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SECTION 23 2010 - HVAC PIPING VALVES AND ACCESSORIES

Maintain Section format, including the UH master spec designation and version date in bold in the center columns of the header and footer. Complete the header and footer with Project information.

Edit and finalize this Section, where prompted by Editor's notes, to suit Project specific requirements. Make selections for the Project at text identified in **bold**.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
 - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide HVAC piping valves and accessories as specified and indicated.
- B. Types: The types of HVAC piping valves and accessories required for the project include, but are not limited to:
 - 1. Valves.
 - 2. Strainers.
 - 3. Unions.
 - 4. Flanges.
 - 5. Gaskets.
 - 6. Flexible connections.
 - 7. Flexible hose.
 - 8. Hose balancing kits.
 - 9. Compression/Expansion tanks.
 - 10. Air elimination.
 - 11. Air vents.

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- 12. Steam specialties.
- 13. Pipe expansion joints.
- 14. Gauges and thermometers.
- 15. Btu metering.
- 16. Flow venturis.
- 17. Drain pans.

1.3 SUBMITTALS:

- A. Submittals shall include, but not be limited to, the following:
 - 1. Cut sheets on all valves, strainers, unions, flanges, gaskets, flexible hose, hose balancing kits, compression/expansion tanks, air elimination, air vents, steam specialties, gauges and thermometers, Btu metering, and flow venturis clearly showing all ratings, capacities and features.
 - 2. Valve samples, when requested.
 - 3. Additional information as required in Section 23 01 00.

1.4 DELIVERY, STORAGE AND HANDLING:

- A. Store HVAC piping valves and accessories in their factory-furnished coverings, and in a clean, dry indoor space which provided protection against the weather.

PART 2 - PRODUCTS

2.1 VALVES:

- A. General: All valves shall be similar to numbers listed. All similar type and size valves shall be products of one manufacturer
- B. Applications: Valve application shall be as follows:

<u>Service</u>	<u>Application</u>	<u>Type</u>
Chilled Water, Heating Hot Water, Condenser Water and Glycol	Shutoff/Balancing Shutoff/Balancing Check	Ball Butterfly Silent Check
Steam and Steam Condensate	Shutoff Throttling Check	Gate Globe/Needle Swing Check

- C. Pressure Ratings:

<u>System</u>	<u>Working Pressure</u>	<u>Operating Temperatures</u>
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Chilled Water[/Glycol]

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High	300 psig	40°F to 60°F
Medium	300 psig	40°F to 60°F
Low	150 psig	40°F to 60°F
 Condenser Water		
High	300 psig	65°F to 100°F
Medium	300 psig	65°F to 100°F
Low	150 psig	65°F to 100°F
 Heating Hot Water		
High	300 psig	100°F to 180°F
Medium	300 psig	100°F to 180°F
Low	150 psig	100°F to 180°F

Steam/Steam Relief	[150 psig]	[212°F to 375°F]
Steam Condensate/Condensate Vent	[150 psig]	[150°F to 250°F]
Temperature Control Air	20 to 200 psig	

* Pressures		
High	= Floors [] through []	
Medium	= Floors [] through []	
Low	= Floors [] through []	

- D. Insulated Piping: Stems on all valves installed in insulated piping shall be extended to allow adequate clearance between the operator and the insulation specified for the piping system when the valve is installed. Provide stems with a stationary protective sleeve or neck to prevent damage to insulation or vapor barrier when valve is opened or closed.
- E. Chain Operators: Chain operators shall be provided for all valves installed over eight feet (8') above finished floor in the central plant, fan rooms, mechanical rooms, and other areas where valves are exposed.
- F. Flanges: Valve flanges and companion flanges for all valve applications shall be compatible with the valve rating and the system pressure at the point of application. Flanges shall conform to ASME B16.1 and ASME B16.10.
- G. General Requirements:
 - 1. All valves shall be of threaded or flanged type. No solder connected valves shall be used on this project. All bronze and iron body gate and globe valves shall be of one manufacture for each project. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacture, all ball valves shall be of the same manufacture, etc.
 - a. Valves may be grooved or mechanical coupling type if piping system the valve is installed is joined by grooved or mechanical couplings.

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2. All valves at system points where the System Working Pressure (SWP) at the point of application, including appropriate pump shutoff head, does not exceed 150 psi, may use Class 150 valves.
3. All bronze gate valves for pressures up to 150 psi shall be ASTM B62 composition bronze. Bronze valves for pressures above 150 psi shall be ASTM B61 steam bronze. All bronze valves shall be union or screw over bonnet, rising stem type with ASTM B-99 alloy 651 or ASTM B371 alloy 694 or equal stem material
4. All bronze ball valves for pressures up to 300 psi shall be ASTM B62 composition bronze or ASTM B584 alloy 844.
5. All iron body valves shall have the pressure containing parts constructed of ASTM A126 Class B cast iron. Stem material shall meet ASTM 584 alloy 876 or ASTM 371 Alloy 694 silicon bronze, B-16 Alloy or its equivalent. All iron body gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design.
6. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron handwheels, except iron body valves 2-1/2" and larger which may have either malleable iron or ASTM A126 Class B, gray iron handwheels.
7. Packing for all valves shall be selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service. At the end of one-year period, spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked at no expense to the Owner with a packing material selected by the Owner.
8. Valves located with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 at Boss G to accommodate a drain valve.

H. HVAC Valves for Service at or Less Than 150 PSIG:

1. Ball Valves:

- a. Ball valves shall be two-piece with a full line size (full port) [**chromium plated brass**] [**316 stainless steel**] balls [**and stems**] [, **brass stems**], and reinforced seats and stuffing box rings. All ball valves shall be designed to permit repacking while valve is in line. Valves shall be furnished with blowout-proof stems. Valves used for balancing shall be provided with balancing stops.
- b. Ball valves 2" and smaller shall be threaded body bronze or brass valves of a [**standard**] [**full**] port design. Valves shall be rated for 300 psi WOG and shall conform to Federal Specification WW-V-35B and shall be:
 - 1) Apollo No. 70-100 Series [Standard Port].
 - 2) Crane No. 9032 Series [**Standard Port**].
 - 3) Nibco No. T-585 Series [**Full Port**].
 - 4) Red and White No. 5044F Series [**Full Port**].

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5) Stockham No. S-216-BR-R-T [**Standard Port**].

6) KITZ No. 68 Series [**Full Port**]

7) Milwaukee 400S

c. HVAC diversion valves 2" and smaller shall be three-way diversion type ball valves, bronze body, 300 psig non-shock WOG at 200°F, Apollo 70-600 Series, Red and White No. 5045 or equal.

2. Butterfly Valves:

a. All butterfly valves shall be full tapped and threaded lug type, manufacturer certified for bubble-tight, dead end shut off from either direction at design working pressure and temperature without need for downstream flange. Valves 2-1/2" through 5" in size shall have lever type operators with memory stops. Valves 6" and larger and all valves requiring chain operators, shall have enclosed, self-locking wheel-operated worm gear type, waterproof, factory-lubricated operators. Gear segment shall be manganese bronze or ductile iron with a steel or ductile iron worm and oil impregnated bronze bushings or worm shaft. Operators shall have built-in adjustable mechanical stops and position indicators. Valves used for balancing shall be certified suitable for continuous throttling service.

b. Valves 2-1/2" and larger shall be 200 psig non-shock WOG at 200°F, ANSI Class 150 with ductile iron lug body, EPDM (EPT) seat, silicon or aluminum bronze disc, 316 or 416 stainless steel upper and lower stems (stems shall be positively connected to the valve disc) and EPDM (EPT) stem seals or shall have single piece disc core/drive stem of EPDM encapsulated ductile iron. Valves shall be:

- 1) Centerline No. LT Series.
- 2) Demco No. NE Series 250 psi lug body.
- 3) Dezurik No. 660, L, RS82, 3, *.
- 4) Jenkins No. 232EL/EG.
- 5) Nibco No. LD 2000.
- 6) Nibco No. GD 3765.
- 7) Red and White No. [918-B-E-M-*] [938-BN5L/G-*].
- 8) Stockham No. LD7*2B52E.
- 9) Victaulic Style VIC-300.
- 10) KITZ No. 6123E
- 11) Milwaukee ML233E Lever Milwaukee
- 12) Milwaukee ML333E Gear

3. Gate Valves:

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- a. Valves 2" and smaller shall be 150 psi SWP, 300 psi WOG rated, all bronze gate valves with solid wedge, union bonnet, inside screw, traveling stem and threaded connections. Valves shall conform to MSS SP-80 and shall be:
 - 1) Crane No. 431 UB.
 - 2) Jenkins No. 47-U.
 - 3) Lunkenheimer No. 3151.
 - 4) Nibco No. T-134.
 - 5) Red and White No. 298.
 - 6) Stockham No. B-120.
 - 7) Walworth No. 11.
 - 8) KITZ No. 42T
 - 9) Milwaukee 1151

- b. Valves 2-1/2" and larger shall be flanged bronze mounted Class 125 iron body, outside screw and yoke gate valves with bolted bonnets and solid wedges. Valves 4" and larger for steam service shall be provided with warm-up bypass valves. Valves shall be rated for 125 psi SWP and shall conform to MSS SP-70 and shall be:
 - 1) Crane No. 465-1/2.
 - 2) Jenkins No. 651-C.
 - 3) Lunkenheimer No. 1430.
 - 4) Nibco No. F-617-0.
 - 5) Red and White No. 421.
 - 6) Stockham No. G-623.
 - 7) Walworth No. 8726-F.
 - 8) KITZ No. 72
 - 9) Milwaukee 2885A

- c. Valves 2-1/2" and larger shall be flanged bronze mounted Class 250 iron body, outside screw and yoke gate valves with bolted bonnets and solid wedges. Valves 4" and larger for steam service shall be provided with warm-up bypass valves. Valves shall be rated for 250 psi SWP and shall conform to MSS SP-70 and shall be:
 - 1) Crane No. 7-1/2E.
 - 2) Jenkins No. 204.
 - 3) Lunkenheimer No. 1436.
 - 4) Nibco No. F-667-0.

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- 5) Stockham No. F-667.
 - 6) Walworth No. 8786-F
 - 7) Milwaukee 2894a
4. Needle Valves: Valves one inch (1") and smaller shall be Mueller Steam Company Type 21 female-female globe type brass needle valves rated for 500 psi at 150°F and 100 psi saturated steam.
5. Globe Valves:
- a. Valves 2" and smaller shall be 150 psi SWP, 300 psi WOG rated, all bronze globe valves with renewable disc, screw over or union bonnet and threaded connections. Valves shall conform to MSS SP-80 and shall be:
 - 1) Crane No. 7TF.
 - 2) Jenkins No. 106-A.
 - 3) Lunkenheimer No. 123.
 - 4) Nibco No. T-235-Y.
 - 5) Red and White No. 221.
 - 6) Stockham No. B-22-T.
 - 7) Walworth No. 3095.
 - 8) KITZ No. 09
 - 9) Milwaukee 590T
 - b. Valves 2" and smaller for bypass or throttling service shall be 150 psi SWP, 300 psi WOG rated, all bronze globe valves stainless steel plug disc and seat ring, union bonnet and threaded connections. Valves shall conform to MSS SP-70 and shall be:
 - 1) Crane No. 14-1/2-P.
 - 2) Jenkins No. 546-P.
 - 3) Lunkenheimer No. LQ-600-150.
 - 4) Nibco No. T-276-AP.
 - 5) Stockham No. B-29.
 - 6) Walworth No. 3237-P.
 - 7) KITZ No. 17S
 - 8) Milwaukee 593A
 - c. Angle and Y-pattern globe valves corresponding to the standard globe valve models specified above may be used where more suited to the installation location.

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- d. Valves 2-1/2" and larger shall be flanged bronze mounted Class 125 iron body, outside screw and yoke globe valves with bolted bonnets and renewable seat and disc. Valves shall be rated for 125 psi SWP and shall conform to MSS SP-85 and shall be:
 - 1) Crane No. 351.
 - 2) Jenkins No. 613-B.
 - 3) Lunkenheimer No. 1123.
 - 4) Nibco No. F-718-B.
 - 5) Red and White No. 400.
 - 6) Stockham No. G-512.
 - 7) Walworth No. 8906-F.
 - 8) KITZ No. 76
 - 9) Milwaukee 2981A
 - e. Valves 2-1/2" and larger shall be flanged bronze mounted Class 250 iron body, outside screw and yoke globe valves with bolted bonnets and renewable seat and disc. Valves shall be rated for 250 psi SWP and shall conform to MSS SP-85 and shall be:
 - 1) Crane No. 21E.
 - 2) Jenkins No. 923.
 - 3) Lunkenheimer No. 884.
 - 4) Nibco No. F-768-B.
 - 5) Stockham No. F-532.
 - 6) Walworth No. 8955-F.
 - 7) Milwaukee 2983M
6. Check Valves:
- a. Silent Check Valves: 2-1/2" and larger shall be non-slam type ASTM A126 Class B cast iron body, bronze or stainless steel fitted wafer style spring check valves. Valves shall be ASA Class 125/150 rated and shall be:
 - 1) Mission Duo-Check II Type.
 - 2) Mueller Sure Check Type.
 - 3) Nibco No. W-920-W.
 - 4) Red and White Fig. No. 442.
 - 5) Stockham No. WG-970.
 - 6) Techno Corporation 5050 Series.

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- 7) Victaulic 716/W715.
 - 8) KITZ 7022.
 - 9) Milwaukee 8800.
- b. Swing Check Valves: 2" and smaller for low velocity, non-pulsating applications shall be 150 psi SWP rated all bronze swing check valves with regrinding bronze disc and threaded connections. Valves shall conform to MSS SP-80 and shall be:
1. Crane No. 141.
 2. Jenkins No. 352-C.
 3. Lunkenheimer No. 230.
 4. Nibco No. T-433-B.
 5. Red and White Fig. No. 238.
 6. Stockham No. B-321.
 7. KITZ No. 29.
 8. Milwaukee 508.
- b. Lift Check Valves: 2" and smaller for pulsing applications shall be 150 psi SWP rated all bronze spring-loaded lift check valves with renewable composition disc and threaded connections. Valves shall conform to MSS SP-80 and shall be:
- 1) Jenkins No. 655-A.
 - 2) Milwaukee 548T
- c. Swing Check Valves: 2-1/2" and larger shall be 125 psi SWP rated, iron body, bronze fitted swing check valves with re-grindable and renewable seats and discs and Class 125 flanged connections. Valves shall conform to MSS SP-71 and shall be:
- 1) Crane No. 373.
 - 2) Jenkins No. 624-C.
 - 3) Lunkenheimer No. 1790.
 - 4) Nibco No. F-918-B.
 - 5) Red and White No. 435.
 - 6) Stockham No. G-931.
 - 7) Walworth No. 8928-F.
 - 8) KITZ No. 78
 - 9) Milwaukee

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- d. Swing Check Valves: 2-1/2" and larger shall be 250 psi SWP rated, iron body, bronze fitted swing check valves with re-grindable and renewable seats and discs and Class 250 flanged connections. Valves shall conform to MSS SP-71 and shall be:
 - 1) Crane No. 39-E.
 - 2) Jenkins No. 339-R.
 - 3) Lunkenheimer No. 323.
 - 4) Nibco No. F-968-B.
 - 5) Stockham No. F-947.
 - 6) Walworth No. 8970-F..
 - 7) Milwaukee
- e. All swing check valves shall be installed in vertical piping only. Allow adequate pipe clearance to allow for proper valve operation.

I. HVAC Valves for Service Over 150 PSIG:

[VERIFY REQUIREMENTS]

1. Ball Valves:

- a. Ball valves shall be two-piece with a full line size (full port) **[chromium plated brass] [316 stainless steel] balls [and stems] [, brass stems]**, and reinforced seats and stuffing box rings. All ball valves shall be designed to permit repacking while valve is in line. Valves shall be furnished with blowout-proof stems. Valves used for balancing shall be provided with balancing stops.
- b. Ball valves 2" and smaller shall be threaded two-piece body bronze or brass valves of a **[standard] [full]** port design. Valves shall be rated for 300 psi WOG and shall conform to Federal Specification WW-V-35B and shall be:
 - 1) Apollo No. 77-100 **[Standard Port]**.
 - 2) Crane No. 903TF [Standard Port].
 - 3) Nibco No. T-585 **[Full Port]**.
 - 4) Red and White No. 5044F **[Full Port]**.
 - 5) Stockham No. S216-BR-R-T **[Standard Port]**.
 - 6) Victaulic 722 **[Standard Port]**.
 - 7) KITZ No. 68 Series **[Full Port]**
 - 8) Milwaukee BA 400S
- c. HVAC diversion valves 2" and smaller shall be three-way diversion type ball valves, bronze body, 300 psig non-shock WOG at 200°F, Apollo 70-600 Series or equal.

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2. Butterfly Valves:

- a. All butterfly valves shall be full tapped and threaded lug type, manufacturer certified for bubble-tight, dead end shut off from either direction at design working pressure and temperature without need for downstream flange. Valves 2-1/2" through 5" in size shall have lever type operators with memory stops. Valves 6" and larger and all valves requiring chain operators, shall have enclosed, self-locking wheel-operated worm gear type, waterproof, factory-lubricated operators. Gear segment shall be manganese bronze or ductile iron with a steel or ductile iron worm and oil impregnated bronze bushings or worm shaft. Operators shall have built-in adjustable mechanical stops and position indicators. Valves used for balancing shall be certified suitable for continuous throttling service.
- b. Valves 2-1/2" and larger shall be 285 psig non-shock WOG at 200°F, ANSI Class 150 with ductile iron or carbon steel lug body, EPDM (EPT) or TFE replaceable seat, silicon bronze, aluminum bronze or stainless steel disc, 316 or 416 stainless steel upper and lower stems (stems shall be positively connected to the valve disc) and EPDM (EPT) or TFE stem seals or shall have single piece disc core/drive stem of EPDM encapsulated ductile iron. Valves shall be:
 - 1) Centerline No. B285 Series.
 - 2) Dezurik No. 644, L, E, SSI, 3, *.
 - 3) Milwaukee HP1LCS4212 Lever
 - 4) Milwaukee HP1LCS42123 Gear

3. Gate Valves:

- a. Valves 2" and smaller shall be 300 psi SWP rated, all bronze gate valves with solid wedge, union bonnet, inside screw, traveling stem and threaded connections. Valves shall conform to MSS SP-80 and shall be:
 - 1) Crane No. 634E.
 - 2) Jenkins No. 270-U.
 - 3) Nibco No. T-174-A.
 - 4) Stockham No. B-144.
 - 5) Walworth No. 55.
 - 6) KITZ No. 37
 - 7) Milwaukee 1182
- b. Valves 2-1/2" and larger shall be flanged bronze mounted Class 250 iron body, outside screw and yoke gate valves with bolted bonnets and solid wedges. Valves 4" and larger for steam service shall be provided with warm-up bypass valves. Valves shall be rated for 250 psi SWP and shall conform to MSS SP-70 and shall be:
 - 1) Crane No. 7-1/2E.

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- 2) Jenkins No. 204.
 - 3) Lunkenheimer No. 1436.
 - 4) Nibco No. F-667-0.
 - 5) Stockham No. F-667.
 - 6) Walworth No. 8786-F.
 - 7) Milwaukee 2894A
4. Needle Valves: Valves one inch (1") and smaller shall be Mueller Steam Company Type 21 female-female globe type brass needle valves rated for 500 psi at 150°F and 100 psi saturated steam.
5. Globe Valves:
- a. Valves 2" and smaller shall be 250 psi SWP rated, all bronze globe valves with renewable disc, screw over or union bonnet and threaded connections. Valves shall conform to MSS SP-80 and shall be:
 - 1) Crane No. 229-C.
 - 2) Jenkins No. 801.
 - 3) Nibco No. T-275-Y.
 - 4) KITZ No. 18
 - 5) Milwaukee 572
 - b. Valves 2" and smaller for bypass or throttling service shall be 300 psi SWP rated, all bronze globe valves with renewable re-grindable stainless steel plug disc, and seat ring, union bonnet and threaded connections. Valves shall conform to MSS SP-70 and shall be:
 - 1) Crane No. 382P.
 - 2) Jenkins No. 556-P.
 - 3) Lunkenheimer No. 16-PS.
 - 4) Nibco No. T-276-AP.
 - 5) Stockham No. B-74.
 - 6) Walworth No. 3260-P.
 - 7) KITZ No. 17S
 - 8) Milwaukee 593A
 - c. Angle and Y-pattern globe valves corresponding to the standard globe valve models specified above may be used where more suited to the installation location.

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- d. Valves 2-1/2" and larger shall be flanged bronze mounted Class 250 iron body, outside screw and yoke globe valves with bolted bonnets and renewable seat and disc. Valves shall be rated for 250 psi SWP and shall conform to MSS SP-85 and shall be:
 - 1) Crane No. 21E.
 - 2) Jenkins No. 923.
 - 3) Lunkenheimer No. 884.
 - 4) Nibco No. F-768-E.
 - 5) Stockham No. F-532.
 - 6) Walworth No. 8955-F.
6. Check Valves:
 - a. Silent Check Valves: Valves 2-1/2" and larger shall be non-slam type ASTM A126 Class B cast iron body, bronze or stainless steel fitted wafer style spring check valves with renewable seats and discs. Valves shall be ASA Class 250/300 rated and shall be:
 - 1) Mission Duo-Check II Type.
 - 2) Mueller Sure Check Type.
 - 3) Nibco No. W-960-B.
 - 4) Stockham No. WG-970.
 - 5) Techno Corporation 5050 Series.
 - b. Swing Check Valves: Valves 2" and smaller shall be 300 psi SWP rated all bronze swing check valves with regrinding bronze disc and threaded connections. Valves shall conform to MSS SP-80 and shall be:
 - 1) Crane No. 76E.
 - 2) Jenkins No. 762-A.
 - 3) Lunkenheimer No. 624.
 - 4) Nibco No. T-473-B.
 - 5) Stockham No. B-364.
 - 6) Walworth No. 3428.
 - 7) KITZ No. 19
 - 8) Milwaukee 507
 - c. Swing Check Valves: Valves 2-1/2" and larger shall be 250 psi SWP-rated, iron body, bronze fitted swing check valves with re-grindable and renewable seats and discs and Class 250 flanged connections. Valves shall conform to MSS SP-71 and shall be:
 - 1) Crane No. 39-E.

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- 2) Jenkins No. 339-R.
- 3) Lunkenheimer No. 323.
- 4) Nibco No. F-968-B.
- 5) Stockham No. F-947.
- 6) Walworth No. 8970-F.
- 7) Milwaukee 2970M

- d. All swing check valves shall be installed in vertical piping only. Allow adequate pipe clearance to allow for proper valve operation.

[VERIFY REQUIREMENTS]

- J. Automatic Flow Control Valves: Flow control valves shall be factory-calibrated, direct acting, automatic pressure compensating type. Each valve shall limit flow rates to within _5% accuracy, regardless of system pressure fluctuations. Valve control mechanism shall consist of a tamperproof, stainless steel cartridge assembly with open chambers and unobstructed flow passages. Cartridge assembly shall include a self-cleaning, spring-loaded moving cup guided at two separate points and shall utilize the full available differential pressure to actuate without hysteresis or binding. Four differential pressure ranges shall be available with the minimum range requiring less the 2 psig. Each valve to be provided with a metal tag, chain and stamped for system identification. Pressure taps and quick disconnect valves shall be provided with ferrous bodies. All hydronic system flow control valves shall be of one manufacturer.
- K. Valves for Automatic Water Make-up Connections: Valves 2" and smaller shall be Jenkins Fig. No. 900T or equal. Valves 2-1/2" and larger shall be Jenkins Fig. No. 632B, No. 632E or equal butterfly valve with operator.
- L. Relief Valves: The pressure relief valves installed for the protection of the water circulating circuits shall be Watts Regulator Company Series 174A or Series 740. Valve body shall be constructed of ASTM B 61 or ASTM B 62 bronze or ASTM A126 cast iron. Valve shall be ASME rated direct spring-loaded type, level operated, non-adjustable factory set discharge pressure. Pressure relief valve shall be suitable for the maximum system operation pressure and temperature encountered. Size valve as indicated on drawings.
- M. Refrigerant Valves and Specialties:
 1. Valves and specialties shall be as manufactured by Mueller, Sporlan or an approved substitution and shall be as follows:
 - a. Refrigerant Shut-off Valves Mueller Series A-15250, size as required.
 - b. Refrigerant Strainers Sporlan Type 10000 "Y", size and type as required.
 - c. Refrigerant Relief Valves Mueller Safety master, size and type as required.
 - d. Filter/Dryers Sporlan "Catch-All" scaled type, size as required.
 - e. Sight-glass-moisture Indicator Sporlan "See All", size as required.

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- f. Solenoid Valves Sporlan Type A3, size as required.
- g. Thermostatic Expansion Valves Sporlan, size and type as required.
2. Not all of the above specialties are required on all systems, but all systems shall have shut-off valves, a relief valve, a filter/dryer and a sight-glass-moisture indicator. Where such items are furnished unit mounted on equipment, they may be deleted from the external piping circuit with the following exception:
 - a. A filter/dryer shall always precede a solenoid valve in the liquid line.
 - b. Charging valves in equipment shall not be construed as alternates to shut-off valves.

2.2 STRAINERS

A. General: Strainers shall be as follows:

1. 150 PSIG Working Pressure Water Strainers: 150 psig working pressure, 2" and smaller, shall be Mueller No. 11M or equal, 400 pounds WOG, cast iron body with perforated 20 mesh monel screen with cleanout and screwed ends. 150 psig working pressure, 2-1/2" through 24", shall be Mueller No. 758 or equal, 150 pounds WOG, perforated monel screen with 1/16" perforations for sizes through 4", and 5/32" perforations for 5" and above, with blowdown connection, and Class 125 ASME B16.1 flanged ends. Blowdown valves shall be full port ball valves.
2. 300 PSIG Working Pressure Water Strainers: 300 psig working pressure, 2" and smaller, shall be Mueller No. 11 or equal, 400 pounds WOG, cast iron body with perforated 20 mesh monel screen with cleanout and screwed ends. 300 psig working pressure, 2-1/2" to 24", shall be Mueller No. 752 or equal, 300 pounds WOG, perforated metal monel screen with 1/16" perforations in sizes through 4", and 5/32" perforations for 5" and above, with blowdown connection, and Class 250 ANSI B16.5 flanges. Blowdown valves shall be full port ball valves.
3. 150 PSIG Working Pressure Duplex Basket Water Strainers: 150 psig working pressure, 3" and smaller, Mueller No. 692 Series or equal, 200 psi WOG cast iron body, 150 pound ASME B16.1 flanges, dual 40 mesh stainless steel strainer baskets, diverter valve. Blowdown valves shall be full port ball valves.
4. 150 PSIG Working Pressure Steam Strainers: 150 psig working pressure, 2" and smaller, shall be Mueller No. 11 or equal, 250-pound steam, cast iron body with perforated 20 mesh monel screen with cleanout and screwed ends. 150 psig working pressure, 2-1/2" through 24", shall be Mueller No. 752 or equal, 250-pound steam, perforated monel screen with 1/16" perforations for sizes through 4", and 5/32" perforations for 5" and above, with blowdown connection, and Class 250 ASME B16.5 flanged ends. Blowdown valves shall be full port ball valves.

- #### B. Pump Suction Diffusers: Provide Taco Series 300 or approved equal 150 psi WOG pump strainer/suction diffusers. Diffusers shall consist of an angle body with inlet vanes and a combination **[monel] [304 stainless steel]** diffuser strainer with 3/16" diameter openings. Flow direction shall be from inside the strainer to outside. The diffuser body shall fit the pump and connecting piping size and shall be provided with an adjustable support foot. Suction diffusers shall be factory-drilled and tapped for field-installation of a pressure gauge and gauge cock as shown on the

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drawings. Where suction diffusers are provided, strainers may be omitted. Blowdown valves shall be full port ball valves.

2.3 FLEXIBLE CONNECTIONS:

- A. General: Refer to Specification Section 23 0548, "Vibration Isolation", for flexible connections.

2.4 FLEXIBLE HOSE:

- A. General: Provide flexible hose in piping systems where shown on the Drawings or specified under Division 23.
- B. Flexible Hose: Provide pressure rated, wire helix reinforced, flexible, insulated rubber hose kits for final chilled water connections to CRAC units as shown on the Drawings. Hose kits shall be fabricated in lengths as required to suit site conditions, twenty feet (20') maximum, with ASME Class 150 flanged connections at both ends. Coordinate flange pattern with existing flanges on site. Hose kits shall be nominal 2-1/2" pipe size. Flange end fittings, hose connection fittings and hose shall be pressure rated as a unit for a minimum of 150 psi standard operating pressure, 275 psi minimum burst pressure and 275 psi minimum hose/fitting leak or separation. Hoses shall be insulated using 1/2" elastomeric insulation with a continuous vapor barrier. Insulation shall have a maximum flame spread of 25 and a maximum smoke developed of 100, as installed. Hoses shall be installed and supported as recommended by the manufacturer. Hoses shall be manufactured by Motion Industries; HoseTex, Texas; Houston, Inc., Houston, Texas; Allied Hose and Specialty Company, Houston, Texas; Coastal Rubber Company, Houston, Texas; Houston Gasket, Houston, Texas or an approved equal. Details of all components and hose kits construction shall be submitted for approval prior to fabrication.

2.5 HOSE BALANCING KITS:

- A. General: Provide an automatic balancing hose kit for each **[heating hot water and]** chilled water connections to fan coil units **[and heating hot water connections to HVAC Terminal Units]**. Hoses shall be flexible, stainless steel braided hose, minimum length of 24" and shall have brass swivel end connection a minimum of 3/4" MPT suitable for a pressure differential of 4 psi through 57 psi and a flow rate range of 1.0 through 10.0 gpm.
- B. Components: Each automatic balancing hose kit shall consist of a return hose with a 3/4" bronze ball valve, a 3/4" automatic flow control valve with two P-T test plugs, a 3/4" x 24" long flexible stainless braided hose with 3/4" MPT brass swivel end and a supply hose with a 3/4" bronze ball valve a 3/4" P-T Adaptor connector with a P-T Test plug, a 3/4" bronze Wye-strainer with built-in drain valve, a 3/4" x 24" long flexible stainless braided hose with 3/4" MPT brass swivel adapter.
- C. Ratings: Hose kits shall meet flame retardant testing standards similar to UL No. 723, NFPA No. 255, ANS No. 3.5, UBC No. 42-1 and ASTM E84. Manufacturer shall provide independent laboratory tests verify compliance with these standards or UL-listing and label for flame spread zero (0) and smoke density zero (0). Minimum pressure and temperature rating of automatic hose balancing kits shall be 200 psig at 230°F.

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- D. Control Valves: Automatic Flow Control Valves shall automatically control flow rates with _5% accuracy. Valve control mechanism shall consist of a passivated, stainless steel cartridge with a ported cup, segmented orifices and full travel linear coil spring and a ductile iron housing with 1/8" FPT taps for P.T. plugs. The inner tube is a nontoxic synthetic polymer suitable for water temperatures from 5°F to 230°F. The tube has an outer covering of braided stainless steel. Y-Strainer-Bronze Body with stainless steel cylinder screen, 0.055" diameter holes.
- E. Manufacturers: Automatic Balancing hose kits shall be as manufactured by Griswold Controls or approved substitution.
- F. Meter: Provide a differential pressure meter calibrated for flow in gpm for initial balance as well as for the Engineer to verify balance. This meter shall be turned over to the Owner during the Owner training period.

2.6 COMPRESSION/EXPANSION TANKS:

- A. General: Provide a diaphragm-type pre-pressurized expansion tank with replaceable bladder. Each tank shall accommodate the expanded/compressed water of the connected system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. It shall maintain minimum operating pressure necessary to eliminate all air. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. Tank size shall be as indicated on the drawings.
- B. Tanks: Provide 125 psig or greater, ASME construction, expansion, compression tanks complete with drain fitting, lifting lugs, base ring, pipe connections, and charging connection. Pressure rating shall be compatible with the system pressure. The tank shall be a diaphragm-type, hydro-pneumatic expansion/ compression tank designed for the indicated services. The tank shall be constructed of welded steel and equipped with a flexible, replaceable diaphragm to maintain a separation between the system water and the air cushion. The outside of each tank shall be factory-painted with a primer and two coats of enamel after fabrication. Each tank shall bear an appropriate ASME label for the system working pressures and temperatures.
- C. Manufacturers: Tanks manufactured by Amtrol, Armstrong, Taco, or Woods Industrial and meeting the above specifications will be acceptable.

2.7 AIR ELIMINATION:

- A. Air Separators (Tangential Type): All free air originally contained in each closed water system, and all entrained air bubbles carried by system water shall be eliminated by air separator system points as indicated on the Drawings. Air separators shall have removable stainless steel strainers.
- B. Construction: The air separator shall be cast iron or welded steel, constructed, tested and stamped in accordance with Section VIII of the ASME Code for a working pressure of 125 psi as manufactured by Amtrol, Taco, Woods Industrial or approved substitution.

2.8 AIR VENTS:

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- A. General: Provide Sarco Type 13W, 150 psig working pressure, Sarco Type 13WH, 300 psig working pressure or equal 3/4" inlet automatic air vents with cast iron body, bronze pilot mechanism and stainless-steel hardware. Air vents shall be rated for the working pressure at the point of installation.
- B. Operation: Valves shall provide a high air removal rate at low pressure differentials and shall tightly seal to prevent system water loss and to prevent entrance of air in negative pressure situations.
- C. Isolation Valves: Provide an isolation valve for each air vent to facilitate maintenance.

2.9 PIPE EXPANSION JOINTS:

- A. Split Type Joints: Provide slip type pipe expansion fittings in [steam] [and pumped condensate] piping mains at locations shown on the Drawings. Expansion joints shall be Advanced Thermal Systems, Inc. Series **[TP2F]**, Hyspan, or an approved equal and shall be 150-pound flanged packed single or double slip type expansion joints designed for packing injection under full line pressure of self-lubricating teflon/asbestos injectable packing. The injectable packing shall be contained by a minimum of three 1/2" square self-lubricating containment rings each side of the injectable packing zone. The packing area in contact with the joints sliding slip shall be a minimum of sixteen times the joint nominal pipe size. Expansion joints shall be designed for 150 psig - 500°F and have 150 pounds ANSI flanged ends.
 - 1. Expansion joints shall have a minimum of three packing injection cylinders with mating plungers. Packing injection cylinders shall be a minimum 2" diameter with heavy duty internal acme thread. "V" threads not acceptable. Minimum shear area of the carbon steel plungers shall be 0.5 square inches. Packing cylinders to be welded in place prevent accidental disengagement.
 - 2. Pressure containing components of each joint shall be machined from seamless steel A-53 Gr B pipe or equivalent tubing with the traverse chamber having a standard wall thickness. No longitudinal welds allowed and no lap welds allowed.
 - 3. Slip shall be machined from A-53 Gr B Schedule 80 seamless pipe. Slips shall be ground and polished to a 16 RMS finish prior to chrome plating.
 - 4. Sliding slips shall be plated with a duplex chrome plate consisting of one mil of crack-free hard chrome and certified by Permascope inspection per ASTM B499.
 - 5. The internal end of all slips shall be provided with stainless steel outward limit slops fully welded in place and designed to prevent slip disengagement in event of an anchor failure.
 - 6. Provide a minimum of two spare packing plugs of injectable packing minimum 5/8" diameters x 7/8" long or equivalent volume for each packing cylinder.
 - 7. The joints internal and external guide shall be equipped with bronze filled teflon Inserts to protect the sliding slip from scoring. The bronze filled teflon inserts shall be capable of compressing under a load caused by severe misalignment in order to prevent slip from binding. Metal inserts or guides surfaces shall not be acceptable.

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8. Packing for steam piping shall be Code No. 350H reinforced graphite. Packing for steam condensate shall be Code No. 200H fiberglass/rubber/teflon.

- B. Bellows Type Joints: Provide bellows type pipe expansion fittings in [**steam relief**] piping at locations shown on the Drawings. Expansion couplings shall be stainless steel with 150-pound flanged connections and shall be suitable for a 225 psi design pressure. Expansion couplings shall be as manufactured by Flexible Metal Hose Company, Flexonics, Inc., Hyspan, or an approved equal. Piping shall be securely anchored between each pair of expansion joints as recommended by the joint manufacturer. Expansion fittings shall be as follows:
1. Type "A" shall be single control flexible low corrugation stainless steel type with mated neck rings and control rings and pipe alignment guides for piping on either side of the expansion joint.
 2. Type "B" shall be dual control flexible low corrugation stainless steel type with a pipe anchor coupling between the two expansion couplings and pipe alignment guides for piping on either side of the expansion joint.
- C. Testing: Each expansion coupling shall be hydrostatically tested by the manufacturer at 225 psi prior to shipment.
- D. Sizing: Axial movement available at each expansion coupling shall be equal to or greater than that scheduled on the Drawings.
- E. Pipe Guides: Piping on either side of expansion couplings and elsewhere where noted on the Drawings shall be supported with pipe alignment guides as recommended by the expansion joint manufacturer. The guides shall allow free axial movement while limiting lateral and angular movement. Primary and secondary guides shall be located as shown on the Drawings and per the manufacturer's recommendations. Additional guides shall be provided as recommended by the coupling manufacturer.
- F. Insulation: Provide a removable, reusable and weather resistant insulation blanket for each joint. Blankets shall be 4" thick for steam applications and 2" thick for steam condensate, condensate vent, and steam relief applications.

2.10 GAGES AND THERMOMETERS:

- A. General: Provide gauges and thermometers for monitoring HVAC systems as shown on the Drawings and specified herein.
- B. Gages: Gages shall be Ashcroft, Trerice, Weksler, Moeller, or U.S. with 4-1/2" dial face, phenol case, stainless steel movement with Grade A phosphor bronze bourdon tube and micrometer-type calibration adjustment screw. Accuracy shall be 1/2 of 1% of full scale. Provide a Crane No. 88 or equal needle valve gauge cock [**and pulsation dampener**] in pressure tube to gauge. [**Provide coil syphons for all steam gauges.**] Gradation shall be one pound or less.
- C. Thermometers: Thermometers shall be Trerice, Weksler, Moeller, or Scientific red-reading mercury-type with 9" case, maximum 2°F scale divisions, minimum 3-1/2" union stem, and complete with separable brass or stainless steel socket well. Thermometers shall be straight,

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incline or recline, selected and installed as best suited for ease in reading. Adjustable angle thermometers will not be acceptable.

- D. Thermometer Wells: Thermometer wells shall be brass or stainless steel with pressure and temperature ratings suitable for their application. Wells for insulated piping shall have a 2-1/2" lagging protrusion. Locate thermometer wells so the sensing bulb will give a true and correct reading. Install thermometer wells so as not to cause undue restriction in small piping. Where wells are located in pipe lines 1-1/2" and smaller, provide a section of pipe of such diameter that the net area of the pipe line will not be reduced by the thermometer well. All wells shall be filled with silicon and complete with caps and chains. Thermometer wells shall be installed on a 45-degree angle into the direction of water flow in the monitored piping. Thermometers and wells shall have the following insertion lengths:

<u>Diameter</u>	<u>Pipe Orientation</u>	<u>Insertion Length</u>
4"	Horizontal	2-1/2"
4", 6"	Vertical	5"
6", 8"	Horizontal	5"
8", 10"	Vertical	8"
>8"	Horizontal	8"
>10"	Vertical	14"

- E. Range and Gradations: Gauges and thermometers shall be selected to give range and graduations best suited for quantities to be measured. Generally, gauges and thermometers shall be selected so that normal operating pressures and temperatures are not more than 2/3 nor less than 1/2 of the range; scale division shall be 2°F or less. Typical ranges shall be:

1. Chilled water 0°F to 100°F.
2. Condenser water 30°F to 130°F.
3. Heating water 30°F to 240°F.
4. Glycol 30°F to 180°F.

[VERIFY REQUIREMENTS]

- F. Gauge Locations: Provide pressure gauges at the following locations:

1. Suction side of each pump inlet suction diffuser or strainer.
2. Suction side of each pump.
3. Discharge side of each pump.
4. Entering water side of each heat exchanger.
5. Leaving water side of each heat exchanger.
6. **[Entering water side of each air handling unit preheat and chilled water coil.]**
7. **[Leaving water side of each air handling unit preheat and chilled water coil.]**

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8. Where shown on the Drawings.

G. Thermometer Locations: Provide thermometers and thermometer wells at the following locations:

1. Entering chilled water at each chiller.
2. Leaving chilled water at each chiller.
3. Entering condenser water at each chiller.
4. Leaving condenser water at each chiller.
5. Entering hot water at each hot water boiler or heat exchanger.
6. Leaving hot water at each hot water boiler or heat exchanger.
7. Chilled water supply main to building.
8. Chilled water return main from building.
9. Hot water supply main to building.
10. Hot water return main from building.
11. Entering hot water at each shell and tube heat exchanger.
12. Leaving hot water at each shell and tube heat exchanger.
13. **[Chilled water supply to each air handling unit chilled water coil.]**
14. **[Chilled water return to each air handling unit chilled water coil.]**
15. **[Hot water supply to each air handling unit heating coil.]**
16. **[Hot water return from each air handling unit heating coil.]**
17. Where shown on the Drawings.

[VERIFY REQUIREMENTS]

H. Pressure and Temperature Test Taps: Taps shall be provided at the supply, bypass and return connections to all coils and at other locations as shown on the drawings. Taps shall be Peterson Engineering "Pete's Plugs", 1/2" NPT, brass with Nordel core, and color-coded cap and gasket, Model 170 or equal. Provide the Owner with **[six]** [] pressure gauge adapters with gauges and probes and **[six]** [] 5" stem pocket testing thermometers, **[three]** [] 25°F to 120°F and **[three]** [] 0°F to 220°F.

2.11 DRAIN PANS:

A. General: Provide 3" deep galvanized sheet metal auxiliary drain pans under any equipment where shown on the drawings and under all horizontal air handling units, duct mounted chilled water

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coils, horizontal suspended fan coil units and suspended domestic water heaters located above ceilings.

- B. Construction: Drain pans shall be minimum 16 gauge galvanized steel with water tight soldered joints. Drain pans shall be at least 2" larger in each dimension than the equipment served and shall extend under control and isolation valves. Chain suspend drain pans under equipment served. Pan shall have a welded coupling of the same size as the unit condensate drain (minimum 3/4" FPT). Pan bottom shall be cross-broken and sloped to the drain connection.
- C. Drain Lines: Auxiliary drain lines shall be routed through the ceiling in "tell-tale" fashion above a general use plumbing lavatory or janitors sink. A chrome plated escutcheon shall be provided. Locations of "tell-tale" drains shall be approved by the Architect.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Except as otherwise indicated, comply with the following requirements.
- B. Isolation Valves: Provide isolation valves at each runout to a piece of equipment and elsewhere as shown on the Drawings.
- C. Valve Stems: Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane. All valves shall be located so as to make the removal of their bonnets possible. All flanged valves shown in the horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be made up with their valve stems inclined at an angle of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested for final acceptance. Valves shall be installed as nearly as possible in the locations as shown on and Drawings. Any change in valve location must be so indicated on the As-built Drawings.
- D. Valve Chain Operators: In central plant, fan rooms, mechanical rooms, and other areas where valves are exposed and are installed over 8' above floor, provide chain operators.
- E. Swing Check Valves: Swing check valves shall be installed in horizontal piping only.
- F. Unions and Companion Flanges: Provide unions or companion flanges where required to facilitate dismantling of valves and equipment.
- G. Access Doors and Panels: Provide access doors or panels as required to provide full valve access.
 - 1. Label access doors to identify what is accessible behind door. Labels shall be metal or plastic and shall be mechanical fastened to the access door. Letter size shall be one quarter inch (1/4") minimum.
 - 2. Refer to Section 23 0300, "Basic Materials and Methods", for additional requirements.

3.2 STRAINERS:

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- A. General: Install strainers ahead of each control valve, steam trap and pressure reducing valve and at other locations shown on the Drawings.
- B. Orientation: Install strainers to allow for easy blowdown and so that strainer baskets can be removed for cleaning.
- C. Strainer Blowdown: Provide a blowdown valve with hose connection and cap at each strainer for blowdown.
- D. Cleaning: Strainers shall be cleaned after initial start-up, after 30 days of operation, and at final acceptance. Provide written report with photos of the contents of the strainer at the 30-day cleaning to the Architect and Owner for review.

3.3 COMPRESSION/EXPANSION TANKS:

- A. General: Install tanks on reinforced concrete housekeeping pads or suspended from the structure with not less than two saddles with two stems per saddle.
- B. Piping: Pipe tanks as detailed on the Drawings.
- C. Charging: Prior to filling each tank, verify tank has been properly charged to a pressure approximately 5 psi above the system pumped pressure at the point of connection.

3.4 AIR VENTS:

- A. General: Install air vents at the top of the air separator, at all system high points, and at all other locations where necessary to remove air from piping systems.
- B. Piping: Install isolation valves in the piping connection to all air vents. Extend a drain line from each air vent to a suitable drain in an accessible location.
- C. Location: Whenever possible, cluster air vents and their drain lines in common locations.

3.5 RELIEF VALVES:

- A. General: Install pressure relief valves for each closed water system. Extend a relief line sized at the full size of the valve discharge, to an accessible drain location.

3.6 IDENTIFICATION:

- A. Refer to Division 23 Section "Basic Materials and Methods" for applicable painting, nameplates, and labeling requirements.

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