



**Fresno Unified  
School District**

# **Chilled Water Buffer Tanks Installation at Various Sites Technical Specifications**

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**FRESNO UNIFIED SCHOOL DISTRICT**  
**Chilled Water Buffer Tank Installations**  
**at Various Sites**

**A. SCOPE OF WORK**

1. Install (18) owner provided buffer tanks at various sites, and replace (1) existing pump with contractor provided pump per contract drawings.

**B. RELATED SECTIONS**

1. Chilled Water Buffer Tank Installations at Various Sites Contract Drawings
2. Chilled Water Tank Installations at Various Sites Technical Specifications

**C. QUALITY ASSURANCE**

1. Contractor Qualifications:
  - a. The contractor must have a current California C20 contractor's license at time of bid.
2. Warranty:
  - a. The contractor must supply a one-year (12 month) guarantee against faulty workmanship and materials.

**D. CONTRACTOR RESPONSIBILITY**

1. Contractor to provide all labor, material, tools, and equipment to install all buffer tanks, and pump by completion date.
2. Clean and treat all new piping and buffer tank at each site.
3. Provide closed loop water treatment to supplement increase in volume from new tank and piping.
4. Insulate/jacket new piping and buffer tank per specifications.
5. Provide transport of new owner provided buffer tanks from FUSD Maintenance yard, 4600 N Brawley Ave. Fresno, CA 93722 to each site of installation.

**E. EXECUTION**

1. Chillers and related equipment to remain operational during normal school hours, shutdowns to be scheduled during non-student hours w/48hr notice.
2. Comply with manufacturer's installation instructions
3. Verify conditions are acceptable for product installation in accordance with manufacturer's instructions.
4. Protect installed product and other surfaces from damage during construction.

**F. SITE INFORMATION**

1. Addams: 2117 W McKinley Ave
2. Anthony: 1542 E Webster Ave
3. Ayer: 5272 E Lowe Ave
4. Aynesworth: 4765 E Burns Ave
5. Balderas: 4625 E Florence Ave
6. Cooper: 2277 W Bellaire Way
7. Easterby: 5211 E Tulare St
8. Edison: 540 E California Ave
9. Fort Miller: 1302 E Dakota Ave
10. Fremont POD: 1005 W Weldon Ave
11. Fresno High: 1839 Echo Ave
12. Greenberg: 5081 E Lane Ave
13. Leavenworth: 4420 E Thomas Ave
14. Storey East Plant: 5250 E Church Ave
15. Terronez: 2300 S Willow Ave
16. Thomas: 4444 N Millbrook Ave
17. Wawona: 4524 N Thorne Ave
18. Yosemite: 1292 N Ninth St

SECTION 220000  
GENERAL MECHANICAL AND PLUMBING

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. This division requires the furnishing and installation of items specified or indicated on the drawing or reasonably inferred there from, including every article, device or accessory necessary to facilitate each system's functioning as a complete and lawful system.
- B. General Requirements, Division 01 of the Specifications, pertains to and is hereby made a part of Divisions 22 and 23. Contractor is to review the conditions and requirements of Division 1, including Sections on submittals and job site conditions and procedures.
- C. Electrical power and control wiring 50 volts and greater, motor starters, and disconnects are included in FACILITY SERVICES SUBGROUP, unless otherwise noted.

1.2 SCOPE OF WORK:

- A. This work shall consist of, but not be limited to, the following: Furnish and install plumbing fixtures and piping as shown for a complete and functioning system; and furnish and install chiller, boilers, unit ventilators, fans, controls, ductwork, grilles, flex duct and dampers as shown for a complete and functioning system. Prior to fabrication of ductwork, contractor shall verify clearances to determine if structural or other trades have infringed on the space allotted for mechanical equipment. If interferences occur, notify the General Contractor, District and the Architect or Mechanical Engineer.

1.3 FEES AND PERMITS:

- A. The contractor shall secure all permits, licenses, and inspections required for this work as outlined in Division 01.

1.4 CODES AND REGULATIONS:

- A. All work and materials shall be in accordance with the following codes as adopted and amended by the authority having jurisdiction. Nothing in these drawings or specifications is to be construed to permit work not conforming to these codes. Should the drawings or specifications call for material or methods of construction of a higher quality or standard than required by these codes, the specifications shall govern.
  - 1. California Code of Regulations:
    - a. Title 8, Industrial Relations.
    - b. Title 19, Public Safety.
    - c. Title 20, Building Standards.

- d. Title 24, Building Standards.
2. California Building Code.
3. California Mechanical Code.
4. California Plumbing Code.
5. Standards and regulations of other agencies or organizations, as listed in this specification relating to products or procedures. For example, American National Standards Institute, American Society for Testing and Materials, American Society of Mechanical Engineers, etc.

## 1.5 GUARANTEE:

- A. Guarantee shall be in accordance with the General Conditions. These specifications may extend the period of guarantee for certain items. Where such extensions are called for, or where items are normally provided with guarantee periods in excess of that called for in the General Conditions, the certificate of guarantee shall be furnished to District per Specification Section – GUARANTEES.

## 1.6 DRAWINGS:

- A. Layout of equipment and systems is generally diagrammatic, unless specifically dimensioned. Drawings shall be checked for interferences with structural or other conditions before installing work. Interferences shall be called to the attention of the District.

## 1.7 DEFINITIONS:

- A. Piping: The term piping shall mean all pipe, fittings, valves, insulation and accessories as required for a complete piping system.
- B. Agencies and Organizations:
  1. AABC - Associated Air Balance Council
  2. AAR - Association of American Railroads
  3. AGA - American Gas Association
  4. AMCA - American Moving and Conditioning Association
  5. ANSI - American National Standards Institute
  6. ARI - Air Conditioning and Refrigeration Institute
  7. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
  8. ASME - American Society of Mechanical Engineers
  9. ASTM - American Society for Testing and Materials
  10. AWWA - American Water Works Association
  11. AAPMO - International Association of Plumbing and Mechanical Officials
  12. NEMA - National Electrical Manufacturers' Association
  13. NEBB - National Environmental Balancing Bureau
  14. NFPA - National Fire Protection Association
  15. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
  16. UL - Underwriters' Laboratories

## PART 2 - PRODUCTS:

## 2.1 QUALITY STANDARDS OF MATERIALS:

- A. The listing of product manufacturers in the various sections of the specifications and drawings is intended to establish a standard of quality only. It is not the intent of the Engineer to discriminate against any material or product that is equivalent, in the opinion of the Engineer, to the standards as described in the specifications and drawings, nor is it intended to preclude open competitive bidding.
- B. Products by other manufacturers will be accepted as outlined in Division 1, Specification Section - SUBSTITUTIONS. No products will be reviewed less than 10 days prior to bid date.
- C. The contractor shall submit to the District copies of complete lists of materials proposed for use, giving manufacturer's name and catalog numbers. Complete shop drawings shall follow for all equipment and fixtures. Shop drawings shall include dimensions, capacities, performance curves and other characteristics as listed in product specifications. Material or equipment shall not be ordered until a written reply is received from the District indicating review and approval of the submittals.

## PART 3 - EXECUTION

## 3.1 TESTING AND START-UP:

- A. ~~Refer to Division 01, and individual sections, for requirements for clean-up, testing, balancing and start-up.~~
- B. ~~The HVAC system shall be balanced by a contractor licensed by a nationally recognized air balance certification agency to the to the satisfaction of the District's representative per Specification Section - TESTING, ADJUSTING AND BALANCING.~~
- C. ~~The piping systems shall be tested in accordance with the California Plumbing Code. Domestic hot and cold water piping shall be tested at 100 psig air pressure for a period of 2 hours. Gas piping shall be tested at 60 PSIG air pressure for a period of 1 hour. Sewer piping shall be tested with a water column to the height of the highest vent line. There shall be no detectable drop in pressure during the test, except that associated with temperature change. The gauge used shall have a least count of 1 PSIG and a range not greater than 150% of the testing pressure.~~
- D. ~~Maintenance and operations manuals shall be provided at the conclusion to the project. They are to be loose-leaf vinyl covered binders with the project name displayed on the spine of the book in 1/2" high letters. Indexed tabs shall identify the individual sections. The manuals shall include installation, repair manuals provided by the equipment manufacturers, parts lists, listing of local supplier which carries replacement parts, wiring and control diagrams, air balance report, and other pertinent data. Copies shall be delivered to the Engineer for review prior to submission to the District as outlined in Division 1.~~
- E. ~~Verbal: The Contractor shall also verbally instruct the District's maintenance staff in the operation and maintenance of all equipment and systems.~~

# ***SPECIFICATIONS***

3.2 WORKMANSHIP:

- A. All work done under this Division shall be the highest quality for the trade. Ductwork and piping shall be parallel to building lines. Exposed work shall be properly finished to reflect pride in workmanship.

3.3 SITE VISITATION:

- A. Prior to bidding this project, the contractor shall visit the site and become familiar with the site conditions. The contractor shall verify the work to be performed. Failure to visit the site will not be accepted as an excuse for extra compensation for visible obstacles.

END OF SECTION

SECTION 220529  
PLUMBING AND HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Pipe, duct and equipment hangers, supports, and associated anchors.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.
- E. Seismic bracing.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS:

- A. Furnish hanger and support inserts and sleeves to General Contractor for placement into formwork.

1.3 REFERENCES:

- A. ANSI/ASME B31.1 - Power Piping.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems.
- C. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.
- D. State of California Seismic Code Requirements, Titles 21, 22, 24, Table 2-23J.
- E. Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems (SMACNA - Los Angeles).

1.4 QUALITY ASSURANCE:

- A. Supports for Sprinkler Piping: In conformance with NAPA 13.

1.5 SUBMITTALS:

- A. Submit shop drawings and product data under provisions of Specification Section - SUBMITTALS.
- B. Indicate hanger and support framing and attachment methods.



## 2.1 PIPE HANGERS AND SUPPORTS:

- A. Hangers for pipe sizes 1/2 to 1 1/2 inch carbon steel, adjustable swivel, split ring.
- B. Hangers for pipe sizes two to four inches and cold pipe sizes six inches and over: Carbon steel, adjustable, clevis.
- C. Hangers for hot pipe sizes 6 inches and over: Adjustable steel yoke, cast iron roll, double hanger.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for hot pipe sizes six inches and over.
- E. Wall support for pipe sizes to three inches: Cast iron hook.
- F. Wall support for pipe sizes four inches and over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe sizes six inches and over.
- G. Vertical support: Steel riser clamp.
- H. Floor support for pipe sizes to four inches and all cold pipe sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- I. Floor support for hot pipe sizes six inches and over adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- J. Copper pipe support: Carbon steel ring, adjustable, copper plated.
- K. Shield for insulated piping two inches and smaller: 18 gauge galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.
- L. Shield for insulated piping 2 1/2 Inches and larger (except cold water piping): Pipe covering protective saddles.
- M. Shields for insulated cold water piping 2 1/2 inches and larger: Hard block non-conducting saddles in 90 degree segments, 12 inch minimum length, block thickness same as insulation thickness.
- N. Shields for vertical copper pipe risers: Sheet lead.

## 2.2 HANGER RODS:

- A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

## 2.3 INSERTS:

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 2.4 FLASHING:

- A. Metal Flashing: 26 gauge galvanized steel.
- B. Lead Flashing: 5 lb./sq. ft. sheet lead for waterproofing; one lb./sq. ft. sheet lead for soundproofing.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

## 2.5 EQUIPMENT CURBS:

- A. Fabricate curbs according to drawings and specification section for equipment.

## 2.6 SLEEVES:

- A. Sleeves for pipes through non-fire rated floors: Form with 18 gauge galvanized steel.
- B. Sleeves for pipes through non-fire rated beams, walls, footings, and potentially wet floors: Form with steel pipe or 18 gauge galvanized steel.
- C. Sleeves for pipes through fire rated and fire resistive floors and walls, and fireproofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for round ductwork: Form with galvanized steel.
- E. Sleeves for rectangular ductwork: Form with galvanized steel or wood.
- F. Stuffing insulation: Glass fiber type, non-combustible.
- G. Caulk: Sealant of quality specified in Specification Section -SEALANTS.

## 2.7 FABRICATION:

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- B. Design hangers without disengagement of supported pipe.
- C. Provide copper plated hangers and supports for copper piping or sheet lead packing between hanger or support and piping.

## 2.8 FINISH:

- A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

## 2.9 SEISMIC BRACING FOR DUCTS:

- A. Provide a lateral bracing system as shown on drawings. A typical vertical support system conforming to Title 24 must also be used. However, where bracing occurs, the vertical angle shown may replace a typical vertical support. This includes a trapeze vertical supporting system.
- B. Brace all rectangular ducts six sq. ft. of area and larger. Brace all round ducts 28" in diameter and larger.
- C. Transverse bracing shall be installed at each duct turn and at each end of a duct run. Longitudinal bracing shall occur at 60' - o.c. maximum. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if the bracing is installed within four feet of the intersection of both ducts and bracing is sized for the larger duct. Duct joints shall conform to SMACNA duct Construction standard. All joints in duct sections shall provide a positive fastening together of the section.
- D. No bracing is required if the top of duct is suspended 12" or less from the supporting structural member and attached to top of duct.
- E. A group of ducts may be combined in a larger size frame using the overall dimensions with maximum weight for selection of the members.
- F. Walls (including gyp-board non-bearing partitions), which have ducts running through them may replace a typical transverse brace except where fire damper is installed. Provide solid blockings around duct penetration at stud wall construction.
- G. Ducts and pipes not braced shall be installed with a 6" minimum clearance to vertical ceiling hanger wires.
- H. All sheet metal for bracing to be  $F_y = 33$  ksi.

## 2.10 SEISMIC BRACING FOR PIPES:

- A. Brace all pipes 2 1/2" diameter and larger:
  - 1. EXCEPTIONS:
    - a. Brace all piping 1 1/4" and larger located in boiler rooms, mechanical equipment rooms and refrigeration machinery rooms. Bracing requirements for pipes less than 2 1/2" in diameter shall be the same as for 2 1/2" pipes in all other locations.
    - b. Brace all fuel gas and oil piping, medical gas piping and compressed air piping 1" and larger.
    - c. Seismic braces may be omitted: (1) when the top of the pipe is suspended 12" or less from the supporting structure member and the pipe is suspended by an individual hanger and (2) on all piping 3/4" and smaller.
- B. Provide a lateral bracing system as shown on drawings. A typical vertical support system conforming to the following Title 24 requirements must also be used.
  - 1. Vertical Piping:

- a. Attachment - Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Stacks shall be supported at their bases and if over two stories in height at each floor by approved metal floor clamps.
  - b. Screwed pipe - Screwed pipe (I.P.S.) or flanged pipe shall be supported at approximately 10-foot intervals.
  - c. Copper tubing - Copper tubing shall be supported at approximately 6 foot intervals for tubing 1 1/2" and smaller in diameter and 10-foot intervals for tubing 2" and larger in diameter.
  - d. Pipes of other approved materials shall be supported in accordance with their approved installation standards.
- C. Transverse bracings at 40' 0" o.c. maximum, unless otherwise noted.
- D. Longitudinal bracings at 80' 0" o.c. maximum, unless otherwise noted. When thermal expansion or contraction is involved, provide longitudinal bracings at anchor points. The longitudinal braces and the connections must be capable of resisting the force induced by expansion and contraction.
- E. Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 24" of the elbow or tee of similar size.
- F. For threaded piping the flexibility may be provided by the installation of swing joints. In welded or solder joint piping the flexibility shall be provided by expansion loops or manufactured flexible connectors. For piping with manufactured ball joints select length of piping offset using "Seismic Drift" in place of "Expansion Per Joint Manufacturers" selection table. Seismic Drift = 0.015 ft. per foot of height.
- G. Do not use branch lines to brace main lines.
- H. Trapeze hangers may be used. Provide flexibility in joints where pipes pass through building seismic or expansion joints, or where rigidly supported pipes connect to equipment with vibration isolators.
- I. A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
- J. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements (minimum 1" clearance per side).
- K. At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 30' 0" on center.
- L. Cast iron pipe of all types, glass pipe and any other pipe joined with a shield and clamp assembly where the top of the pipe is 12" or more from supporting structure shall be braced on each side of a change in direction of 90 deg. or more. Riser joints shall be braced or stabilized between floors.
- M. For gas piping, the bracing details, schedules and notes may be used except that transverse bracing shall be at 20' 0 o.c. maximum and longitudinal bracing at 40'-0" o.c. maximum. Also 1", 1 1/4", 1 1/2", and 2" diameter pipes shall be braced the same as 2 1/2" diameter pipe in the schedule. (No bracing is required for pipes 3/4" diameter and smaller.)

- N. Proprietary bracing systems approved by the OSA may be used in lieu of the braces shown in the details. Written proof of approval must accompany submittals.

## 2.11 SEISMIC BRACING OF EQUIPMENT:

- A. Mechanical Equipment Anchorages such as bolts, expansion anchors, screws, etc., shall comply with the force level requirements of Title 24, C.C.R., Table No. 2-23-J-Part B.
- B. Restraining Devices shall be designed to conform with the force level requirements of Note 1. The following companies, in the past, have met these requirements on a job-to-job submittal. The names are listed for convenience only with no intention of excluding other companies.
1. California Dynamics Corporation
  2. Mason Industries, Inc.
  3. M.W. Sausse and Company, Inc.
- C. Restraining Devices must be placed on all sides of the equipment base.
- D. It is the entire responsibility of the Equipment Manufacturer to design his equipment so that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

## PART 3 - EXECUTION

### 3.1 INSERTS:

- A. Provide inserts to General Contractor for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four inches.
- D. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- E. Where inserts are omitted, notify District and get instructions from Structural Engineer.

### 3.2 PIPE HANGERS AND SUPPORTS:

- A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
1/2 to 1 1/4 inches	6' 6"	3/8"
1 1/2 to 2 inches	10' 0"	3/8"
2 1/2 to 3 inches	10' 0"	1/2"
4 to 6 inches	10' 0"	5/8"
8 to 12 inches	14' 0"	7/8"
14 inches and Over	20' 0"	1"
PVC (all sizes)	6' 0"	3/8"

C.I. Bell and Spigot  
(or No-Hub) and at Joints

5' 0"

1/2"

- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place a hanger and seismic brace (as required) within 12 inches of each horizontal elbow.
- D. Use hangers with 1 1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with five feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.

### 3.3 EQUIPMENT BASES AND SUPPORTS:

- A. Provide equipment bases of concrete type.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

### 3.4 FLASHING:

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting three inches minimum above finished roof surface with lead worked one inch minimum into hub, eight inches; minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower, mop sink drains watertight to adjacent materials.
- E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- F. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Flexible sheet flash and counterflash with sheet metal; seal watertight.

# ***SPECIFICATIONS***

3.5 SLEEVES:

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- C. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and calk seal. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION

## SECTION 220750 PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED:

- A. Piping insulation.
- B. Jackets and accessories.
- C. No asbestos allowed.

#### 1.2 REFERENCES:

- A. Insulation shall comply with California Title 24, Energy Conservation Standards.

#### 1.3 QUALITY ASSURANCE:

- A. Applicator Company specializing in piping insulation application with three years minimum experience.
- B. Materials: Flame spread/fuel contributed/smoke developed rating of 25/50/50 in accordance with ASTM E84, NAPA 255, UL 723.

#### 1.4 SUBMITTALS:

- A. Submit product data under provisions of Specification Section - SUBMITTALS.
- B. Include product description, list of materials and thickness for each service, and locations.
- C. Submit manufacturer's installation instructions under provisions of Specification Section - SUBMITTALS.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS:

- A. Knauf.
- B. Certainteed.
- C. Armstrong.



- D. Substitutions: Under provisions of Fresno Unified School District Division 01.

## 2.2 FIBERGLASS INSULATION:

- A. Glass fiber insulation; ANSI/ASTM C 47; 'k' value of 0.24 at 75 degrees F; noncombustible. Preformed with all service jacket.

## 2.3 FOAM INSULATION:

- A. Cellular foam; flexible, plastic; 'k' value of 0.28 at 75 degrees F. Armaflex FR or equivalent For 3/4" and smaller pipes or refrigerant piping.

## 2.4 JACKETS:

### A. Interior Applications:

1. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
2. PVC Jackets: One-piece, premolded type. Comply with Paragraph 1.03, B.

### B. Exterior Applications:

1. Aluminum Jackets: ASTM B209; 0.020 inch; smooth finish.
2. Stainless Steel Jackets: Type 304 stainless steel; 0.010 inch thick; smooth finish.
3. Cellular foam insulation to have manufacturer's approved coating for UV protection.

## 2.5 ACCESSORIES:

- A. Insulation Bands: 3/4-inch wide; 0.015-inch thick stainless steel, or 0.007-inch thick aluminum depending on jacket.
- B. Metal Jacket Bands: 3/8-inch wide; 0.015-inch thick aluminum. 0.010-inch thick stainless steel.
- C. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.
- D. Adhesives: Compatible with insulation.

## PART 3 - EXECUTION

### 3.1 PREPARATION:

- A. Install materials after piping has been tested and approved.

### 3.2 INSTALLATION:

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

- B. Continue insulation with vapor barrier through penetrations.
- C. In exposed piping, locate insulation and cover seams in least visible locations.
- D. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- E. On insulated piping without vapor barrier and piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.
- F. Provide an insert, not less than six inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping two inches diameter or larger, to prevent insulation from sagging at support points. Inserts shall be cork or other heavy density insulating material suitable for the planned temperature range. Kin-Line 463 or 466 insulation rings.
- G. Neatly finish insulation at supports, protrusions, and interruptions.
- H. Jackets:
  - 1. Indoor, Concealed Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. All service or PVC jackets may be used.
  - 2. Indoor, Concealed Applications: Insulated dual-temperature pipes or pipes conveying fluids below ambient temperature shall have vapor barrier jackets. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. All service or PVC jackets may be used.
  - 3. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications. Provide PVC or metal jackets unless metal jacket is specifically required.
  - 4. Exterior Applications: Provide vapor barrier jackets. Cover with aluminum or stainless steel jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Caulk with silicone (clear or silver) at all joints.
  - 5. Buried Piping: Provide factory fabricated assembly with PVC pipe jacket and foam insulation (equivalent to PermaPipe).

### 3.3 SCHEDULE:

- A. Comply with California Title 24 Energy Conservation Standards as minimum.
- B. Provide 1" minimum on domestic hot water. Insulate cold water line to water heater per Code.
- C. Provide 1 1/2" minimum for chilled or heating hot water mains and 1" or branches.
- D. Provide 1/2" on all cold water exposed to exterior.

END OF SECTION

## SECTION 232113 HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED:

- A. Pipe and pipe fittings.
- B. Valves.
- C. Heating water piping system.
- D. Chilled water piping system.
- E. Chilled/Hot water piping system.
- F. Condensate drains.

#### 1.02 REFERENCES:

- A. ANSI/ASME - Boiler and Pressure Vessel Code.
- B. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- D. ANSI/ASME B31.9 - Building Services Piping.
- E. ANSI/ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- F. ANSI/AWS A5.8 - Brazing Filler Metal.
- G. ANSI/AWS DI.1 - Structural Welding Code.
- H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- I. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- J. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- K. ASTM B32 - Solder Metal.
- L. ASTM B88 - Seamless Copper Water Tube.
- M. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- N. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
- O. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe.

- P. ASTM D2466 - Socket-Type PVC Plastic Type Fittings, Schedule 40.
  - Q. ASTM D2467 - Socket-Type PVC Plastic Type Fittings, Schedule 80.
  - R. ASTM D2855 - Making Solvent-Cemented Joints with PVC Pipe and Fittings.
  - S. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- 1.03 REGULATORY REQUIREMENTS:
- A. Conform to ANSI/ASME B31.9.
- 1.04 QUALITY ASSURANCE:
- A. Valves: Manufacturer's name and pressure rating marked on valve body. Valves shall be manufactured in the USA.
  - B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.
  - C. Welders Certification: In accordance with ANSI/ASME SEC 9. ANSI/AWS D1.1.
- 1.05 SUBMITTALS:
- A. Submit product data under provisions of Section 01300.
  - B. Include data on pipe materials, pipe fittings, valves, and accessories.
  - C. Include welder's certification of compliance with ANSI/ASME SEC 9 or ANSI/AWS D1.1.
- 1.06 DELIVERY, STORAGE AND HANDLING:
- A. Deliver material to job-site in new, dry, unopened, and well-marked containers showing product and manufacturer's name.
  - B. Material handling equipment shall be selected and operated so as not to damage equipment or existing construction.
  - C. Deliver material in sufficient quantity to allow continuity of work.
  - D. No material may be stored uncovered in the open or in contact with the ground.
  - E. Handle material to prevent damage during transportation and installation.
  - F. The Contractor shall assume full responsibility for the protection and safekeeping of products stored on premises.
  - G. Deliver and store valves in shipping containers with labeling in place.

## PART 2 - PRODUCTS

- 2.01 HEATING WATER/CHILLED/HOT WATER PIPING, ABOVE GROUND:
- A. Steel Pipe: ASTM A53 or A120, Schedule 40, black.
    - 1. Fittings: ANSI/ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings, long radius ells, ANSI B16.9. Exposed joints may be grooved pipe unions, EPDM gaskets. Anvil International, Victaulic.
    - 2. Joints: Screwed, ANSI/AWS D1.1, welded, or grooved.
  - B. Copper Tubing: ASTM B88, Type L, hard drawn, may be used at unit ventilators and air handlers; all other shall be steel pipe.
    - 1. Fittings: ANSI/ASME B 16.23 cast brass or ANSI/ASME B 16.29 solder wrought copper.
    - 2. Joints: ASTM B32, solder, Grade 95TA. ANSI/AWS A5.8, BCuP silver braze.
- 2.02 EQUIPMENT DRAINS AND OVERFLOWS:
- A. Steel Pipe: ASTM A53 or A120, Schedule 40 galvanized.
    - 1. Fittings: Galvanized cast iron, or ANSI/ASTM B16.3 malleable iron.
    - 2. Joints: Screwed, or grooved mechanical couplings.
  - B. Copper Tubing: ASTM B88, Type M, K hard drawn.
    - 1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
    - 2. Joints: ASTM B32, solder, Grade 95TA. ANSI/AWS A5.8, BCuP silver braze.
- 2.03 FLANGES, UNIONS AND COUPLINGS:
- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
  - B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; 1/16 inch thick preformed neoprene.
  - C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; C-shape elastomeric composition sealing gasket for operating temperature range from - 30 degrees F to 230 degrees F; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.
- 2.04 GATE VALVES:
- A. Up to 2" Inches: Threaded or soldered, lead-free, Bronze body, non-rising stem, malleable iron hand wheel w/ stainless steel nut. Nibco T-113 or equal.
  - B. Over 2" Inches: Flanged, lead-free, ductile iron body, resilient wedge non rising stem w/ 2" operating nut below grade or hand wheel above grade.
- 2.05 GLOBE VALVES:
- A. Up to 2 Inches: Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, screwed ends, with backseating capacity.
  - B. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel OS&Y, plug-type disc, flanged ends, renewable seat and disc.
- 2.06 BALL VALVES:
- A. Up to 2 Inches: Bronze one piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle, and balancing stops, threaded ends with union.

- B. Over 2 Inches: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, or gear drive handwheel for sizes 10 inches and over, ranged.
- 2.07 PLUG COCKS:
- A. Up to 2 Inches: Bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends, with one wrench operator for every ten plug cocks.
  - B. Over 2 Inches: Cast iron body and plug, pressure lubricated, Teflon packing, flanged ends, with wrench operator with set screw.
- 2.08 BUTTERFLY VALVES:
- A. Iron body, bronze or stainless steel disc, resilient replaceable seat for service to 250 degrees F wafer or lug ends, extended neck, 10-position lever handle.
- 2.09 SPRING LOADED CHECK VALVES:
- A. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer or flanged ends.
- 2.10 RELIEF VALVES:
- A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

## PART 3 - EXECUTION

- 3.01 PREPARATION:
- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
  - B. Remove scale and dirt on inside and outside before assembly.
  - C. Prepare piping connections to equipment with flanges or unions.
  - D. After completion, fill, clean, and treat systems.
- 3.02 INSTALLATION:
- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
  - B. Install piping to conserve building space, and not interfere with use of space and other work.
  - C. Group piping whenever practical at common elevations.
  - D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Slip joints for underground piping when certified by pipe manufacturer shall be acceptable as expansion compensation. Welded or other mechanical joints shall require expansion loops or joints as required.
  - E. Provide clearance for installation of insulation, and access to valves and fittings.

- F. Provide access where valves and fittings are not exposed.
- G. Slope piping and arrange systems to drain all low points. Use eccentric reducers to maintain top of pipe level.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Section 09900.
- J. Install valves with stems upright or horizontal, not inverted.
- K. PVC material will not be allowed within a building. Use only for exterior.

### 3.03 APPLICATION:

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install gate, ball, or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install gate, ball, or butterfly valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of condenser water pumps.
- G. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- H. Use butterfly valves in heating, and chilled water systems interchangeably with gate and globe valves.
- I. Use only butterfly valves in chilled water systems for throttling and isolation service.
- J. Use lug end butterfly valves to isolate equipment.
- K. Provide 3/4-inch gate or ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest drain.
- L. Use all-electric unions or couplings where dissimilar metals are joined.

END OF SECTION

SECTION 232116  
HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Pump suction fittings.
- F. Combination fittings.
- G. Flow indicators, controls, meters.
- H. Relief valves.

1.2 REFERENCES:

- A. ANSI/ASME - Boilers and Pressure Vessels Code.

1.3 REGULATORY REQUIREMENTS:

- A. Conform to ANSI/ASME Boilers and Pressure Vessels Code Section 8D for manufacture of tanks.

1.4 QUALITY ASSURANCE:

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout. Valves shall be manufactured in the USA.

1.5 SUBMITTALS:

- A. Submit shop drawings and product data under provisions of Specification Section-SUBMITTALS.
- B. Submit shop drawings and product data for manufactured products and assemblies required for this project.



- C. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.
  - D. Submit inspection certificates for pressure vessels from authority having jurisdiction.
  - E. Submit manufacturer's installation instructions under provisions of Specification Section-SUBMITTALS.
- 1.6 OPERATION AND MAINTENANCE DATA:
- A. Submit operation and maintenance data under provisions of Specification Section-PROJECT CLOSEOUT.
  - B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.
- 1.7 DELIVERY, STORAGE AND HANDLING:
- A. Deliver material to job-site in new, dry, unopened, and well-marked containers showing product and manufacturer's name.
  - B. Material handling equipment shall be selected and operated so as not to damage equipment or existing construction.
  - C. Deliver material in sufficient quantity to allow continuity of work.
  - D. No material may be stored uncovered in the open or in contact with the ground.
  - E. Handle material to prevent damage during transportation and installation.
  - F. The Contractor shall assume full responsibility for the protection and safekeeping of products stored on premises.

## PART 2 - PRODUCTS

- 2.1 ACCEPTABLE MANUFACTURERS - DIAPHRAGM-TYPE COMPRESSION TANKS:
- A. Amtrol.
  - B. A.O. Smith.
  - C. Substitutions: Under provisions of Specification Section-SUBSTITUTIONS.

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### 2.2 DIAPHRAGM-TYPE COMPRESSION TANKS:

- A. Construction: Welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible diaphragm sealed into tank, and steel legs or saddles.
- B. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.
- C. Size: See Schedule on Drawings.

### 2.3 ACCEPTABLE MANUFACTURERS - AIR VENTS:

- A. Amtrol.
- B. Substitutions: Under provisions of Specification Section-SUBSTITUTIONS.

### 2.4 AIR VENTS:

- A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber (Amtrol 710).
- B. Float Type: Brass or semi-steel body, copper float, stainless steel valve and valve seat; suitable for system operating temperature and pressure (Amtrol 720); with isolating valve.

### 2.5 ACCEPTABLE MANUFACTURERS - AIR SEPARATORS:

- A. Amtrol and #79 Hoffman.
- B. Substitutions: Under provisions of Section 01630.

### 2.6 AIR SEPARATORS:

- A. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.
- B. In-line Air Separators: Cast iron for sizes 1 1/2 inches and smaller, or steel for sizes 2 inches and larger, tested and stamped in accordance with Section 8D of ANSI/ASME Code; for 125 psig operating pressure (Amtrol Model AS).
- C. Air Elimination Valve: Bronze, float operated, for 125 psig operating pressure.
- D. Combination Air Separators/Strainers: Steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code, for 125 psig operating pressure, with galvanized steel integral strainer with 3/16-inch perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

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### 2.7 STRAINERS:

- A. Size 2 inches and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.
- B. Size 2 1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.
- C. Size 5 inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

### 2.8 PUMP SUCTION FITTINGS:

- A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2 1/2 inch and larger, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16-inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
- B. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

### 2.9 ACCEPTABLE MANUFACTURERS - COMBINATION PUMP DISCHARGE VALVES:

- A. Amtrol.
- B. Substitutions: Under provisions of Section 01600.

### 2.10 COMBINATION PUMP DISCHARGE VALVES:

- A. Valve: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.
- B. 2.11 RELIEF VALVES:
- C. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

## PART 3 - EXECUTION

### 3.1 INSTALLATION AND APPLICATION:

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.

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HYDRONIC SPECIALTIES

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- B. Support tanks inside building from building structure, in accordance with manufacturer's instructions and seismic details on drawings.
- C. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- D. Provide manual air vents at system high points and as indicated.
- E. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- F. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- G. Provide valved drain and hose connection on strainer blow down connection.
- H. Support pump fittings with floor mounted pipe and flange supports.
- I. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- J. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- K. Pipe relief valve outlet to nearest floor drain.
- L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION

## SECTION 232500 CHEMICAL WATER TREATMENT

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES:

- A. Cleaning of piping systems.
- B. Chemical feeder equipment.
- C. Treatment for closed systems.

#### 1.2 SUBMITTALS:

- A. Submit shop drawings under provisions of Specification Section-SUBMITTALS.
- B. Submit shop drawings indicating system schematics, equipment locations, and controls schematics.
- C. Submit product data under provisions of Specification Section-SUBMITTALS.
- D. Submit product data indicating chemical treatment materials, chemicals, and equipment.
- E. Submit manufacturer's installation instructions under provisions of Specification Section-SUBMITTALS.
- F. Submit manufacturer's field reports.
- G. Submit reports indicating start-up of treatment systems is completed and operating properly.
- H. Submit reports indicating analysis of system water after cleaning and after treatment.

#### 1.3 OPERATION AND MAINTENANCE DATA:

- A. Submit operation and maintenance data under provisions of Specification Section-PROJECT CLOSEOUT.
- B. Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs.
- C. Include step by step instructions on test procedures including target concentrations.

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### 1.4 QUALIFICATIONS:

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel

### 1.5 REGULATORY REQUIREMENTS:

- A. Conform to applicable EPA code for addition of non-potable chemicals to building mechanical systems and for delivery to public sewage systems.

### 1.6 MAINTENANCE SERVICE:

- ~~A. Furnish service and maintenance of treatment systems for one year from date of substantial completion.~~
- ~~B. Provide semiannual technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.~~
- ~~C. Provide laboratory and technical assistance services for warranty period.~~
- ~~D. Include two-hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start-up of systems.~~
- ~~E. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.~~

### 1.7 MAINTENANCE MATERIALS:

- ~~A. Submit maintenance materials under provisions of Specification Section-PROJECT CLOSEOUT.~~
- ~~B. Provide sufficient chemicals for treatment and testing during warranty period.~~

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. San Joaquin Chemicals.
- B. Substitutions: Under provisions of Specification Section-SUBSTITUTIONS.

## 2.2 MATERIALS:

- A. System Cleaner:
  - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
  - 2. Algaecide, chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate) or isothiazolones.
- B. Closed System Treatment (Water):
  - 1. Sequestering agent to reduce deposits and adjust ph.
  - 2. Corrosion inhibitors.
  - 3. Conductivity enhancers.

## 2.3 ~~EQUIPMENT:~~

- A. ~~Bypass (Pot) Feeder 5.0 gal. quick opening cap for working pressure of 175 psig~~

## PART 3 - EXECUTION

### 3.1 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.

### 3.2 CLEANING SEQUENCE:

- A. Add cleaner to closed systems at concentration as recommended by manufacturer.
- B. Hot Water Heating Systems: Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water. Circulate for six hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed.
- C. Chilled Water Systems: Circulate for 48 hours, then drain systems as quickly as possible. Refill with clean water, circulate for 24 hours, then drain. Refill with clean water and repeat until system cleaner is removed.
- D. Use neutralizer agents on recommendation of system cleaner supplier and review of
- E. District/Engineer.
- F. Remove, clean, and replace strainer screens.

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- G. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

### 3.3 INSTALLATION:

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

### 3.4 CLOSED SYSTEM TREATMENT:

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around globe valve downstream of circulating pumps unless indicated otherwise.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.

END OF SECTION