HESNOR
ENGINEERING ASSOCIATES

SCOPE OF WORK

BOILER REPLACEMENTS
New York State Insurance Fund
15 Computer Drive, Albany, NY 12205

May 12, 2020

Project Description

This project involves the replacement of hot water boilers at the New York State Insurance Fund's (NYSIF's) facility located at 15 Computer Drive West.

The following scope of work generally describes the contractor's responsibilities*. A one-line diagram and work area sketches follow, along with specifications for the new boilers and related valves, hangers and supports, piping, insulation, venting, etc.

** The drawings and descriptions provided with this Scope of Work are schematic and intended only to give the contractor a general outline of the work required. The Contractor shall be responsible for final layouts, sizing, connection, etc. as required to furnish a complete and safe operating system.*

Contractor's Scope of Work

The contractor's scope of work shall include (but not be limited to):

1. Remove/demolish the existing boilers and breeching through the roof.
   - **a.** Refer to sketches SK-1A and SK-1B.
   - **b.** Contractor shall obtain the services of the owner-approved contractor/roofing vendor to perform the work on the roof. See Part 5-b-viii.
2. Disconnect the existing gas piping and prepare for connection to the new boilers.
3. De-energize power and prepare for connection to the new boilers and boiler pumps.
4. Disconnect the hot water supply and return piping and prepare for connection to the new boilers.
5. Furnish and install the new boilers in the penthouse mechanical room.
   - **a.** Basis of Design Product Information (refer to specification section 23 52 16):
     - **i.** Tags: B-N1 and B-N2
     - **ii.** Manufacturer: Weil McLain
     - **iii.** Model: SF750
     - **iv.** Type: Condensing
     - **v.** Input (max): 750 MBH
     - **vi.** Output (max): 702 MBH
     - **vii.** Thermal Efficiency (max): 94%
     - **viii.** Provide with the following:
       - **a)** Single-point electrical connection
       - **b)** Boiler circulation pumps (BP-N1/-N2)
       - **c)** Low-water cut-off
       - **d)** Controller with BMS Gateway

b. Execution:
- **i.** Set boilers in similar location as existing in the penthouse mechanical room. Confirm location with Owner's Representative.
- **ii.** Place new equipment pad as required to accommodate the new installations.
- **iii.** Reconnect gas piping as required. Connect per manufacturer's recommendations. Increase pipe size to boilers, if required.
- **iv.** Reconnect hot water supply and return piping.
  - **a)** Refer to the one-line diagram following this scope of work.
- **v.** Boiler controls shall be extended to the Building existing BMS.
  - **a)** Metasys, by Johnson Controls.
- **vi.** Install new freeze-stat at ERV's hot water coil.
- **vii.** Furnish and install all new required sensors, control valves, etc.
- **viii.** Install vent and combustion air through the roof. Terminate per manufacturer's requirements.
  - **a)** Refer to specification section 23 92 05.
  - **b)** The building has a Carlisle roof, which is currently under warranty. All roofing work shall be performed by a Carlisle-approved vendor. Confirm with Owner prior to any work.
- **ix.** Install new piping as required.
  - **a)** Refer to specification sections 23 05 23, 23 05 29 and 23 21 13.
- **x.** Install new piping insulation.
  - **a)** Refer to specification section 23 07 19.
- **xi.** Connect power to new boilers and boiler pumps as required.

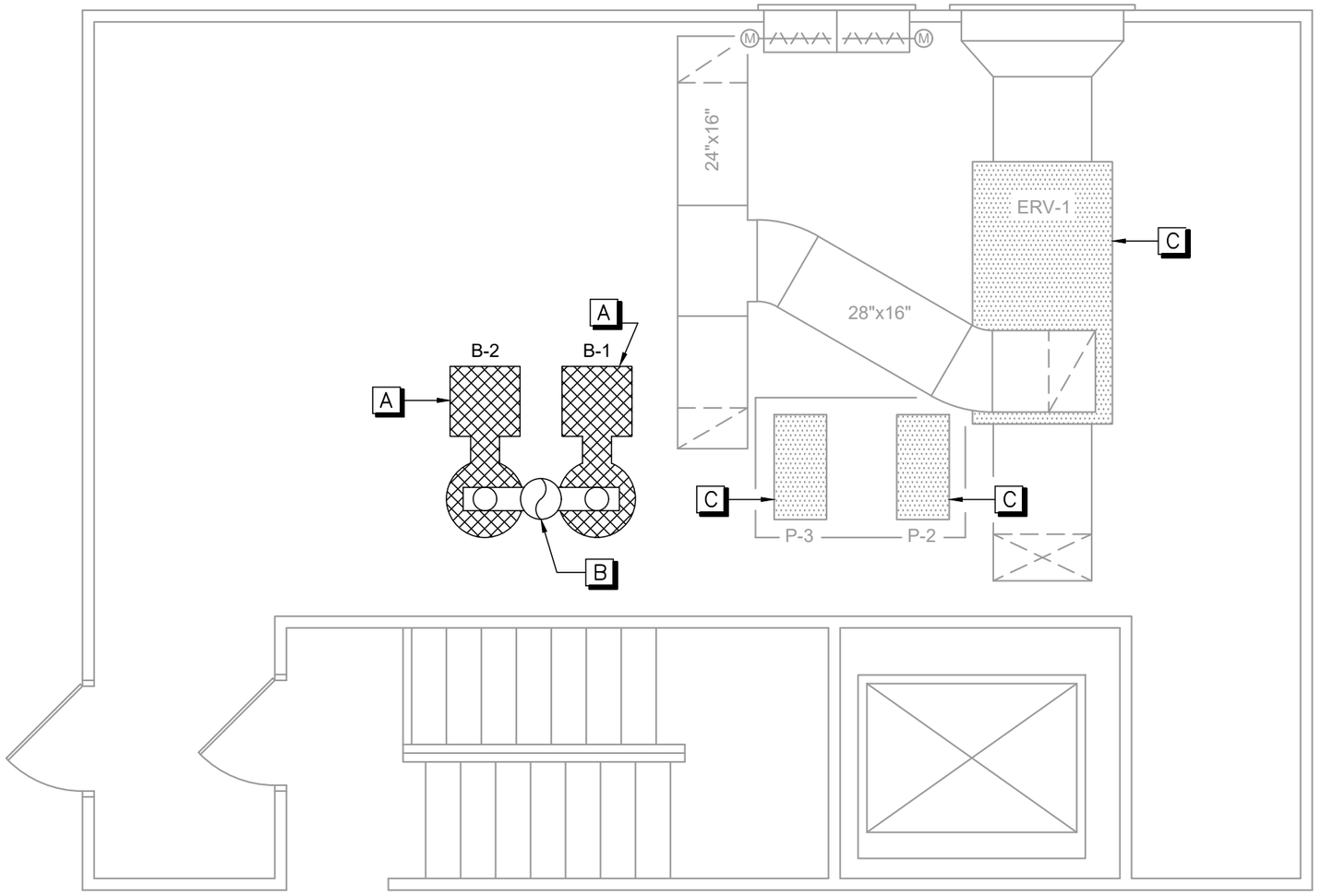
6. Start-up and test boilers (by a manufacturer-approved vendor)
7. Provide Owner training.
8. Provide as-built drawings to Owner.
9. Provide warranty to Owner (refer to specification section 23 52 16).

Drawings/Sketches and Specifications

The following pages contain:

1. Sketch SK-1A: Mechanical Room Demolition Plan
2. Sketch SK-1B: One Line Diagram - Demolition
3. Sketch SK-2A: Mechanical Room New Work Plant
4. Sketch SK-2B: One-Line Diagram - New Work
5. Specification Sections:
   - **a.** Section 23 00 07 - Codes, Regulations, Standards and Fees
   - **b.** Section 23 05 23 - General-Duty Valves for HVAC Piping
   - **c.** Section 23 05 29 - Hangers and Supports for HVAC Piping And Equipment
   - **d.** Section 23 05 95 - Selective Demolition and Restructuring
   - **e.** Section 23 07 19 - HVAC Piping Insulation
   - **f.** Section 23 21 13 - Hydronic Piping
   - **g.** Section 23 52 16 - Condensing Boilers
   - **h.** Section 23 92 05 - Venting of Gas-Fired Appliances

□ End of Scope of Work □



KEYED NOTES: (THIS SHEET)

A — EXISTING GAS-FIRED BOILER - TO BE REMOVED
- REMOVE BOILER, BURNER, POWER, CONTROL, LOCAL PIPING, ETC.
- PREPARE FOR INSTALLATION OF NEW BOILER

B — EXISTING BREECHING - TO BE REMOVED
- REMOVE BREECHING, SUPPORTS, ETC.
- INFILL AND REPAIR ROOF TO MATCH EXISTING. UTILIZE OWNER-APPROVED ROOFING CONTRACTOR/VENDOR TO PERFORM THE WORK.

C — EXISTING EQUIPMENT - TO REMAIN

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MECHANICAL ROOM DEMOLITION PLAN

SCALE: 1/4" = 1'-0"

SK-1A

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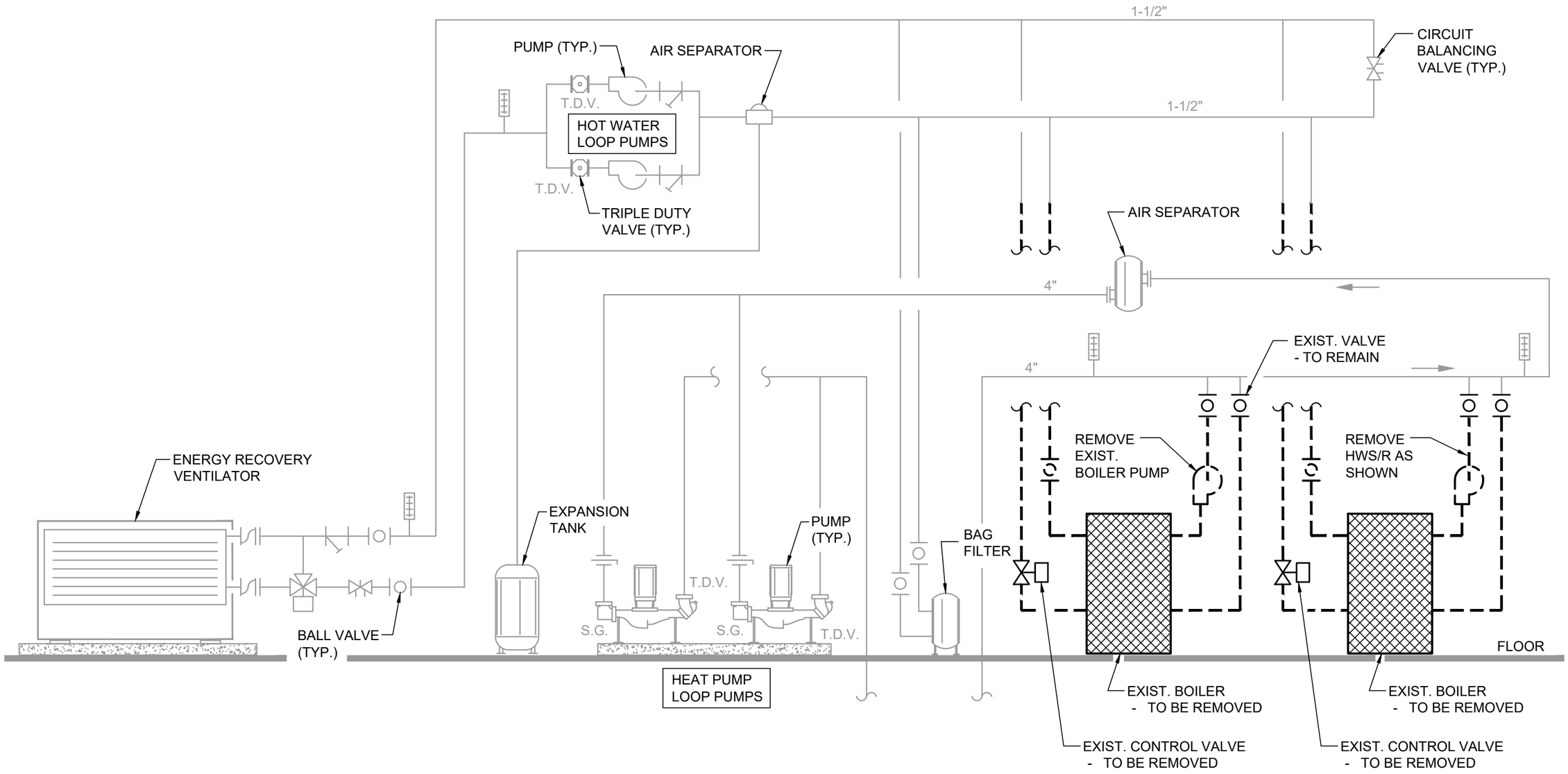

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ONE-LINE DIAGRAM DEMOLITION

SCALE: NTS

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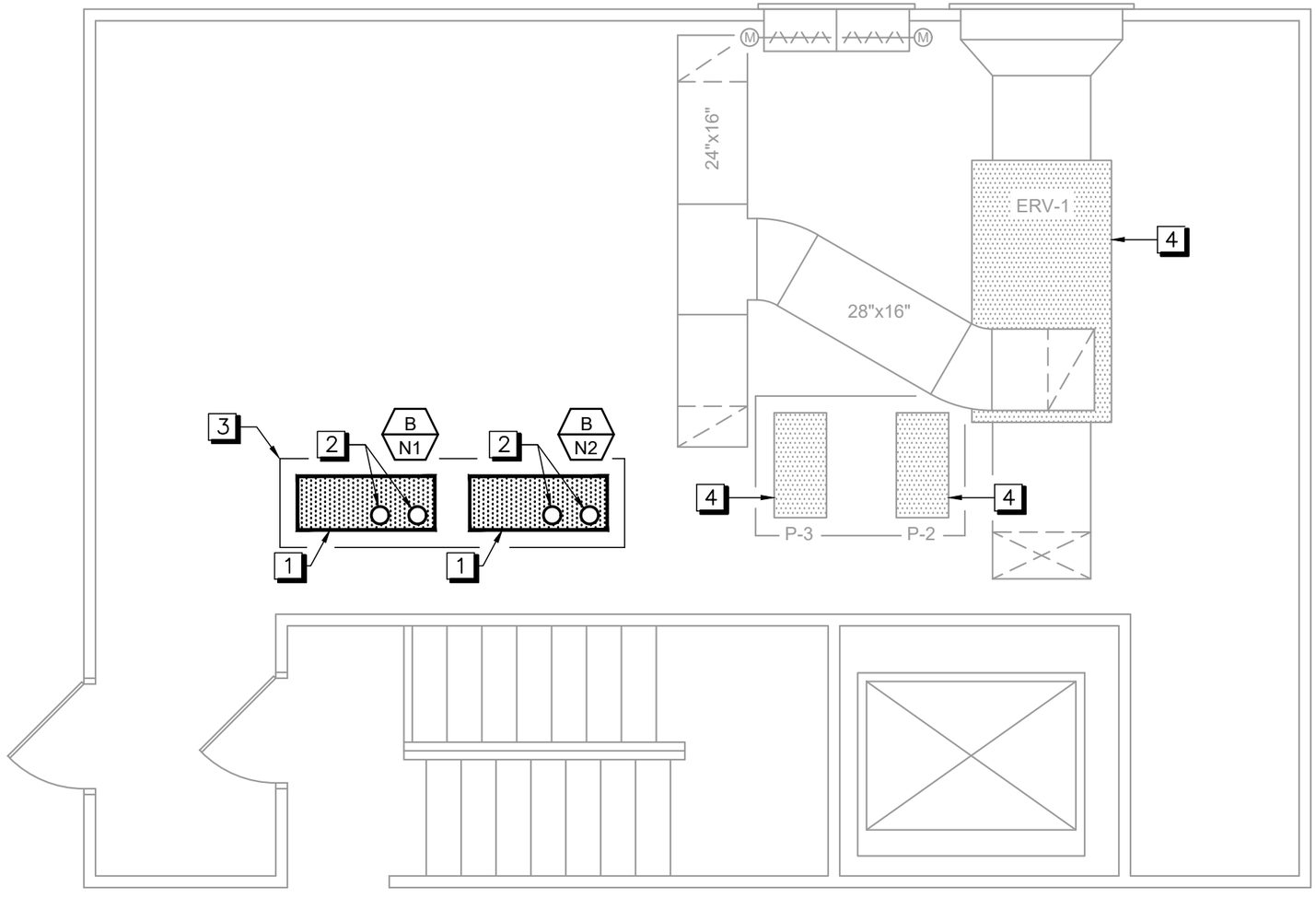
SK-1B



KEYED NOTES: (THIS SHEET)

1. NEW GAS-FIRED BOILER
   - FURNISH AND INSTALL NEW BOILER. SEE SPECS FOR BOILER REQUIREMENTS.
   - RECONNECT HWS/R AS SHOWN ON ONE-LINE.
   - RECONNECT NATURAL GAS PIPING PER MANUF'S REQUIREMENTS.
   - PLACE NEW EQUIPMENT PAD AS REQUIRED TO ACCOMMODATE THE NEW WORK.
   - POWER BOILER PER MANUF'S RECOMMENDATIONS.
   - EXTEND BOILER CONTROLS TO BLDG's EXIST. BMS:
     -- METASYS (CONTRACTOR SHALL CONTRACT DIRECTLY WITH JOHNSON CONTROLS)

2. EXTEND 6" VENT AND 6" COMBUSTION AIR PIPING THRU ROOF.
   - TERMINATE PER MANUF'S REQUIREMENTS. SEE SPECS FOR MATERIAL REQUIREMENTS.

3. NEW EQUIPMENT PAD.
   - CONCRETE, 4-INCHES HIGH.

4. EXISTING EQUIPMENT - TO REMAIN

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MECHANICAL ROOM
NEW WORK PLAN

SCALE: 1/4" = 1'-0"

SK-2A

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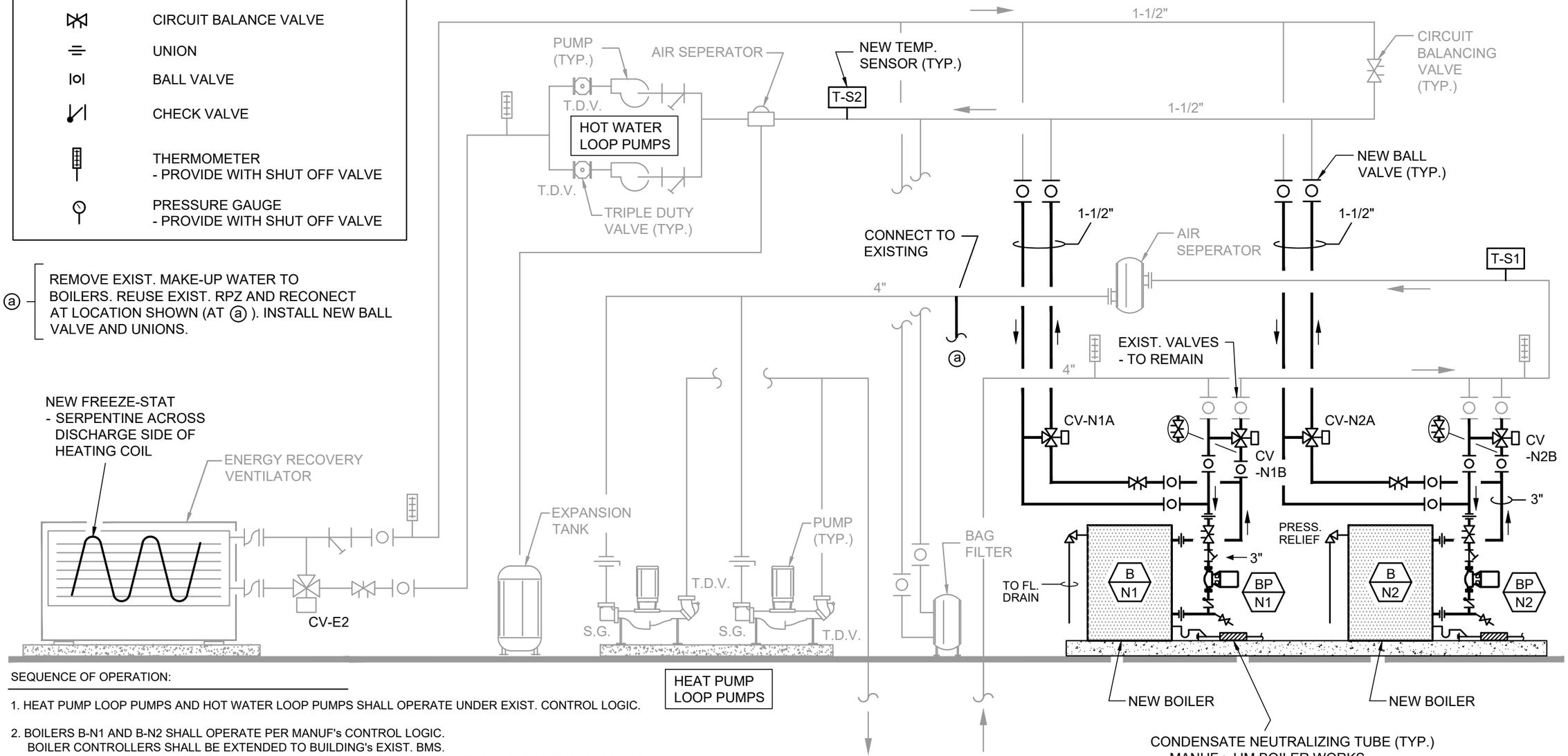
LEGEND:

- CIRCUIT BALANCE VALVE
- UNION
- BALL VALVE
- CHECK VALVE
- THERMOMETER
  - PROVIDE WITH SHUT OFF VALVE
- PRESSURE GAUGE
  - PROVIDE WITH SHUT OFF VALVE

ⓐ REMOVE EXIST. MAKE-UP WATER TO BOILERS. REUSE EXIST. RPZ AND RECONECT AT LOCATION SHOWN (AT ⓐ). INSTALL NEW BALL VALVE AND UNIONS.



CONDENSATE NEUTRALIZING TUBE (TYP.)
- MANUF.: JJM BOILER WORKS
- MODEL NO.: JM-10

TERMINATE AT FLOOR DRAIN

SEQUENCE OF OPERATION:

1. HEAT PUMP LOOP PUMPS AND HOT WATER LOOP PUMPS SHALL OPERATE UNDER EXIST. CONTROL LOGIC.

2. BOILERS B-N1 AND B-N2 SHALL OPERATE PER MANUF's CONTROL LOGIC.
   BOILER CONTROLLERS SHALL BE EXTENDED TO BUILDING's EXIST. BMS.
   ALL SETTINGS, SENSORS, SETPOINTS, ALARMS, ETC. SHALL BE FULLY CONTROLLABLE AT BMS. GRAPHICS SHALL BE UPDATED AT BMS.
   a. BOILERS SHALL LEAD/LAG ON A WEEKLY (ADJ.) BASIS.

   b. HEAT PUMP LOOP -
      b.a. WHEN HEAT PUMP LOOP (AT T-S1) FALLS BELOW HEATING SETPOINT (ADJ.) ENABLE LEAD BOILER.
         b.a.a. MODULATE CONTROL VALVE (CV-N1B/N2B) AND BOILER AS REQUIRED TO MAINTAIN SETPOINT.
         b.a.b. IF SETPOINT CANNOT BE MAINTAINED WITH LEAD BOILER, ENABLE LAG BOILER.
      b.b. WHEN HEAT PUMP LOOP (AT T-S1) RISES ABOVE SETPOINT, DISABLE BOILER(S).

   c. HOT WATER LOOP -
      c.a. WHEN HOT WATER LOOP (AT T-S2) FALLS BELOW HEATING SETPOINT (ADJ.) ENABLE LEAD BOILER.
         c.a.a. MODULATE CONTROL VALVE (CV-N1A/N2A) AND BOILER AS REQUIRED TO MAINTAIN SETPOINT.
         c.a.b. IF SETPOINT CANNOT BE MAINTAINED WITH LEAD BOILER, ENABLE LAG BOILER.
         c.a.c. WHEN HOT WATER LOOP (AT T-S2) RISES ABOVE SETPOINT, DISABLE BOILER(S).

   d. ERV HOT WATER COIL -
      d.a. CONTROL VALVE CV-E2 SHALL OPERATE PER EXIST. CONTROL LOGIC.
      d.b. IF FREEZE-STAT FALLS BELOW SETPOINT (40F, ADJ.):
         d.b.a. DISABLE ERV
         a.b.b. CLOSE ERV DAMPERS
         a.b.c. OPEN CV-E2 FOR FULL FLOW THRU ERV COIL.
         a.b.d. FULLY OPEN CV-N1A/N2A.
         a.b.e. ENABLE HOT WATER LOOP PUMP
         a.b.f. ENABLE BOILER
         a.b.g. ALARM

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ONE-LINE DIAGRAM
NEW WORK

SCALE: NTS

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SK-2B

SECTION 23 00 07 - CODES, REGULATIONS, STANDARDS AND FEES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The contract work, materials and equipment shall conform to the applicable requirements of all governing codes, rules and regulations of current issue including, but not necessarily limited to the following:
   1. All equipment shall meet the requirements of the International Energy Conservation Code.
   2. All mechanical systems shall meet the requirements of the International Mechanical Code.
   3. Ductwork, including all components and accessories, shall conform to requirements of the latest editions of the various standards published by Sheetmetal and Air Conditioning Contractor's National Association, Inc. (SMACNA).
   4. All installations shall conform to design standards as outlined in ASHRAE handbooks, latest edition.
   5. All installations and materials shall conform to applicable New York State and Local building construction codes.
   6. All system testing, inspection and balancing shall conform to the requirements of the Associated Air Balance Council (AABC).
   7. When codes or regulations are not consistent, the more stringent code or regulation shall apply.

1.2 NON-COMPLIANCE

A. Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances and industry standards, he shall bear all costs arising in correcting the deficiencies.

1.3 INSPECTIONS

A. During and upon completion of the work, the Contractors shall obtain and submit to the Owner's Representative:
   1. Any local certificate required.
   2. Said certificate(s) shall be submitted to the Owner's Representative before final payment is made.

B. The Contractor is responsible for all fees associated with any required inspections.

1.4 APPLICABLE CODES

A. All workmanship and materials shall conform to all state laws, local ordinances, local utility company regulations, and applicable Codes and Standards. In case of conflict with the Contract Drawings and Specifications, such laws, regulations and codes shall govern, except that the Contract Drawings and Specifications shall apply wherever they may require workmanship or materials other than required by the Codes and Standards. Applicable Codes and Standards shall include all pertinent requirements of the following Organizations:

1. 2015 Existing Building Code
2. 2015 International Energy Conservation Code
3. 2015 International Building Code
4. 2015 International Mechanical Code
5. 2016 Supplement to the New York State Energy Code
6. 2017 New York State Uniform Code Supplement
7. Local Codes
8. National Fire Protection Association (NFPA)
9. Public Health Service Regulations
10. Local Utility Standards & Regulations
11. American Society of Mechanical Engineers (ASME)
12. American Society of Civil Engineers (ASCE)
13. American National Standards Institute (ANSI)
14. American Refrigeration Institute (ARI)
15. Certified Ballast Manufacturer (CBM)
16. Electrical Testing Laboratories (ETL)
17. Independent Testing Laboratories (ITL)
18. International Organization for Standardization (ISO)
19. National Electrical Code (NEC) Latest Edition
20. National Environmental Balancing Bureau (NEBB)
21. National Electrical Manufacturers Association (NEMA)
22. Structural Engineering Institute (SEI)
23. Underwriters Laboratories (UL)
24. American Society for Testing & Materials (ASTM)
25. Insulated Power Cable Engineers Association (IPCEA)
26. Institute of Electrical and Electronic Engineers, Inc. (IEEE)

1.5 PERMITS

A. If any permits are required, it shall be the full responsibility of the CONTRACTOR to obtain and pay for all appropriate permits from all applicable agencies, prior to installation of any equipment.

END OF SECTION 23 00 07

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Bronze swing check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

C. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

D. ASME B31.1 for power piping valves.

E. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
   3. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

B. Valve Sizes: Same as upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
   2. Handwheel: For valves other than quarter-turn types.
   3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
   4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
   5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

E. Gate Valves: With rising stem.

F. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

G. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Grooved: With grooves according to AWWA C606.
   3. Solder Joint: With sockets according to ASME B16.18.
   4. Threaded: With threads according to ASME B1.20.1.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Conbraco Industries, Inc.; Apollo Valves.
2. Crane Co.; Crane Valve Group; Crane Valves.
3. Hammond Valve.
4. Milwaukee Valve Company.

C. Description:
1. Standard: MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Threaded or soldered.
7. Seats: PTFE or TFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but re not limited to, the following:
1. Crane Co.; Crane Valve Group; Jenkins Valves.
2. Kitz Corporation.
3. Milwaukee Valve Company.
4. NIBCO INC.

C. Description:
1. Standard: MSS SP-80, Type 3.
2. CWP Rating: 300 psig.
3. Body Design: Horizontal flow.
4. Body Material: ASTM B 62, bronze.
5. Ends: Threaded or soldered.
6. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Smaller:
   1. Bronze Ball Valves:
      a. Soldered or threaded ends.
   2. Bronze Swing Check Valves:
      a. Soldered or threaded ends.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Fastener systems.
   5. Pipe stands.
   6. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

B. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

C. Trapeze pipe hangers.

D. Metal framing systems.

E. Equipment supports.

1.6 QUALITY ASSURANCE

A. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

B. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

C. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

F. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

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

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Allied Tube & Conduit.
   2. Cooper B-Line, Inc.
   3. Flex-Strut Inc.
   4. or equal

C. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
   1. Standard: MFMA-4.
   2. Channels: Continuous slotted steel channel with inturned lips.
   3. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
   4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
   5. Metallic Coating: Electroplated zinc.

2.4 FASTENER SYSTEMS

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

2.5 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
   1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Base: Stainless steel.
   3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
   4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:
   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   2. Bases: One or more; plastic.
   3. Vertical Members: Two or more protective-coated-steel channels.
   4. Horizontal Member: Protective-coated-steel channel.
   5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

2.6 EQUIPMENT SUPPORTS

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

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

C. Properties: Non-staining, noncorrosive, and nongaseous.

D. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

C. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

D. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

E. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:
   1. Attach clamps and spacers to piping.
   2. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   3. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   4. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   5. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   6. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation

Q. Piping shall be prohibited from being used as a hanger or support for other piping, conduits, etc.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use padded hangers for piping that is subject to scratching.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1,050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

4. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
5. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
3. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
4. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
3. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

M. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
1. Vertical (MSS Type 55): Mounted vertically.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use mechanical-expansion anchors instead of building attachments where required in concrete constructions.

END OF SECTION 23 05 29

SECTION 23 05 95 – SELECTIVE DEMOLITION AND RESTRUCTURING

PART 1 - GENERAL

1.1 INTRODUCTION

A. The Contractor(s) shall furnish all labor, materials, equipment, and services necessary for, and incidental for Selective Demolition of all systems identified or shown on the drawings and/or specified herein.

B. This Section applies to all mechanical systems scheduled to be either: Removed, Removed and Salvaged, Removed and Reinstalled, Existing to Remain, or Decommissioned.

C. The Demolition Contractor(s) shall take ownership of all equipment scheduled to be removed from the buildings/site upon verbal or written authorization to proceed with demolition.
   1. The Contractor shall disconnect and drain (where applicable) all utilities and services (water, steam, gas, power, refrigerant, etc.) to allow for removal of equipment.
   2. The Contractor shall coordinate with the utility companies and municipal departments (water department, electrical utility, gas utility, fire department) as necessary to coordinate the disconnecting and removal of applicable services.

D. The Contractor(s) may peruse through available documents the Owner has in their position.
   1. Owner does not warrant or guarantee that the documents do in fact represent in situ conditions.
   2. The Contractor(s) may refer to these drawings in order to acquire a more comprehensive understanding of the Selective Demolition Work of this Section.
   3. The Engineer cautions that their field work does not represent in situ conditions.

1.2 DEFINITIONS

A. Existing Mechanical Systems are those systems that are in existence and currently considered to be the infrastructure of the building.
   1. This equipment includes but is not limited to: piping, ductwork, air handling units, cooling towers, chillers, terminal units, registers/grilles/diffusers, refrigerant piping, hydronic piping, pumps, exhaust fans, expansion tanks, heat exchangers, air separators, compressors and motors, piping, fittings and valves, and miscellaneous hardware and supports.
      a. The Contractor shall be responsible to completely demolish the existing building control system including all wiring, devices, compressors, piping, actuators, BMS hardware/software, etc.

B. System(s): All that equipment, components and machinery comprised of mechanical, fire protection, electrical and plumbing used to perform, support or enhance a utility function such as hot water heating system.

C. Selective Demolition: As describe in 1 thru 5 below.
   1. **Remove:**
      a. Disassemble as required to accommodate the safe transfer from the Owner's premises to a state approved waste handling facility; remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
   2. **Remove and Salvage:**
      a. Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
   3. **Remove and Reinstall:**
      a. Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage; and, reinstall items in locations indicated when approved by Owner’s Representative.
   4. **Existing to Remain:**
      a. Protect equipment indicated to remain against damage and soiling during selective demolition. When permitted by the Owner's Representative items may be removed to a suitable, protected storage location during selective demolition; and, then cleaned and reinstalled in their original locations.
      b. There are no aspects of the existing mechanical system scheduled to remain. MC shall perform system removals in their entirety.
   5. **Decommissioning:**
      a. The abandoning in-place of designated equipment for future use.

1.3 GENERAL

A. Portions of the building will be occupied during selective demolition. Conduct selective demolition so that Owner's operations will not be disrupted.
   1. Provide not less than 96 hours notice to Owner’s Representative of activities that will affect Owner's operations.

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

C. Contractor (respective) shall video record existing conditions prior to commencing any demolition, and turn over one copy of the recording to the Owner's Representative.
   1. This video will be used to verify existing conditions prior to the commencement of actual work that might be misconstrued as damage caused by selective demolition operations.
   2. In the event no video is turned over to the Owner’s Representative, all disputes shall favor the Owner and conditions prior to demolition shall be considered reasonably good, having 10 to 15 years of remaining life.

D. Regulatory Requirements: Comply with local governing EPA notification regulations before starting selective demolition.

E. Comply with hauling and disposal regulations of authorities having jurisdiction.

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

G. Conduct demolition operations to prevent injury to people and damage to adjacent buildings, facilities, and site improvements. Ensure safe passage of people around selective demolition area.

H. Provide temporary weather protection, during interval between demolition and removal of existing equipment to ensure that no water leakage or damage occurs to structure or interior areas.

I. Coordinate all roofing work with the Owner's Representative. Give advance notice and confirmation that no part of the roofing substrate will be left exposed.

J. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.

K. Cover and protect furnishings and equipment that have not been removed.

L. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

M. Survey existing conditions to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition.
   1. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of equipment to be selectively demolished.

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

O. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return premises to condition existing before start of selective demolition.

P. Patch and repair floor and wall surfaces damaged by demolition operations.

Q. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

R. Sweep work area broom clean at the end of each day.

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

T. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

U. Locate, identify, shut off, disconnect, and seal or cap off utility services scheduled to be selectively demolished.

V. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.

W. Conduct demolition operations and remove debris to ensure minimum interference with the operations of the Owner and Neighboring properties.

1.4 QUALITY ASSURANCE

A. Submit a written (typed) Demolition Plan.

B. Submit written (typed) plan to maintain unobstructed egress out of the building for all occupants.

C. Comply with all OSHA requirements.

1.5 PROJECT REQUIREMENTS

A. Contractors are encouraged to avail himself/herself of the original construction drawings which depict some, but not all of the above existing equipment.

B. Contractors are expected to visit the site and conduct their own reconnaissance.

C. Contractors shall conduct all operations according to the Phasing of the Work.

D. Notify the Owner's Representative in advance of demolition or decommissioning any systems.
   1. Generally, authorization to commence demolition or decommissioning of any system will be given at the weekly project meetings.

E. Protection of Existing Utilities:
   1. Locate existing utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during demolition operations.
   2. Coordinate interruption and/or termination of utilities with the Owner’s Representative.
   3. Provide a minimum of 1-week notice to the Owner's Representative and receive written notice to proceed before interrupting any utility.
   4. Repair any damaged utilities as acceptable to the Owner's Representative, at no additional cost to the Owner.

F. Protection of Persons and Property:

   1. Barricade all work zones as part of this work and post with warning signs and lights.

1.6 NOISE & VIBRATION

A. The Contractors shall conduct all operations to minimize noise and vibration throughout the building.
   1. Contractor shall be sensitive to any and all complaints Owner receives from occupants.
   2. In the event Owner receives complaints, Contractor shall redirect or reschedule their operations to eliminate the disturbance.

   3. In the event Owner receives a second complaint. Contractor shall schedule the work task to off-hours.

1.7 HAZARDOUS MATERIALS

A. The MC or EC shall not be responsible for hazardous material abatement.

B. However, if any substance should e suspect, it shall be brought to the attention of the Owner's Representative..\

1.8 **REMOVE:**

A. Contractors shall refer to contract documents for proposed demolition.

B. Note that all piping, equipment, hangers, valves and components have not been shown. Demolition work has been described as Performance-type work and Contractors shall remove systems in their entirety.

1.9 **REMOVE AND SALVAGE:**

A. As indicated on Drawings.

1.10 **REMOVE AND REINSTALL:**

A. As indicated on Drawings.

1.11 **EXISTING TO REMAIN/MODIFIED:**

A. All Equipment/Systems not proposed for Demolition shall remain in use.

1.12 **DECOMMISSIONING:**

A. None.

1.13 **APPLICABLE EQUIPMENT:**

A. Omitted.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to the actual demolition and removal of any equipment the Contractor(s) shall identify by a small burst of distinctively colored paint all such equipment.
   1. Prior to actual cutting and removal the Owner's Representative shall approve all equipment identified by Contractor(s) for removal.
      a. In the event any equipment is removed and not approved by the Owner's Representative, it shall be returned to found conditions at the expense of the Contractor(s).

3.2 DEBRIS REMOVAL

A. The Contractor shall park their dumpster in the area designated by the Owner's Representative.

B. All debris shall be taken out the same route designated by the Owner’s Representative.

3.3 EQUIPMENT WEIGHT

A. The Contractor(s) shall be responsible for determining the weight of all equipment scheduled for removal, installation or relocation.

B. The Contractor(s) shall not stock pile or store equipment in such a manner that the structural integrity of the floor or roof systems are compromised.

3.4 CRANE WORK

A. The Contractor(s) shall notify the Owner's Representative of any crane work with 1-week notice prior to any crane work.
   1. A plan depicting the crane's location(s) on the site and radius shall be prepared by the Contractor(s).
   2. The Contractor(s) shall return any damaged topography (roadways, sidewalks, lawns, etc.) caused by his operations to similar conditions existing before demolition/construction commences.

END OF SECTION 23 05 95

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Hot water supply and return piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

D. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.

E. Sheet Form Insulation Materials: 12 inches square.

F. Jacket Materials for Pipe: 12 inches long by NPS 2.

G. Sheet Jacket Materials: 12 inches square.

H. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

B. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

C. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
      a. Aeroflex USA, Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

G. Mineral-Fiber Rigid Pipe Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
      a. Johns Manville; Microlite.
      b. Knauf Insulation; Friendly Feel Duct Wrap.
      c. Owens Corning; SOFTR All-Service Duct Wrap.

H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
      a. Armacell LLC; Tubolit.
      b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
      c. Aprofoam.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric & Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SEALANTS

A. Joint Sealants:
   1. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:
   1. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
   1. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

B. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   1. Sheet and roll stock ready for shop or field sizing.
   2. Finish and thickness are indicated in field-applied jacket schedules.

C. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.

D. Factory-Fabricated Fitting Covers:
   1. Same material, finish, and thickness as jacket.
   2. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
   3. Tee covers.
   4. Flange and union covers.
   5. End caps.
   6. Beveled collars.
   7. Valve covers.
   8. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.5 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
   1. ABI, Ideal Tape Division; 491 AWF FSK.
   2. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   3. Compac Corporation; 110 and 111.

C. Width: 3 inches.

D. Thickness: 6.5 mils.

E. Adhesion: 90 ounces force/inch in width.

F. Elongation: 2 percent.

G. Tensile Strength: 40 lbf/inch in width.

H. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.6 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
   2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.
   3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

B. Verify that systems to be insulated have been tested and are free of defects.

C. Verify that surfaces to be insulated are clean and dry.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 degrees Fahrenheit with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   3. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
   4. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

K. Install insulation continuously through hangers and around anchor attachments.
   1. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   2. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   3. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.

N. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   1. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

O. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

P. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Q. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

R. For above-ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   4. Manholes.
   5. Handholes.
   6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

B. Seal penetrations with flashing sealant.

C. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

D. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

E. Seal jacket to roof flashing with flashing sealant.

F. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

G. Seal penetrations with flashing sealant.
   1. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   2. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   3. Seal jacket to wall flashing with flashing sealant.

H. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
   1. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

I. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

C. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   1. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   2. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   3. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   4. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   7. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
   8. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

E. Install removable insulation covers at locations indicated. Installation shall conform to the following:
   1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
   2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
   3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
   4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
   5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of polyolefin pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

B. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
   1. Finish Coat Material: Interior, flat, latex-emulsion size.

C. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
   1. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
   1. Tests and Inspections:
      a. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE

A. Hot Water Supply and Return Piping (existing and new) (includes existing hot water loop):
   1. Pipe sizes 1-1/4” and smaller:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2-inch thick.
   2. Pipe sizes 1-1/2” and larger:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2-inch thick.

B. Domestic Water / Make-up Water (existing and new):
   1. All pipe sizes:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2-inch thick.

END OF SECTION 23 07 19

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Hot-water heating piping.
   2. Balancing valves.

1.3 DEFNITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Hot-Water Heating Piping: at 200 deg F.
   2. Makeup-Water Piping: 80 psig at 150 deg F.
   3. Blowdown-Drain Piping: 200 deg F.
   4. Air-Vent Piping: 200 deg F.
   5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
   2. Air control devices.
   3. Hydronic specialties.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

1.7 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   1. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. Wrought-Copper Fittings: ASME B16.22.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
      a. Anvil International, Inc.
      b. S. P. Fittings; a division of Star Pipe Products.
      c. Victaulic Company.

D. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
   1. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, pre-lubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

E. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: Schedule 40, ASTM A 53/A 53M, black steel.

B. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

C. Grooved Mechanical-Joint Fittings and Couplings:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International, Inc.
      b. S.P. Fittings. A Division of Star Pipe Products.
      c. Victaulic Company.
      d. Or equal.

D. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM a 53/A 53 M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

E. Couplings: Ductile or malleable iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

F. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thickness as pipe in which they are installed.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

B. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inchmaximum thickness unless thickness or specific material is indicated.

C. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

D. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

F. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

G. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

H. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
      a. Central Plastics Company.
      b. Hart Industries International, Inc.
      c. McDonald, A. Y. Mfg. Co.

C. Description:
   1. Standard: ASSE 1079.
   2. Pressure Rating: 150 psig.
   3. End Connections: Solder-joint copper alloy and threaded ferrous.

2.5 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump; a division of ITT Industries.
      c. Griswold Controls.
      d. Taco.
   2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.
   4. Plug: Resin.
   5. Seat: PTFE.
   6. End Connections: Threaded or socket.
   7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   8. Handle Style: Lever, with memory stop to retain set position.
   9. CWP Rating: Minimum 125 psig.
   10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump; a division of ITT Industries.
      c. Griswold Controls.
      d. Taco.
   2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.
   4. Stem Seals: EPDM O-rings.
   5. Disc: Glass and carbon-filled PTFE.
   6. Seat: PTFE.
   7. End Connections: Flanged or grooved.
   8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   9. Handle Style: Lever, with memory stop to retain set position.
   10. CWP Rating: Minimum 125 psig.
   11. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated, Pressure-Reducing Valves:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
      a. Amtrol, Inc.
      b. Armstrong Pumps, Inc.
      c. Bell & Gossett Domestic Pump; a division of ITT Industries.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Body: Bronze or brass.
   3. Disc: Glass and carbon-filled PTFE.
   4. Seat: Brass.
   5. Stem Seals: EPDM O-rings.
   6. Diaphragm: EPT.
   7. Low inlet-pressure check valve.
   8. Inlet Strainer: removable without system shutdown.
   9. Valve Seat and Stem: Noncorrosive.
   10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
      a. Amtrol, Inc.
      b. Armstrong Pumps, Inc.
      c. Bell & Gossett Domestic Pump; a division of ITT Industries.
      d. Spence Engineering Company, Inc.
      e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
   a. Flow Design Inc.
   b. Griswold Controls.
   c. Appollo
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 250 deg F.

2.6 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

B. Manual Air Vents:
1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:
   1. Body: Bronze or cast iron.
   2. Internal Parts: Nonferrous.
   3. Operator: Noncorrosive metal float.
   4. Inlet Connection: NPS 1/2.
   5. Discharge Connection: NPS 1/4.
   6. CWP Rating: 150 psig.
   7. Maximum Operating Temperature: 240 deg F.

D. Diaphragm -Type Expansion Tanks:
   1. Bladder-type, full acceptance type.
   2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   3. Bladder shall be ASME, removable, heavy-duty, butyl..
   4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. In-Line Air Separators:
   1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
   2. Maximum Working Pressure: Up to 175 psig.
   3. Maximum Operating Temperature: Up to 300 deg F.
   4. Provide with integral strainer.

2.7 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2and smaller; flanged ends for NPS 2-1/2and larger.
   3. Strainer Screen: 40 -mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
   4. CWP Rating: 125 psig.

B. Basket Strainers:
   1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 40 -mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
   4. CWP Rating: 125 psig.

C. T-Pattern Strainers:
   1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
   2. End Connections: Grooved ends.
   3. Strainer Screen: 40 -mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
   4. CWP Rating: 750 psig.

D. Stainless-Steel Bellow, Flexible Connectors:
   1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
   2. End Connections: Threaded or flanged to match equipment connected.
   3. Performance: Capable of 3/4-inch misalignment.
   4. CWP Rating: 150 psig.
   5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating and piping, aboveground, NPS 1-1/2 and smaller, shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
   2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating and piping, aboveground, NPS 2 and larger, shall be the following:
   1. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
   2. Schedule 40 steel pipe; threaded joints and fittings.

C. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install throttling-duty valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install sleeves for piping penetrations of walls, ceilings, and floors.

U. Install sleeve seals for piping penetrations of concrete walls and slabs.

V. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

G. Copper Tees – shall be tee fittings meeting ASME B16.22.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

H. Install tank fittings that are shipped loose.

I. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

J. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

B. Leave joints, including welds, uninsulated and exposed for examination during test.

C. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

D. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.

E. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

F. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

G. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
   5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   6. Prepare written report of testing.

H. Perform the following before operating the system:
   1. Open manual valves fully.
   2. Inspect pumps for proper rotation.
   3. Set makeup pressure-reducing valves for required system pressure.
   4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
   5. Set temperature controls so all coils are calling for full flow.
   6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
   7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 52 16 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, fire-tube condensing boilers, trim, and accessories for heating hot water.

1.3 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports: Indicate and interpret test results for compliance with performance requirements before shipping.

D. Field quality-control test reports: Indicate and interpret test results for compliance with performance requirements.

E. Warranty: Standard warranty specified in this Section.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. AHRI Compliance: Boilers shall be AHRI listed and must meet the minimum efficiency specified under AHRI BTS-2000 as defined by Department of Energy in 10 CFR Part 431.
E. ANSI Compliance: Boilers shall be compliant with ANSI Z21.13 test standards for US and Canada.

F. CSA Compliant: Boilers shall be compliant with CSA certification.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 WARRANTY

A. Standard Warranty: Boilers shall include manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Fire-Tube Condensing Boilers:
      a. Heat Exchanger, Pressure Vessel and Condensation Collection Basin shall carry a 10 year limited warranty against defects in materials or workmanship and failure due to thermal shock.
      b. All other components shall carry a one year warranty from date of boiler start up.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
   1. Lochinvar
   2. Weil-McLain
   3. Patterson-Kelly

2.2 CONSTRUCTION

A. Description: Boiler shall be natural gas fired, fully condensing, and fire tube design. The boiler shall be factory-fabricated, factory-assembled, and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.

B. Heat Exchanger: The heater exchanger shall bear the ASME “H” stamp for 160 psi working pressure and shall be National Board listed. The heat exchanger shall be constructed of a fully welded 316L stainless steel and of fire tube design. Fire tube shall be of the Wave Fire Tube design and capable of transferring 16,000 to 20,000 Btu’s per tube. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. There shall be no banding material, bolts, gaskets or “O” rings in the heat exchanger design. Cast iron, aluminum, or condensing copper tube boilers will not be accepted.

C. Condensate Collection Basin: Fully welded 316L stainless steel.

D. Intake Filter and Dirty Filter Switch: Boiler shall include an intake air filter with a factory installed air pressure switch. The pressure switch will alert the end user on the screen of the boiler that the intake filter is dirty and needs to be changed.

E. Pressure Vessel: The pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The pressure vessel shall be designed for a single-pass water flow to limit the water side pressure drop. Pressure drop shall be no greater than 3.2 psi at 180 gpm.

F. Burner: Natural gas, forced draft single burner premix design. The burner shall be high temperature stainless steel with a woven Fecralloy outer covering to provide modulating firing rates. The burner shall be capable of the stated gas train turndown without loss of combustion efficiency.

G. Blower: Boiler shall be equipped with a pulse width modulating blower system to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The burner firing sequence of operation shall include pre-purge, firing, modulation, and post-purge operation.

H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

I. Casing:
   1. Jacket: Heavy gauge primed and painted steel jacket with snap-in closures.
   2. Control Compartment Enclosures: NEMA 250, Type 1A.
   3. Insulation: Minimum ½ inch thick, mineral fiber insulation surrounding the heat exchanger.
   4. Combustion-Air Connections: Inlet and vent duct collars.

J. Characteristics and Capacities:
   1. Heating Medium: Hot water.
   2. Design Water Pressure Rating: 160 psi working pressure.
   3. Safety Relief Valve Setting: 50 psig

2.3 TRIM

A. Safety Relief Valve:
   1. Size and Capacity: 50 lb.
   2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

B. Pressure Gage: Minimum 3-1/2 inch diameter. Gage shall have normal operating pressure about 50 percent of full range.

C. Drain Valves: Minimum NPS 3/4 or nozzle size with hose-end connection.

D. Condensate Neutralization Kit: Factory supplied condensate trap with condensate trip sensor, high capacity condensate receiver prefilled with appropriate medium.

2.4 CONTROLS

A. Boiler controls shall feature a standard, factory installed 8” LCD screen display with the following standard features:
   1. Variable Speed Boiler Pump Control: Boiler may be programmed to send a 0-10V DC output signal to an ECM or VFD boiler pump to maintain a designed temperature rise across the heat exchanger. The boiler shall be able to operate in this mode with a minimum temperature rise of 20 degrees F and a maximum temperature rise of 60 degrees F.
   2. Password Security: Boiler shall have a different password security code for the User and the Installer to access adjustable parameters.
   3. Outdoor air reset: Boiler shall calculate the set point using a field installed, factory supplied outdoor sensor and an adjustable reset curve.
   4. Pump exercise: Boiler shall energize any pump it controls for an adjustable time if the associated pump has been off for a time period of 24 hours.
   5. Ramp delay: Boiler may be programmed to limit the firing rate based on six limits steps and six time intervals.
   6. Boost function: Boiler may be programmed to automatically increase the set point a fixed number of degrees (adjustable by installer) if the setpoint has been continuously active for a set period of time (time adjustable by installer). This process will continue until the space heating demand ends.
   7. Time clock: Boiler shall have an internal time clock with the ability to time and date stamp lock-out codes and maintain records of runtime.
   8. Service reminder: Boiler shall have the ability to display a yellow colored service notification screen based upon months of installation, hours of operation, and number of boiler cycles. All notifications are adjustable by the installer.
   9. Anti-cycling control: Boiler shall have the ability to set a time delay after a heating demand is satisfied allowing the boiler to block a new call for heat. The boiler will display an anti-cycling blocking on the screen until the time has elapsed or the water temperature drops below the anti-cycling differential parameter. The anti-cycling control parameter is adjustable by the installer.
   10. Night setback: Boiler may be programmed to reduce the space heating temperature set point during a certain time of the day.
   11. Freeze protection: Boiler shall turn on the boiler and system pumps when the boiler water temperature falls below 45 degrees. When the boiler water temperature falls below 37 degrees the boiler will automatically turn on. Boiler and pumps will turn off when the boiler water temperature rises above 43 degrees.
   12. Isolation valve control: Boiler shall have the ability to control a 2-way motorized control valve. Boiler shall also be able to force a fixed number of valves to always be energized regardless of the number of boilers that are firing.
   13. BMS integration with 0-10V DC input: The Control shall allow an option to Enable and control set point temperature or control firing rate by sending the boiler a 0-10V input signal.
   14. Data logging: Boiler shall have non-volatile data logging memory including last 10 lockouts, hours running and ignition attempts and should be able to view on boiler screen.

B. The boiler shall have a built in Cascade controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of up to 8 boilers of different btu inputs without utilization of an external controller. The factory installed, internal cascade controller shall include:
   1. Lead lag:
   2. Efficiency optimization: The Control module shall allow multiple boilers to fire at minimum firing rate in lieu of Lead/Lag.
   3. Front end loading:
   4. Rotation of lead boiler: The Control module shall change the lead boiler every hour for the first 24 hours after initializing the Cascade. Following that, the leader will be changed once every 24 hours.

C. Boiler operating controls shall include the following devices and features:
   1. Set-Point Adjust: Set points shall be adjustable.
   2. Operating Pressure Control: Factory wired and mounted to cycle burner.
   3. Sequence of Operation: Factory installed controller to modulate burner firing rate to maintain system water temperature in response to call for heat.
   4. Sequence of Operation: Electric, factory-fabricated and factory-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 10 deg F outside-air temperature, set supply-water temperature at 180 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 140 deg F.

D. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
   1. High Temperature Limit: Automatic and manual reset stops burner if operating conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.
   2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manually reset on the control interface.
   3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
   4. High and Low Gas Pressure Switches: Pressure switches shall prevent burner operation on low or high gas pressure. Pressure switches to be manually reset on the control interface.
   5. Proof of Closure Valve (FB 6001 only): Proof of closure valve (POC) shall prevent the boiler from firing if the POC valve seat is detected open. Upon a call for heat, once the POC valve seat is proven to be closed, the pre-purge cycle will begin and the POC valve will begin to open.
   6. Blocked Drain Switch: Blocked drain switch shall prevent burner operation when tripped. Switch to be manually reset on the control interface.
   7. Low air pressure switch: Pressure switches shall prevent burner operation on low air pressure. Switch to be manually reset on the control interface.
   8. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for any lockout conditions.

E. Building Automation System Interface: Factory installed Modbus gateway interface to enable building automation system to monitor, control, and display boiler status and alarms.

2.5 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

2.6 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
   1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in of piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Install equipment on 4” concrete housekeeping pad.

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Install boilers level on concrete bases.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of equipment connection. Provide a reducer if required.

E. Connect hot-water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.

F. Install piping from safety relief valves to nearest floor drain.

G. Boiler Venting:
   1. Install flue venting kit and combustion-air intake.
   2. Connect full size to boiler connections.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform installation and startup checks according to manufacturer's written instructions. Complete startup form included with Boiler and return to Manufacturer as described in the instructions.
   2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
   3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
      a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
      b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

D. Performance Tests:
   1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
   2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
   3. Perform field performance tests to determine capacity and efficiency of boilers.
   4. Repeat tests until results comply with requirements indicated.
   5. Provide analysis equipment required to determine performance.

6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Owner in advance of test dates.
8. Perform a combustion an
9. alysis after installation and adjust gas valve per the Installation and Operations manual and note in startup report.
10. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory representative or a factory-authorized service representative for boiler startup and to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 52 16

SECTION 23 92 05 - VENTING OF GAS-FIRED APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment and services necessary for, and incidental to, the installation of vents as specified herein.

B. This Section is applicable for the following:
   1. Gas-Fired Boilers

1.2 SUBMITTALS

A. Submit product data including materials, dimensions, weights, and accessories.

B. Submit shop drawings including required clearances, assembly and installation instructions, and support of components.
   1. Fully detail all components.
      a. One-line drawings are not accepted.
   2. See schedule on drawings for description of fuel burning
   3. Equipment.

C. Quality Control Submittals:
   1. Certificates: Submit certificates of materials compliance with specified ASTM, UL, and ASHRAE requirements.

1.3 QUALITY ASSURANCE

A. Codes and Standards:
   1. Comply with applicable portions of UL safety standards; provide products which have been UL listed and labeled.
   2. Comply with the ASHRAE Equipment Handbook, Chapter 27, for Chimney, Gas Vent, and Fireplace Systems, material requirements and design criteria.

PART 2 - PRODUCTS

2.1 GAS-FIRED BOILERS

A. PVC, Schedule 40, pipe and fittings meeting ANSI/ASTM D1785.
   1. PVC Cement and Primer (for Flue Gas Venting) shall be used and shall meet ANSI/ASTM D2564.
      a. Do not mix primers and cements from one manufacturer with a vent system from a different manufacturer.

B. Venting shall follow all Local and State codes for Category IV venting systems.

C. Combustion air and vent pipe, fittings, primers, and solvents must conform to American National Standards Institute (ANSI) standards and American Society for Testing and Materials (ASTM) standards.

D. Direct Vent / 2-Pipe System:
   1. All air for combustion shall be taken directly from outdoor atmosphere, and all flue products shall be discharged to outdoor atmosphere.
   2. Combustion-air and vent pipes must terminate together in the same atmospheric pressure zone, either through the roof or a sidewall (if allowed on drawings).

E. Furnish and install concentric vent kit for terminations.

F. Maintain all required clearances per the International Mechanical Code and the International Fuel Gas Code.

G. Install per manufacturer's recommendations.

PART 3 - EXECUTION

3.1 ADJUSTING AND CLEANING

A. Clean to remove dust and debris. Clean external surfaces to remove welding slag and mill film.

END OF SECTION 23 92 05