leakage to less than 1% of terminal rated airflow at 3.0 inches water column differential pressure.

d. Mechanical stop to prevent damper over-stroking.

E. Accessories:

1. Sound Liner:

a. UL Listed and in conformance with NFPA Standard 90A. Liners shall be fungi and bacterial resistant.

b. 1" thick fiber-free closed cell foam insulation, minimum 1-1/2 pound per cubic foot density, mechanically fastened to unit casing.

c. Cut liner edges and seal to prevent erosion with discharge edges secured with metal barrier strips for fiberglass or similar insulation.

2. Hydronic Reheat Coils:

a. Performance characteristics as scheduled.

b. Constructed from seamless copper tubing (minimum 0.016-inch wall thickness) with aluminum fins, enclosed in 20 gauge (minimum) galvanized steel casing with slip and drive connections. Provide extended copper sweat connections.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Installer: Perform work by experienced personnel previously engaged in ventilation system construction and under the supervision of a qualified installation supervisor.

3.2 PREPARATION

A. Protection of In-Place Conditions: Cover air terminal unit inlet and discharge openings to protect components from construction dirt and debris.

3.3 INSTALLATION

A. General:

1. Install air terminal units in strict compliance with the manufacturer's written installation instructions.

2. Do not locate any part or the terminal unit assembly, including reheat coil and associated low pressure sound lined plenums, such that it passes over a partition wall or through a full height wall penetration.

3. Locate terminal units such that the bottom of the complete assembly is six (6) to eighteen (18) inches above the top of the ceiling grid or hard lid ceiling framing as applicable.

4. Locate terminal unit controller, coil hydronic piping/valves, and coil access doors on same side of unit. Locate on side that maximizes accessibility (i.e. above accessible ceiling tiles, away from full height walls and main duct runs).
5. Support air terminal units independent of duct system. Provide sway bracing within 12 inches of support attachment.
6. Connect air terminal unit inlets to ductwork using straight sections of unrestricted rigid duct of the same inlet diameter as terminal unit inlet. Provide a minimum straight duct length of 4 duct diameters at each terminal unit inlet. Medium pressure flexible duct connections to terminal units is not allowed except where specifically shown.
7. Install low pressure ductwork branches vertically centered along the sides of the low pressure sounded lined plenum. A minimum of two (2) inches of sheet metal is required between the spin-in (or similar connection) and top and bottom external edge of the metal plenum.
8. Provide insulated access doors upstream and downstream of reheat coil for coil cleaning.
9. Secure control enclosure cover in place as intended by the manufacturer.
10. Verify mechanical connections, electrical and control wiring and sensor tubing are properly secured.

B. Interface with Other Work:

1. Coordinate and sequence the installation of air terminal units with trades responsible for portions of this and other related sections of the Project Manual.
2. Coordinate ceiling and/or wall access panel locations to provide convenient maintenance and cleaning access for each air terminal unit.
3. Coordinate air terminal unit locations with ceiling grids, lighting troffers, air outlets and return grilles to maximize accessibility and minimize interference.
4. Rework required as a result of failure to follow the manufacturer's written installation instructions, properly coordinate the installation with related work, or provide adequate access (as determined by the Contracting Agency) shall be completed at no additional cost to the Owner.

3.4 REPAIR/RESTORATION

A. Refer to Section 20 0000 - Mechanical General Requirements for general repair/restoration requirements.

3.5 SYSTEM START-UP

A. With the applicable central ventilation system air balancing completed and the ventilation system operating under automatic control utilizing the BAS, cycle each air terminal unit control damper between minimum and maximum scheduled air flow settings to demonstrate proper operation and capacity in accordance with 25 9000 - Sequence of Operations for verification by the Contracting Agency.

B. Verify reheat coil and auxiliary heating unit (as applicable) hydronic control valves properly cycle with terminal unit control damper, in accordance with Section 25 9000 - Sequence of Operations.

3.6 ADJUSTING

A. Adjust velocity sensor bias adjustment as necessary to provide accurate air flow measurement.

3.7 CLEANING

A. Upon completion of installation and prior to initial operation, vacuum clean and wipe down air terminal units and control enclosures.

B. Remove any debris from control enclosure.

C. Inspect and clean reheat coils. Re-straighten coil fins if necessary.

END OF SECTION 23 3600

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SECTION 23 3700
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Air Diffusers and Registers.
2. Return/Exhaust Grilles.
3. Stationary Louvers.

B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 23 0593 - Testing, Adjusting and Balancing
4. 23 3100 - Ducts and Accessories

1.2 REFERENCES

A. Codes and Standards:

1. SMACNA HVAC Duct Construction Standards - Metal and Flexible Third Edition 2005.
2. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
3. ARI Standard 890-2001 - Air Diffusers and Air Diffuser Assemblies.

1.3 PREINSTALLATION MEETINGS

A. Coordinate and sequence installation of air diffusers, registers, grilles, louvers and roof hoods with trades responsible for portions of this and other related sections of the Project Manual prior to installation of air outlets and inlets.

1.4 SUBMITTALS:

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data:

1. Air outlets and inlets performance data at operating conditions.
2. Submit color selections for air outlets and inlets from manufacturer’s color selection chart.
3. Submit color selections for louvers from manufacturer’s color selection chart.
4. Submit color selections for louvers which match exterior architectural wall panels.

C. Shop Drawings:

1. This Section shop drawings to be submitted under Section 20 0000 - Mechanical General Requirements.
2. Include the following information on scaled ventilation system shop drawings:
   a. Air diffuser, register and grille locations, duct connection sizes and throw directions.
   b. Louver locations with plenum dimensions.

c. Louver penetration detail which clearly shows wall type, louver frame type, duct connection method, sealant and or gasket locations and drainage path.

D. Test and Evaluation Reports:

1. Louver plenum water tightness test: Submit written certification that louver plenums have been satisfactorily tested and have been verified water-tight prior to insulating plenums. Refer to louver test under Part 3 below.

E. Installation, Operation and Maintenance (IO&M) Manuals.

1.5 CLOSEOUT SUBMITTALS:

A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.

C. Record Documentation.

1.6 QUALITY ASSURANCE:

A. Qualifications:

1. Manufacturers: Minimum five (5) years of documented experience manufacturing the products specified.

2. Installers: Minimum five (5) years of experience in the installation of products specified.

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 20 0000 - Mechanical General Requirements for general delivery, storage and handling requirements.

1.8 WARRANTY

A. Refer to Section 20 0000 - Mechanical General Requirements for general warranty requirements.

PART 2 - PRODUCTS

2.1 AIR DIFFUSERS AND REGISTERS

A. Manufacturers:

1. Titus (Basis of Design).

2. Price.

3. Nailor Industries Inc.

4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Performance/Design Criteria: As scheduled.

C. Finishes: Color by Architect or as scheduled. Standard white unless indicated otherwise. Coordinate with architectural requirements.

D. Accessories: Earthquake tabs.

E. Correlate diffuser style, dimension, and fit with ceiling. Provide diffusers with modules of the proper size to match the suspended ceiling layout or with appropriate factory provided frame for surface mounting.

2.2 RETURN/EXHAUST GRILLES

A. Manufacturers:

1. Titus (Basis of Design).
2. Price.
3. Nailor Industries Inc.
4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Performance/Design Criteria: As scheduled.

C. Finishes: Color by Architect. Standard white, baked enamel or powder coated finish suitable for field application of custom finish color. Coordinate with architectural requirements.

D. Accessories: Earthquake tabs.

E. Correlate grille style, dimension, and fit with ceiling. Provide grilles with modules of the proper size to match the suspended ceiling layout or with appropriate factory provided frame for surface mounting.

2.3 WALL LOUVERS

A. Manufacturers:

1. Ruskin.
2. Greenheck.
3. Pottorff.
4. Substitution request required.

B. Description:

1. General:
   a. Depth as scheduled, stationary wall louvers.
   b. Frame style designed for installation into wall penetration construction type indicated. See Architectural penetration details to coordinate style types.
   c. Louver frame with surfaces designed to accept exterior caulking.
2. Regulatory Requirements:
   a. Louvers shall bear the AMCA Certified Ratings label for Water and Air Performance.
   b. Manufacturer’s ratings based on testing in accordance with AMCA Publication 511.

C. Performance/Design Criteria:

1. Size and performance as scheduled.
2. Water penetration: 0.01 ounces of water per square foot of free area at 1000 FPM free area velocity.

D. Materials: Heavy gauge extruded aluminum.

E. Finishes:

1. Premium Finish: Kynar®. Color selected by Architect.

F. Accessories:

1. Bird Screens: Flattened, expanded aluminum with 1/2 inch mesh pattern. Located on internal side of louver assembly.
2. Extended Sills: Extruded aluminum.

PART 3 - EXECUTION

3.1 PREPARATION

A. Removal: Remove existing air diffusers, registers and grilles designated for relocation and reuse after repair and cleaning.

3.2 INSTALLATION

A. General:

1. Install products in compliance with the manufacturer's written installation instructions.
2. Connect air outlets, registers, grilles and louvers to ventilation duct systems in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Air Diffusers, Registers and Grilles:

1. Install air diffusers, registers and return/exhaust grilles at the locations shown.
2. Orient and adjust diffusers to provide the throw directions indicated.
3. Provide appropriate borders for the ceiling, wall or floor construction type.

C. Wall Louvers:

1. Install wall louvers at the locations shown and in accordance with manufacturer's written installation instructions and details for the specific wall type.
2. Coordinate louver locations, borders and mullion spacing with architectural panels.
3. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
4. Seal louver penetrations watertight. Install, seal and insulate louver ductwork (intake or exhaust/relief plenums) to interior louver frame to prevent condensation or entrained water that enters ductwork from leaking into building. Provide sleeves, special connections and sealant as required to accomplish this requirement.
5. Slope plenum ductwork such that any entrained water drains out through base frame of wall louver. If drain holes are not provided by the manufacturer, drill 1/2-inch (minimum diameter) weep holes at twelve (12) inch intervals on center through base of louver as required for drain water to escape. Touch-up holes with factory supplied touch-up paint.

3.3 REPAIR/RESTORATION

A. Refer to Section 20 0000 - Mechanical General Requirements for general repair/restoration requirements.

B. Clean and repair existing air outlets and inlets to function as originally intended prior to reinstallation. Air outlets and inlets which require major repair may be replaced at the Contractor's option.

3.4 CLEANING

A. Clean exposed surfaces of air outlets and inlets, with water and mild soap or detergent not harmful to finish, in order to remove fingerprints and dirt.

END OF SECTION 23 3700

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SECTION 23 5223
CAST IRON BOILERS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Packaged hydronic boilers and appurtenances.
2. Fuel oil burners.
3. Boiler venting.

B. Related sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0513 - Common Motor Requirements
3. 20 0529 - Mechanical Hangars and Supports
4. 20 0553 - Mechanical Identification
5. 23 0593 - Testing, Adjusting and Balancing
6. 23 1113 - Fuel Oil Piping and Specialties
7. 23 2113 - Hydronic Piping and Specialties
8. 23 2123 - Hydronic Pumps
9. 25 9000 - Sequence of Operations

1.2 REFERENCES

A. Codes and Standards:

1. NFPA 31 - Installation of Oil-Burning Equipment.
2. ASME Boilers and Pressure Vessel Code (1998), Sections IV & VI.
3. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for the generation of heat, which will be distributed to the locations shown.
2. The method of distribution of this heat is specified elsewhere.

B. Performance Requirements:

1. Provide product performance characteristics as specified or scheduled on drawings.

2. Operate central heating system in accordance with Section 25 9000 - Sequence of Operations.

1.4 PRE-INSTALLATION MEETINGS

A. Coordinate installation of boilers and associated piping and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any components.

1.5 SUBMITTALS

A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data:

1. Provide manufacturers' product literature, clearly annotated to indicate specified salient features and performance criteria to include:

   a. Product model and selected optional equipment, appurtenances and special features.

   b. Boiler physical and performance characteristics as scheduled.

   c. Include weight of equipment filled with water. Boilers weighing more than 20 percent heavier that the schedule equipment will be disapproved unless it is determined by the Owner's representative that structure is able to bear the additional weight. Contractor may elect to increase structural support, in which case proposed changes to the structure and calculations stamped by a registered engineer shall be submitted.

   d. Dimensional data.

   e. Anchoring method.

2. Regulatory Requirements: Provide automatic boiler controls listed in the Mechanical Code and ASME CSD-1, latest edition, together with most current addenda and interpretations.

C. Shop Drawings:

1. Submit fully dimensioned shop drawings of boiler room(s) showing the following:

   a. Major equipment and housekeeping pads, with clear callouts indicating deviations from layout shown:

      1). Submitted boiler shall be dimensionally equal to scheduled product within 6 inches in each dimension. Maintain clearances shown on drawings. Submit fully dimensioned shop drawings of boiler room(s) at drawing scale of 1/4-inch equals 1 foot 0 inches or larger, showing entire boiler room, equipment and deviations. Provide boiler room modifications required due to dimensional and technical deviation at no additional cost to the Owner. Submit shop drawings of proposed equipment layout and base or pad for each piece of equipment.

      2). If equipment to be provided exceeds the weight of the specified equipment by more than 20 percent, or if the location is to be altered, submit shop drawings and calculations of proposed revised structural design, noting location of pertinent loads, stamped by a registered professional engineer.

   b. Service area boundaries as required by manufacturer's installation.

   c. Boiler piping and vent stack locations with dimensions. Coordinate stack roof penetrations with roof structure.

d. Indicate mechanical and electrical service locations and requirements.

D. Manufacturer Reports:

1. Provide start-up and operational test reports for each boiler. Refer to Article on Site Quality Control.
2. Provide start-up report for boiler control system with selected presets annotated.
3. Submit a letter to document that the training was conducted. Include in the letter the date, start/stop times for the training, list of attendees and signature/title of the person(s) providing the training.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance (IO&M) Manuals:

1. Refer to Section 20 0000 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
2. Include the following:
   a. Copies of approved submittal information.
   b. Manufacturer's installation, operating and maintenance/repair instructions, parts listings, and spare parts list for each product. Annotate the manual to indicate applicable information for the specific equipment model(s) installed.
   c. Computer software manuals and applicable licenses.
   d. Completed start-up and operational test report as required to validate equipment warranty.
   e. Start-up and operational test reports for each boiler. Report shall include printed names and signatures of the installers and documentation that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.
   f. Start-up report for boiler and combustion management system with selected presets annotated.

B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.

C. Record Documentation: Record actual locations of equipment, piping, and components and areas required for maintenance access in accordance with Section 20 0000 - Mechanical General Requirements.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.
2. Installers:
   a. Minimum 3 years' experience in the installation and start-up of boilers.
   b. A factory-authorized technician shall perform boiler startup service.
   c. The manufacturer's authorized technician shall supervise the installation, startup, programming, and adjustment of the Energy Management System.

3. Testing Agencies: Products requiring electrical connection shall be listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and as indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Verify products are new and delivered in original factory packaging/crating and are free from damage and corrosion.
2. Replace products delivered to job site that does not comply with above requirements at no expense to Owner.

B. Storage and Handling Requirements:

1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

1.9 WARRANTY

A. Manufacturer Warranty:

1. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.
2. Provide 1 year manufacturer's warranty.
3. Submit necessary documentation to the Manufacturer's Representative to validate manufacturer's warranty.
4. Provide to the Contracting Agency 1 copy of warranty documentation and confirmation receipt from the Manufacturer's Representative.

PART 2 - PRODUCTS

2.1 HOT WATER BOILER - CAST IRON

A. Manufacturers:

1. Weil-McLain.
2. Burnham.
3. H. B. Smith.

B. Description:

1. Factory assembled, sectional, wet base, cast iron boilers suitable for forced draft firing.
2. Regulatory Requirements:

C. Performance/Design Criteria: The thermal output of each boiler shall not be less than and no more than 10 percent greater than the values scheduled. Required thermal capacity shall be the gross I=B=R water rating.

D. Assembly/Fabrication:

1. Insulated metal jacket.
2. Burner mounting plate.

3. Gas tight seal between sections.
4. Flue damper assembly with valved test connection.
5. ASME safety relief valve (50 psig)
6. Low point system drain valve with end cap.
7. Flange mounted natural gas burner.
8. Instrument panel for each boiler complete with the following:
    a. Stack temperature gauge.
    b. Boiler supply temperature gauge.
    c. Boiler return temperature gauge.
9. Provision for anchoring boiler to its housekeeping pad adequate to meet seismic requirements.
10. Additional components as necessary to provide a complete operational system.

2.2 FUEL OIL BURNER

A. Manufacturer:
    1. Beckett.
    2. No substitutions.

B. Description: Fully packaged boiler and forced draft fuel oil burner, with burner mounted and wired to boiler controls, complete with control transformer.

C. Performance/Design Criteria: Size forced draft fuel oil burner to match boiler rating.

D. Assembly:
    1. UL/FM listed as a complete unit.
    2. Firing control: On/off.
    3. Peripheral controls to include:
        a. Operating temperature controller.
        b. High limit control with manual reset.
        c. Honeywell L4006E auxiliary high limit control.
        d. Low water safety shut-off control.
    4. Provide dry contacts for:
        a. Flame failure relay monitoring.
        b. Lock out alarm.
        c. Boiler status monitoring by Building Automation System.
    5. Provide wiring to connect boiler peripheral controls and safety devices to appropriate burner controls and building automation system in accordance with applicable provisions of Divisions 26, 27 and 28.
    6. Provide electrical leads long enough to allow the burner to hinge fully open.

7. Indicators and alarms shall include; power on, run, lock out, and other indicating lights as applicable. Lock out indicator shall have provision for connection to a remote alarm or monitoring device and burner firing control shall have provision for controlling boiler shut-off valve through the BAS control system.
8. The boiler controls specified in this section shall be fully coordinated with the BAS control system specifications.
9. Since boilers will operate in response to supply header temperature sensed by the BAS control system, the operating temperature controller, shall be selected and wired to function as an automatically resetting, first stage limit control. Coordinate with sequence of operation specified in Section 25 9000 - Sequence of Operations.

2.3 LOW WATER CUTOFF

A. Manufacturers:
   1. McDonnell Miller.
   2. Approved equal.

B. Description: Model #63M low water cut-off device for each boiler.

C. Provide McDonnell Miller #750-MT-120 with remote sensor, as a second, manual reset electronic low water cut-off for each boiler.

D. Performance/Design Criteria:
   1. 50 psig working pressure.
   2. UL/FM approved.

E. Operations: Wired in series with burner control.

F. Accessories: McDonnell Miller TC-4 test and check assembly.

2.4 AUXILIARY HIGH LIMIT

A. Manufacturers:
   1. Honeywell.
   2. Approved equal.

B. Description: Model L4006E auxiliary high limit sensor for each boiler.

C. Operations: Monitor boiler auxiliary high limit from BAS. See Section 25 9000 - Sequence of Operations.

2.5 EMERGENCY BOILER SHUTOFF

A. Provide an emergency boiler shutoff switch. See Division 26.

2.6 BOILER CONTROLLER

A. Packaged, preprogrammed boiler controller capable of operate and firing of two boilers and their dedicated circulation pumps to maintain a supply temperature setpoint.

B. Outdoor temperature reset capable. Equal runtime

C. BAS gateway, coordinate with Section 25 5000 requirements for remote monitoring, enable/disable, demand input, setpoint adjustment and alarm monitoring.

D. Tekmar Model 284 or equal.

2.7 BOILER VENTING

A. Prefabricated, double wall, 1 inch air insulated, vent stack product rated for 60 inches of positive pressure applications.

B. UL103 listed.

C. One-inch clearance to combustible materials.

D. Provide shop drawing for stack layout. Coordinate layout with architectural, as venting will require architectural chase from Mechanical room wall penetration to roof penetration.

E. Type 304 stainless steel inner and type 430 stainless steel outer liner.

F. Provide high wind rain cap by the manufacturer.

G. Provide vent draft calcs and stack layout for the installation.

H. Schebler P1 or equal.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Installer: Perform work by experienced personnel previously engaged in boiler plant construction and under the supervision of a qualified installation supervisor.

3.2 PREPARATION

A. Protection of In-Place Conditions: Cover boilers and burners and plug piping connections to protect equipment from construction dirt and debris.

B. Surface Preparation:

1. Prior to installation of boilers, verify concrete housekeeping pads are complete and properly sized for boiler mounting.
2. Prior to installation of stacks, verify that shop drawings are approved and stack locations and routing have been coordinated with required roof penetrations and the work of other trades.

3.3 INSTALLATION

A. Boiler venting:

1. Provide vent arrangement to facilitate cleaning.
2. Provide a boot tee with capped drain at all vertical to horizontal transitions.
3. Provide 1% slope for horizontal sections toward the boilers.

B. Special Techniques:

1. Install equipment in accordance with manufacturer’s instructions and requirements of the codes specified herein.

2. Setting of equipment:
    a. Set equipment on concrete housekeeping pads compatible with the building structural system.
    b. Level equipment to within recommended tolerances.
3. Anchoring:
    a. Anchor boilers to housekeeping pads as recommended by the manufacturer and to allow for normal expansion and contraction.
    b. Coordinate with Section 20 0548 - Vibration and Seismic Control.
4. In systems containing glycol, provide only products specifically designed and approved for continuous operation with the glycol solution specified.
5. Install components that were removed from equipment for shipping purposes.
6. Install components that were furnished loose with equipment for field installation.
7. Provide interconnecting electrical control and power wiring.
8. Provide piping for boiler pipe connections.
9. Program, adjust and operationally test boiler operation and sequencing in accordance with the manufacturer's written installation and testing instructions and Section 25 9000 - Sequence of Operations.
10. Touch up marred or scratched factory finished surfaces using finish materials furnished by manufacturer.

C. Interface with Other Work: Coordinate and sequence installation of boilers and stacks with trades responsible for portions of this and other related sections of the Project Manual.

3.4 REPAIR/RESTORATION

A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.

B. Substitute replacement parts from other manufacturers are not acceptable.

3.5 SITE QUALITY CONTROL

A. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer’s written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

B. Manufacturer Services:

1. Provide manufacturer's representative start-up and instruction of each complete boiler system including all components assembled and furnished by the manufacturer whether or not of his own manufacture.
2. Start-up shall be conducted by experienced and factory authorized technician in the regular employment of the authorized service organization.
3. Start-up and adjust the system to within the tolerances as specified by the equipment manufacturer.
4. Operationally test safety devices and record settings. Test and record oxygen, carbon dioxide, stack temperature, and calculate excess air and steady state efficiency. Make final lead/lag set point adjustments. List set points in report. Submit final data for review.

5. Test boiler operation and sequencing in accordance with the manufacturer's written installation and testing instructions and Section 25 9000 - Sequence of Operations.
6. Provide a start-up report that includes final control settings, and a performance chart of the control system furnished.
7. Submit a letter of certification with copy of start-up report, indicating that the boiler start-up has been completed, that the boilers are properly adjusted and operating within the tolerances as specified by the manufacturer, and that the sequence of operation is fulfilled.

3.6 ADJUSTING

A. Coordinate and work directly with the requirements of Section 23 0593 - Testing, Adjusting and Balancing, to provide systems in proper operating order.

B. Make corrections and adjustments as required by the Testing, Adjusting and Balancing (TAB) Agency in a timely manner.

3.7 CLEANING

A. Waste Management: After construction is completed, clean and wipe down exposed surfaces of boilers and burners.

3.8 CLOSEOUT ACTIVITIES

A. Demonstration: Provide 2 hours of demonstration conducted by authorized factory start-up personnel to the Contracting Agencies authorized maintenance personnel.

B. Training: Provide 2 hours of operational instruction conducted by authorized factory start-up personnel to the Contracting Agencies authorized maintenance personnel.

END OF SECTION 23 5223

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