

Specifications

for

Solano Community College District

B-1600 Mechanical Room

Hydronic Upgrades

100% Construction Documents

SOBE No. 2510-00648-00

2/25/2026

SPECIFICATIONS

*SOLANO COMMUNITY COLLEGE DISTRICT
Solano Community College
B-1600 Mechanical Room
Hydronic Systems*

Project #2510-00648-00

Fairfield, CA

Approval Stamps



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**SECTION 23 05 19
METERS AND GAUGES FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Positive displacement meters.
- B. Pressure gauges and pressure gauge taps.
- C. Thermometers and thermometer wells.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2024.
- C. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Division 1 for Submittal requirements.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components. Indicate scale range, figure interval and minor graduation markings for all pressure and compound ranges.
- C. Project Record Documents: Record actual locations of components and instrumentation.

1.04 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)

- A. AWWA C700, positive displacement disc type suitable for fluid with metal alloy main case and cast iron bottom cap, hermetically sealed register.

2.02 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, bronze socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 4-1/2 inch (115 mm) diameter.
 - 3. Mid-Scale Accuracy: 1/2 percent.
 - 4. Scale: Psi.

2.03 PRESSURE GAUGE TAPPINGS

- A. Taps: Bonny Forge Thred-O-Let, min 1/2", sized for run pipe diameter. 1/4" minimum sched 40 steel piping from taps to gauge.
- B. Gauge Valve: 150 lb Bronze ball valve, threaded, two piece body, stainless steel ball and stem. Nibco or equal.

2.04 DIGITAL THERMOMETERS

- A. Manufacturers:
 - 1. Weiss Instruments, Inc. Digital Vari-Angle Thermometer,
 - 2. Model DVU35 or DVU6, www.weissinstruments.com
 - 3. Substitutions: See Division 1 - Product Requirements.
- B. Thermometer: Hi-impact ABS case, glass passivated thermistor sensor, 1/2" LCD Digits.
 - 1. Size: 3-1/2 inch or 6 inch industrial stem.

2. Display: 1/2" LCD digits, wide ambient formula. Lens: Clear glass.
3. Accuracy: 1 percent of reading or 1 degree F, whichever is greater/
4. Calibration: Degrees F.
5. Range: -50 to 300 degrees F
6. Resolution: 1/10 Degrees F between -19.9/199.9 Degrees F
7. Power: Integrated Photo Voltaic Cells
8. Sensor: Glass passivated thermistor.
9. Sensing Well: 3/4" NPT, length to suit application.

2.05 THERMOMETER SUPPORTS

- A. Socket: Bronze separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.06 CONTROL SUPPORTS

- A. Pipe taps (branch connection): Forged ASTM A105 carbon steel, threaded branch connection suitable for sizes and schedules to be connected for 150 psig working pressure. Bonney Forge Thred-o-let or approval equal. Coordinate with Controls Subcontractor for size, location and quantities.

2.07 TEST PLUGS

- A. Manufacturers:
 1. Peterson Equipment Co, Pete's Plug www.petesplug.com
 2. Substitutions: See Division 1.
- B. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with Nordel core for temperatures up to 275 degrees F (93 degrees C). Use extended length plugs to clear insulation and jacketing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide one pressure gauge per pump, installing taps before strainers or suction diffusers and on suction and discharge of pump. Pipe to gauge.
- C. Install thermometers in piping systems in sensing wells in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sensing wells. Ensure sensing wells allow clearance from insulation.
- D. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- E. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- F. Pump and strainer pressure gauges: install taps, fittings, valves to allow a single pressure gauge to make suction and discharge pressures on pump and inlet and outlet pressures on strainers. Provide a Petes Plug at every pressure gauge or control sensor and/or each thermometer whether shown on drawings or not.
- G. Locate test plugs adjacent to thermometers and temperature sensors, at pressure gauges and sensors, and where indicated,
- H. Provide new temperature wells for any relocated temperature sensors, as shown on dwgs.

END OF SECTION

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

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ball valves.
- B. Butterfly valves.
- C. Check valves.
- D. Chainwheels.

1.02 ABBREVIATIONS AND ACRONYMS

- 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. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

1.03 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022, with Errata (2023).
- D. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2025.
- E. ASME B31.9 - Building Services Piping; 2025.
- F. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- G. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2021.
- H. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- I. MSS SP-67 - Butterfly Valves; 2022.
- J. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- K. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.04 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.05 QUALITY ASSURANCE

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General-Duty Valves for HVAC
Piping

- A. Manufacturer:
 1. Obtain valves for each valve type from single manufacturer.
 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect valve parts exposed to piped medium against rust and corrosion.
 2. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 3. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
- B. Use the following precautions during storage:
 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
 1. Handle large valves with sling, modified to avoid damage to exposed parts.
 2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
 1. Throttling (Hydronic): Butterfly and Ball.
 2. Isolation (Shutoff): Butterfly and Ball.
 3. Swing Check (Pump Outlet):
 - a. Size 2-1/2 inch (65 mm, DN) and Larger: Iron with lever and spring, center-guided metal, or center-guided with resilient seat.
- D. Required Valve End Connections for Non-Wafer Types:
 1. Steel Pipe:
 - a. Size 2 inch (50 mm, DN) and Smaller: Threaded ends.
 - b. Size 2-1/2 inch (65 mm, DN) and Larger: Flanged ends..
- E. Chilled Water Valves:
 1. Size 2 inch (50 mm, DN) and Smaller, Bronze Valves:
 - a. Threaded ends.
 - b. Ball: Full port, two piece, bronze trim, Class 150.
 2. Size 2-1/2 inch (65 mm, DN) and Larger, Iron Valves:
 - a. 2-1/2 inch (65 mm, DN) to 6 inch (150 mm, DN): Flanged ends.
 - b. Single-Flange Butterfly: 2-1/2 inch (65 mm, DN) to 12 inch (300 mm, DN), aluminum-bronze disc, Chloramine resistant EPDM seat, 200 CWP.
 - c. Swing Check with Closure Control: 2-1/2 inch (65 mm, DN) to 12 inch (300 mm, DN), lever and spring, Class 125.
- F. Heating Hot Water Valves:
 1. Size 2 inch (50 mm, DN) and Smaller, Bronze Valves:
 - a. Threaded ends.
 - b. Ball: Full port, one piece, bronze trim, Class 1.
 2. Size 2-1/2 inch (65 mm, DN) and Larger, Iron Valves:
 - a. 2-1/2 inch (65 mm, DN) to 6 inch (150 mm, DN): Flanged ends.

- b. Single-Flange Butterfly: 2-1/2 inch (65 mm, DN) to 12 inch (300 mm, DN), aluminum-bronze disc, Chloramine resistant EPDM seat, 200 CWP. Lug pattern.
- c. Swing Check: 2-1/2 inch (65 mm, DN) to 12 inch (300 mm, DN), lever and spring closure control, Class 150.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 6 inch (-) and larger.
 - 2. Hand Lever: Quarter-turn valves 4 inch (-) and smaller.
 - 3. 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: Provide 2 inch (50 mm, DN) stem extensions and the following features:
 - 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Butterfly Valves: Extended neck.
 - 3. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
- F. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Building Services Piping Valves: ASME B31.9.
- G. Bronze Valves:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.

2.03 BRONZE, BALL VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Two Piece, Full Port with Bronze or Brass Trim:
 - 1. Comply with MSS SP-110.
 - 2. WSP Rating: 150 psi (1,035 kPa).
 - 3. WOG Rating: 400 psi (2,758 kPa).
 - 4. Body: Forged bronze or dezincified-brass alloy.
 - 5. End Connections: Pipe thread or solder.
 - 6. Seats: PTFE.
 - 7. Stem: Stainless steel.
 - 8. Ball: Stainless steel, vented.
 - 9. Operator: Provide lockable handle and stem extension.
 - 10. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. NIBCO INC; T-580-70-66: www.nibco.com/#sle.
 - c. Substitutions: See Division 1.

2.04 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug Style:

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1. Comply with MSS SP-67, Type I.
2. Lug Style, CWP Ratings:
 - a. Sizes 2 to 12 inches (50 to 300 mm, DN): 250 psi (1725 kPa).
3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
4. Stem: One or two-piece stainless steel.
5. Seat: Chloramine resistant EPDM/.
6. Disc: Aluminum-bronze.
7. Removable Manual Actuator: Lockable lever handle with open/close position indication. 4" pipe size and smaller
8. Service Temperature Range: Minus 30 to 250 degrees F (Minus 34.4 to 121.1 degrees C).
9. Operator: Gear operator with handwheel over direct-mount actuator base for sizes 6" and over.
10. Manufacturers:
 - a. NIBCO INC; LD-2000: www.nibco.com/#sle.
 - b. Substitutions: See Division 1.

2.05 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 150:
 1. Comply with MSS SP-71, Type I.
 2. Sizes 2-1/2 to 12 inch (65 to 300 mm, DN): CWP Rating; 200 psi (1,380 kPa).
 3. Body Design: Clear or full waterway.
 4. Body Material: ASTM A126, gray iron with bolted bonnet.
 5. Ends: Flanged.
 6. Trim: Bronze.
 7. Gasket: Asbestos free.
 8. Closer Control: Factory installed, exterior lever, and spring or weight.
 9. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Nibco; www.nibco.com.

2.06 CARBON STEEL, SWING CHECK VALVES

- A. Class 150:
 1. Design: T-pattern, horizontal or vertical flow.
 2. Body and Disc: ASTM A216/A216M.
 3. CWP Rating: 150 psi (1,034 kPa).
 4. End Connections: Flanged.
 5. Pressure and Temperature Rating: ASME B16.34.

2.07 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to ball, butterfly, and plug valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
 4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Properly recycle or dispose of all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.

- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve be determined defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Swing Check: Install in accordance to manufacturer's installation instructions.
- D. Provide chainwheels on operators for valves 4 NPS (100 DN) and larger where located 96 inches (2.4 m) or more above finished floor, terminating 60 inches (1.5 m) above finished floor.
- E. Provide touch up paint for any material with damaged factory paint. Touch up paint shall be equivalent to factory paint, or approved by manufacturer.
- F. Provide brass valve tags and corresponding valve chart printed and stored inside the mechanical room space.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Testing, adjustment, and balancing of hydronic systems.

1.02 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).
- C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.03 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 2. Include at least the following in the plan:
 - a. List of all water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Expected problems and solutions, etc.
 - g. Details of how TOTAL flow will be determined; for example:
 - 1) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 - h. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - i. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Submit to the Construction Manager within two weeks after completion of testing, adjusting, and balancing.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for architect and for inclusion in operating and maintenance manuals.
 - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 6. Units of Measure: Report data in I-P (inch-pound) units only.
 - 7. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.

- b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Project name.
 - d. Project location.
 - e. Project Engineer.
 - f. Project Contractor.
 - g. Report date.
- E. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. SMACNA (TAB).
 - 4. Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Hydronic systems are flushed, filled, and vented.
 - 5. Pumps are rotating correctly.
 - 6. Proper strainer baskets are clean and in place.
 - 7. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 ADJUSTMENT TOLERANCES

- A. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.04 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.

3. Contract interpretation requests.
 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
 - C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
 - D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
 - E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.05 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.06 SCOPE

- A. Test, adjust, and balance the following:
 1. HVAC Pumps - refer to plans for design criteria.
 2. Primary Hydronic System Balancing Valves - refer to plans for design criteria.
 3. Existing AHU Heating & Cooling Coils:
 - a. AHU HHW Coil Flow Requirement = 36 gpm
 - b. AHU CHW Coil Flow Requirement = 170 gpm
 4. Existing VAV & CAV Reheat Coils - Refer to the table below for reheat coil flow data:

EXISTING VAV/CAV SCHEDULE (HYDRONIC)										
TYPE	MARK	MFG	MODEL	REHEAT						CONTROL VALVE
				CAP. (MBH)	EWT (°F)	LWT (°F)	GPM	W.P.D. (FT H ₂ O)	ROWS	
CAV	23	TITUS	DESV-14	52	180	133	2.30	0.26	2	3-WAY
VAV	24	TITUS	DESV-04	3	180	124	0.10	0.00	2	2-WAY
VAV	25	TITUS	DESV-04	3	180	118	0.10	0.00	2	3-WAY
CAV	26	TITUS	DESV-12	52	180	152	3.90	1.09	2	2-WAY
VAV	27	TITUS	DESV-04	3	180	109	0.10	0.00	2	3-WAY
CAV	28	TITUS	DESV-10	46	180	165	6.40	2.41	2	2-WAY
CAV	29	TITUS	DESV-16	104	180	161	11.50	2.01	2	2-WAY
CAV	30	TITUS	DESV-08	22	180	148	1.40	0.28	2	3-WAY
VAV	31	TITUS	DESV-08	9	180	135	0.40	0.05	2	2-WAY
VAV	32	TITUS	DESV-10	16	180	137	0.80	0.07	2	3-WAY
VAV	33	TITUS	DESV-08	13	180	150	0.60	0.10	2	2-WAY
VAV	34	TITUS	DESV-10	20	180	138	1.00	0.11	2	3-WAY
CAV	35	TITUS	DESV-08	22	180	148	1.40	0.28	2	2-WAY
CAV	36	TITUS	DESV-14	52	180	133	2.30	0.26	2	2-WAY
VAV	1	TITUS	DESV	33	180	150	2.00	-	2	3-WAY
VAV	2	TITUS	DESV	30	180	150	3.00	-	1	2-WAY
VAV	6	TITUS	DESV	45	180	150	3.00	-	2	2-WAY
CAV	20	TITUS	DESV-06	15	180	150	1.00	-	2	3-WAY
VAV	22	TITUS	DESV	30	180	150	3.00	-	1	2-WAY

NOTES:
1) EXISTING DATA IS FROM COLLEGE PROVIDED AS-BUILT DOCUMENTS

3.07 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
1. Manufacturer.
 2. Model/Frame.
 3. HP/BHP.
 4. Phase, voltage, amperage; nameplate, actual, no load.
 5. RPM.
 6. Service factor.
- B. Pumps:
1. Identification/number.
 2. Manufacturer.
 3. Size/model.
 4. Impeller.
 5. Service.
 6. Design flow rate, pressure drop, BHP.
 7. Actual flow rate, pressure drop, BHP.
 8. Discharge pressure.
 9. Suction pressure.
 10. Total operating head pressure.
 11. Shut off, discharge and suction pressures.
 12. Shut off, total head pressure.
- C. Cooling Coils:
1. Identification/number.
 2. Location.
 3. Service.
 4. Water flow, design and actual.
 5. Water pressure drop, design and actual.
- D. Heating Coils:
1. Identification/number.

2. Location.
 3. Service.
 4. Water flow, design and actual.
 5. Water pressure drop, design and actual.
- E. Flow Balancing Devices:
1. Location.
 2. Size.
 3. Manufacturer.
 4. Model number.
 5. Design Flow rate.
 6. Design pressure drop.
 7. Actual/final pressure drop.
 8. Actual/final flow rate.
 9. Device calibrated setting.

END OF SECTION

**SECTION 23 07 19
HVAC PIPING INSULATION**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Piping insulation.
- B. Weather barrier coatings.
- C. Jacketing and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- D. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- H. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

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HVAC Piping Insulation

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, RIGID

- A. Manufacturers:
 - 1. Johns Manville Corporation: www.jm.com/#sle.
 - 2. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.owenscorning.com/en-us/#sle.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Aluminum-Foil Laminate Jacket:
 - 1. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/(Pa s m)).

2.03 HYDROUS CALCIUM SILICATE

- A. Manufacturers:
 - 1. Johns Manville Corporation: www.jm.com/#sle.
- B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, whitcolor.
 - 1. K (Ksi) Value: 0.40 at 300 degrees F (0.057 at 149 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 1200 degrees F (649 degrees C).
 - 3. Density: 15 pcf (240 kg/cu m).
- C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Armacell LLC; AP ArmaFlex: www.armacell.us/#sle.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - 2. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

2.05 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
 - 1. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.

2. Water Vapor Permeance: Greater than 1.0 perm (57 ng/(Pa s m)) in accordance with ASTM E96/E96M.

2.06 JACKETING AND ACCESSORIES

- A. PVC Plastic.
 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com/#sle.
 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/(Pa s m)), maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch (0.25 mm).
 - e. Connections: Brush on welding adhesive.
 3. Covering Adhesive Mastic: Compatible with insulation.
- B. Aluminum Jacket:
 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch (0.41 mm) with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 2. Thickness: 0.016 inch (0.40 mm) sheet.
 3. Type: Factory-applied, self-adhesive jacketing.
 4. Finish: Smooth.
 5. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 6. Fittings: 0.016 inch (0.40 mm) thick die-shaped fitting covers with factory-attached protective liner.
 7. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- G. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
 1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At firestop detail on plans .
- J. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV-resistant finish for flexible elastomeric cellular insulation without jacketing.

3.03 SCHEDULE

- A. Heating Systems: Refer to Table 120.3-A-1 of the 2025 CA Energy Code for minimum pipe insulation requirements.
1. Heating Water Supply and Return.
- B. Cooling Systems: Refer to Table 120.3-A2 of the 2025 CA Energy Code for minimum pipe insulation requirements.
1. Chilled Water Supply and Return.

END OF SECTION

**SECTION 23 21 13
HYDRONIC PIPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Chilled water piping, above grade.
- D. Equipment drains and overflows.
- E. Pipe hangers and supports.
- F. Unions, flanges, mechanical couplings, and dielectric connections.

1.02 REFERENCE STANDARDS

- A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- B. ASME B31.9 - Building Services Piping; 2025.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- D. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.
- E. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- F. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
- G. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2024).
- H. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe; 2000.
- I. AWWA C606 - Grooved and Shouldered Joints; 2022.
- J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting at least one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

- A. See Division 1 for Submittal requirements
- B. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Provide manufacturers catalog information.
 - 3. Indicate valve data and ratings.
- C. Shop Drawings: Submit complete shop drawings for piping system showing all fittings, elevations, pipe accessories, hanger locations and all connected equipment. Submit shop drawings electronically in PDF or DWG format. Drawings shall be produced in AutoCad 2018, or Revit 2018 or later releases.
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Project Record Documents: Record actual locations of valves.
- F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

- G. Piping Pressure Test Reports: Provide piping pressure test reports indicating:
1. Owner
 2. Project Address
 3. Project Name
 4. Testing Contractor
 5. Pipe Segment Tested
 6. Pipe Size, Service and material (including wall thickness information (schedule, SDR, etc.))
 7. Test Medium
 8. Date and Time of Test Start
 9. Starting Pressure and Temperature of Test Medium
 10. Starting Ambient Temperature
 11. Date and Time of Test End
 12. Ending Pressure and Temperature of Test Medium
 13. Ending Ambient Temperature
 14. Observations and Conclusions
- H. As-Built Drawings: At project closeout, provide as-built drawings of the piping systems installed. Submit in same format as for Shop Drawings above.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum three years of experience.
- C. Welder Qualifications: Certify in accordance with AWS D1.1/D1.1M.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 3. Grooved mechanical joints may be used in accessible locations only. (CHW Systems only)
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by architect.
 - b. Use rigid joints unless otherwise indicated.
 4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
1. Where grooved joints are used in piping (CHW Only), provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

2. Where threaded joints are used in piping connections to equipment, provide threaded union in the midpoint of the connecting piping for serviceability whether indicated on plans or not.
- D. Valves: Provide valves where indicated:
1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch (20 mm) ball valves with cap; pipe to nearest floor drain.
 2. Isolate equipment using butterfly valves with lug end flanges.
 3. For throttling and isolation service in chilled and heating hot water systems, use only butterfly valves.

2.02 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 2. Threaded Joints (through 2"): ASME B16.3, malleable iron fittings.

2.03 CHILLED WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.
 2. Threaded Joints (through 2"): ASME B16.3, malleable iron fittings,
 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

2.04 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.

2.05 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Greater: Carbon steel, adjustable, clevis. Sized for insulation
 4. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis. Sized for insulation
 5. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support. With insulated support foot.
 6. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 7. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- B. In grooved installations (CHW only), use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe of 2 Inches (50 mm, DN) and Less:
1. Ferrous Piping: 150 psi (1034 kPa) brass or malleable iron, threaded.
- B. Flanges for Pipe 2 Inches (50 mm, DN) and Greater:
1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
 2. Gaskets: 1/16 inch (1.6 mm) thick, preformed neoprene.

- C. Mechanical Couplings for Grooved and Shouldered Joints (CHW only): Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
1. Dimensions and Testing: In accordance with AWWA C606.
 2. Mechanical Couplings: Comply with ASTM F1476.
 3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
 4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C). Chloramine resistant
 5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 6. When pipe is field grooved, provide coupling manufacturer's grooving tools.
 7. Provide rigid couplings unless otherwise noted.
 8. Manufacturers:
 - a. Victaulic Company: Zero Flex 07 www.victaulic.com/#sle.
- D. Dielectric Connections:
1. Waterways:
 - a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - b. Dry insulation barrier able to withstand 600-volt breakdown test.
 - c. Construct of galvanized steel with threaded end connections to match connecting piping.
 - d. Suitable for the required operating pressures and temperatures.
 2. Flanges:
 - a. Dielectric flanges with same pressure ratings as standard flanges.
 - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - c. Dry insulation barrier able to withstand 600-volt breakdown test.
 - d. Suitable for the required operating pressures and temperatures.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. See Section 23 25 00 for additional requirements.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interference with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- G. Install drain at low points with sloped drain piping.
- H. Pipe Hangers and Supports:

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Hydronic Piping

1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 2. Support horizontal piping as scheduled.
 3. Install hangers to provide minimum 1/2-inch (13 mm) space between finished covering and adjacent work.
 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 5. Use hangers with 1-1/2 inches (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 6. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
 - J. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
 - K. Finish paint exposed piping prepped for painting per previous paragraph.
 - L. Install valves with stems upright or horizontal, not inverted.

3.03 TESTING

- A. Unless otherwise noted, pressure test in accordance with California Mechanical Code, Chapter 12.
- B. Provide necessary caps or blinds to protect equipment not rated for test pressure (safety valves, regulators, etc.).
- C. Pneumatic Testing:
 1. Pneumatic testing is expressly prohibited on any non-metallic piping.
 2. Other than as excepted above, pneumatic testing will not be considered without written consent from Owner or architect, and substantiation as to why hydrotesting is inapplicable. Additional testing requirements and measures may be required for a pneumatic test and will be considered on a case-by-case basis.
- D. Reports: Submit test reports for all pipeline sections tested per Submittals requirements in Part 1 of this specification.

3.04 SCHEDULES

- A. Hanger Spacing for Steel Piping.
 1. 1/2 Inch (15 mm), 3/4 Inch (20 mm), and 1 Inch (25 mm): Maximum span, 7 feet (2100 mm); minimum rod size, 1/4 inch (6 mm).
 2. 1-1/4 Inches (32 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
 3. 1-1/2 Inches (40 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).
 4. 2 Inches (50 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).
 5. 2-1/2 Inches (65 mm): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9 mm).
 6. 3 Inches (80 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 3/8 inch (9 mm).
 7. 4 Inches (100 mm): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
 8. 6 Inches (150 mm): Maximum span, 17 feet (5.1 m); minimum rod size, 1/2 inch (13 mm).

END OF SECTION

**SECTION 23 21 14
HYDRONIC SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air vents.
- B. Suction diffusers.
- C. Balancing valves.

1.02 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- C. Manufacturer's qualification statement.
- D. Project Record Documents: Record actual locations of flow controls.
- E. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in installation of the type of products specified in this section, with minimum three years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Accept Specialties on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on devices, piping and fittings. Maintain in place until installation.
- C. Protect piping systems and equipment from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 AIR VENTS

- A. Manual Air Vent: Short vertical sections of 2-inch (50 mm, DN) diameter pipe to form air chamber, with 1/8 inch (6 mm, DN) brass needle valve at top of chamber.

2.02 SUCTION DIFFUSERS

- A. Manufacturers:
 - 1. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
 - 2. Substitutions: See Division 1
- B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch (50 mm) and smaller, flanged for 2-1/2 inch (65 mm, DN) and larger, rated for 175 psi (1200 kPa) working pressure, with inlet vanes, cylinder strainer with 3/16 inch (5 mm) diameter openings, disposable 5/32 inch (4 mm) mesh strainer to fit over cylinder strainer, 20 mesh startup screen, and permanent magnet located in flow stream and removable for cleaning. Unit shall be provided with adjustable support foot to carry the weight of suction piping

2.03 PUMP CONNECTORS

- A. Manufacturers:
 - 1. The Metraflex Company; SLPC: www.metraflex.com/#sle. (Suction)
 - 2. The Metraflex Company; Vane Flex: www.metraflex.com/#sle. (Discharge)

- B. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
 - 1. Maximum Operating Service: 150 psi (1030 kPa) at 240 degrees F (115.6 degrees C).
 - 2. Accommodate the Following:
 - a. Axial Deflection in Compression and Expansion: 1/8 inch (3.75 mm).
 - b. Lateral Movement: 3/8 inch (9.525 mm).
 - c. Angular Rotation: 15 degrees.
 - d. Force developed by 1.5 times specified maximum allowable operating pressure.
 - 3. End Connections: Same as specified for pipe jointing.
 - 4. Provide pump discharge connector with integral vanes to reduce turbulent flow.

2.04 BALANCING VALVES

- A. Manufacturers:
 - 1. ITT Bell & Gossett: Model Circuit Setter: www.bellgossett.com.
- B. Construction:
 - 1. 1/2" to 2" Pipe Size
 - a. Bronze body, brass ball construction with glass and carbon filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports shall have integral EPT insert and check valve. Valve bodies shall have 1/4" tapped drain/purge point. Valve to have memory stop feature and integral calibrated nameplate with position indication. 300 psig design pressure, NPT connections. 250 F operating temperature.
 - 2. 2-1/2" to 12" Pipe Size
 - a. Cast iron, flanged construction with 125 psig flanged connections suitable up to 175 psig working pressure at 250 F. Valves 2-1/2" - 3" shall have a brass ball with glass and carbon filled TFE seat rings. Valves 4" - 12" shall be fitted with a bronze seat, replaceable bronze disc with EPDM seal insert, and stainless steel stem. Valves shall have memory stop feature and calibrated nameplate with position indication.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install specialties and equipment in accordance with manufacturer's instructions.
- B. Provide manual air vents at system high points and as indicated.
- C. Provide pump suction fitting on suction side of base-mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.
- D. Support pump fittings with floor-mounted pipe and flange supports.

END OF SECTION

SECTION 23 21 23 HYDRONIC PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. End-suction pumps.

1.02 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Millwright's Certificate: Certify that base mounted pumps have been aligned. Submit alignment report.
- D. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
- E. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.
- B. Installers Qualifications: Company specializing in manufacture, assembly, field alignment and adjustment and performance of pumps, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com/#sle.
- B. Substitutions: See Division 1 for substitution requirements and submittals.

2.02 GENERAL

- A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Base Mounted Pumps: Aligned by qualified millwright.
- C. Electrical Requirements:
 - 1. Listed and classified by UL as suitable for the purpose specified and indicated.

2.03 END-SUCTION PUMPS

- A. End Suction Pump:: Base-mounted, single-stage pump with horizontal shaft and radially- or horizontally-split casing rated for discharge pressures up to 175 psi (1200 kPa).
- B. Close-Coupled Pump: Base-mounted, single-stage pump with horizontal shaft and radially-split casing rated for discharge pressures up to 175 psi (1200 kPa).
- C. Casing: Cast iron or ductile iron with renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction, and discharge flanged connections with gauge ports.
- D. Impeller: Stainless steel, balanced, fully enclosed, keyed to shaft.

- E. Bearings: Grease lubricated roller or ball bearings.
- F. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.
- G. Seal: Mechanical, 225 degrees F (107 degrees C) maximum continuous duty temperature.
- H. Drive: Flexible coupling with coupling guard.
- I. Baseplate: Cast iron or fabricated steel with integral drain rim.
- J. Performance:
 - 1. See Contract Drawings for pump schedules.
- K. Electrical:
 - 1. See Contract Drawings for pump schedules.
 - 2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
- C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over.
- D. Provide line sized shut-off valve and suction diffuser (with strainer) on pump suction, and line sized check and shut off valve on pump discharge.
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Provide drains for bases and seals, piped to and discharging into floor drains.
- G. Check, align, and certify alignment of base-mounted pumps prior to start-up. Provide alignment report for each pump. Comply with alignment procedures on vertical turbine pumps per manufacturer's written instruction.
- H. Provide pump anchorage as required by manufacturer and as shown on drawings.
- I. Fully grout all frame bases after pump alignment.
- J. Lubricate pumps before start-up.
- K. Controls: Interface each new pump to the existing motor starter and existing DDC building management system. Intercept and extend existing conduits and wires as necessary.
- L. Electrical: Intercept and extend existing conduit and wires as necessary to feed new motor. Sizes of conduit and wires to match existing. Verify existing motor starter, breaker, overload protection are sized adequately for the new electric motor. Replace equipment as necessary to match new pump motor requirements.

END OF SECTION

**SECTION 23 25 00
HVAC WATER TREATMENT**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Materials.
 - 1. Materials as required to replenish or re-concentrate affected systems during construction progress.

1.02 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- C. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Utilize Treatment company regularly employed by District to maintain temporary systems protected under the contract.

2.02 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.
- B. Perform work in accordance with local health department regulations.

2.03 MATERIALS

- A. Compatible with existing water treatment program.
- B. Provide rental/temporary water treatment equipment such as feeders, test points, injection ports, containment systems for all temporary heating and cooling plants used for the project.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.
- C. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.03 CLOSED SYSTEM TREATMENT

- A. Replenish and continue chemical treatment of hydronic heating and cooling systems affected by this project.

END OF SECTION