

SECTION 232500 – HVAC WATER TREATMENT

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

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 and all other sections of Division 23.

1.2 SUMMARY

- A. Section includes the requirements for HVAC water-treatment systems: <Select only products for particular project>
 - 1. Manual and automatic chemical-feed equipment and controls.
 - 2. Chemical treatment test equipment.
 - 3. Chemicals.
 - 4. HVAC makeup-water softeners.
 - 5. Water filtration equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each specified product, include manufacturers cut sheets, dimensional data, performance data, installation instructions, wirings diagrams, power requirements, specified options, and warranty information.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
 - a. Bypass feeders.
 - b. Inhibitor injection timers.
 - c. pH controllers.
 - d. TSS controllers.
 - e. Biocide feeder timers.
 - f. Chemical solution tanks.
 - g. Injection pumps.
 - h. Chemical test equipment.
 - i. Chemical material safety data sheets.
 - j. Water softeners.
 - k. RO units.
 - l. Multimedia filters.
 - m. Replaceable bag or cartridge-type filters.

2. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems.
3. Include plans, elevations, sections, and attachment details.
4. Include diagrams for power and control wiring.

1.4 INFORMATIONAL SUBMITTALS <Edit for Project>

- A. Seismic Qualification Certificates: For [water softeners] [RO equipment] [water filtration units] and components, from manufacturer. <Retain if seismic requirements are necessary>
- B. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- C. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- D. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.
- E. Field quality-control reports.
- F. Other Informational Submittals:
 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
 2. Water Analysis: Illustrate water quality available at Project site.
 3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.5 CLOSEOUT SUBMITTALS <Edit for Project>

- A. Operation and Maintenance Data: Include a copy of each approved submittal along with any applicable maintenance data in the project operation and maintenance manual.
- B. Additional Data: For sensors, injection pumps, [water softeners,] [RO equipment,] [water filtration units,] and controllers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Supplier Qualifications: A recognized chemical water treatment supplier with warehousing facilities within thirty (30) miles from the project. The supplier shall employ an experienced consultant, available at reasonable times during the course of the work to consult with Contractor, Architect, and Owner about water treatment.

1. Provide a list of at least five (5) projects of similar size and type, which have been in operation for at least five (5) years.
 2. Supplier shall provide twenty four (24) hour emergency service and shall be capable of being on-site within four (4) hours of the emergency notice.
- B. Chemical Standards: Meet state and local pollution-control regulations.
- C. Comply with NFPA 70 for components and installation.
- D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. Provide cleaning of the piping systems and submit a certificate of compliance with the specification.

1.7 PERFORMANCE REQUIREMENTS

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or to the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

1.8 WARRANTY/GUARANTEE

- A. See Division 23 Specification Section “Basic Mechanical Requirements – HVAC” for warranty and guarantee requirements.

PART 2 - PRODUCTS <Select only products for particular project>

2.1 GENERAL REQUIREMENTS

- A. Equipment Design and Selection: Water treatment equipment, controls and specialties shall be designed and selected, for the intended use, in accordance with the requirements of this specification.
- B. UMB Campus Projects: UMB Campus Projects include new projects and renovation projects. For HVAC Hydronic Systems requiring water treatment comply with the following:

1. Water Treatment Company: The CM and/or the mechanical contractor shall use the water treatment company UMB has under contract for serving the hydronic water systems for the Campus Buildings.
 - a. UMB Water Treatment Company: Boland.
 2. HVAC Hydronic Systems: Hydronic Systems include:
 - a. Chilled Water Systems.
 - b. Condenser Water Systems.
 - c. Hot Water Heating Systems.
 - d. Energy Recovery Systems. (40% Glycol, Dowtherm SR-1)
- C. Equipment: Subject to compliance with requirements, provide products by one (1) of the following for:
1. Water Softener – HVAC Make Up Water:
 - a. Boland.
 2. RO for Make Up Water – HVAC: (Electric Boilers Only)
 - a. Boland.
 3. Filtration Equipment:
 - a. Boland.

2.2 HYDRONIC SYSTEM REQUIREMENTS

- A. Closed Hydronic Systems: Closed hydronic systems including [hot-water heating] [chilled water [and] [glycol cooling]], shall have the following water qualities:<Edit as required for project>
1. pH: Maintain a value within 7.0 to 10.0.
 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 3. Boron: Maintain a value within 100 to 200 ppm.
 4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
 5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 6. TSS: Maintain a maximum value of 10 ppm.
 7. Ammonia: Maintain a maximum value of 20 ppm.
 8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
 9. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1,000 organisms/mL
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL

- d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL
 - e. Iron Bacteria: Maintain a maximum value of zero organisms/mL
- B. Open Hydronic Systems: Open hydronic systems, including [condenser] [fluid-cooler spray] water, shall have the following water qualities:
- 1. pH: Maintain a value within 6.5.0 to 8.5.
 - 2. "P" Alkalinity: Maintain a maximum value of 100 ppm.
 - 3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
 - 4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 - 5. TSS: Maintain a maximum value of 10 ppm.
 - 6. Ammonia: Maintain a maximum value of 20 ppm.
 - 7. Free "OH" Alkalinity: Maintain a maximum value of zero ppm.
 - 8. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/mL
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 1,000 organisms/mL
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL
 - d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL
 - e. Iron Bacteria: Maintain a maximum value of zero organisms/mL
 - 9. Polymer Testable: Maintain a minimum value within ten (10) to forty (40).
- C. Steam Condensate and Steam Boiler Systems: <Delete if not required>
- 1. Steam Condensate:
 - a. pH: Maintain a value within 9.0 to 11.5.
 - b. Total Alkalinity: Maintain a value within 5 to 50 ppm.
 - c. Chemical Oxygen Demand: Maintain a maximum value of 15 ppm.
 - d. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 - e. TSS: Maintain a maximum value of 10 ppm.
 - f. Ammonia: Maintain a maximum value of 20 ppm.
 - g. Total Hardness: Maintain a maximum value of 2 ppm.
 - 2. Steam boiler operating at 15 psig and less shall have the following water qualities:
 - a. "OH" Alkalinity: Maintain a value within 200 to 400 ppm.
 - b. TSS: Maintain a value within 600 to 3,000 ppm.
 - 3. Steam boiler operating at more than 15 psig shall have the following water qualities:
 - a. "OH" Alkalinity: Maintain a value within 200 to 400 ppm.

- b. TSS: Maintain a value within 600 to 1,200 ppm to maximum thirty (30) times RO water TSS.

2.3 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum three and one half (3-1/2) inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
 1. Capacity: Five (5) gallons.
 2. Minimum Working Pressure: 175 psig.

2.4 GLYCOL FEEDER

- A. Glycol Feeder shall include the following:
 1. Storage Tank: Fifty (50) gallon polyethylene tank mounted on a painted steel frame.
 2. Pump: Single rotary pump, 1.5 to 3.75 gpm at 100psi.
 3. Pump Controls:
 - a. Start: Low Pressure Range: 10 – 45 psi.
 - b. Stop: High Pressure Range: 20 – 60 psi.
 - c. Adjustable Differential: 10 – 30 psi.
 4. Flow Switch: Low level pump shutoff.
 5. HOA Switch: For makeup gear pump.
 6. Control Panel: NEMA 4X with:
 7. Indicator Lights for Pump “ON” and “Low Level” indicator.
 8. Power: 115 Volts – 1 ph, 15 amps for hard wire connection. Disconnect by Division 26.
 9. Plumbing: Pre piped assembly including:
 - a. Suction Assembly: PVC ball valve, cast iron ‘y’ strainer, and PVC hose fitting.
 - b. Discharge Assembly: PVC ball valve, brass check valve, pressure gauge, brass relief valve with hose return to tank and schedule 40 brass pipe and fittings.
 10. BAS Interface: Dry contact for low tank level, pump “on” BACnet compatibility.

2.5 AUTOMATIC CHEMICAL-FEED EQUIPMENT

- A. Water Meter:
 1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
 2. Body: Bronze.
 3. Minimum Working-Pressure Rating: 150 psig.
 4. Maximum Pressure Loss at Design Flow: 3 psig.
 5. Registration: Gallons.

6. End Connections: Threaded.
7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac, and that will close at adjustable increments of total flow.

B. Inhibitor Injection Timers:

1. Microprocessor-based controller with digital display in NEMA 250, Type 12 enclosure with gasketed and lockable door
2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
3. Test switch.
4. Hand-off-auto switch for chemical pump.
5. Illuminated legend to indicate feed when pump is activated.
6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
7. Digital display makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.

C. pH Controller:

1. Microprocessor-based controller, 1% accuracy in a range from zero to 14 units. Incorporate solid-state integrated circuits and digital display in NEMA 250, Type 12 enclosure with gasketed and lockable door
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal pH indication.
5. High or low-pH-alarm-light trip points, field adjustable; with silence switch.
6. Hand-off-auto switch for acid pump.
7. Internal adjustable hysteresis or deadband.

D. TSS Controller:

1. Microprocessor-based controller, 1% accuracy in a range from zero to 5,000 micromhos. Incorporate solid-state integrated circuits and digital display in NEMA 250, Type 12 enclosure with gasketed and lockable door
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal conductance indication.
5. High- or low-conductance-alarm-light trip points, field adjustable; with silence switch.
6. Hand-off-auto switch for solenoid bleed-off valve.
7. Bleed-off valve activated indication.
8. Internal adjustable hysteresis or deadband.
9. Bleed Valves:

- a. Cooling Systems: Forged-brass body, globe pattern, general-purpose solenoid with continuous-duty coil, or motorized valve.
- b. Steam Boilers: Motorized ball valve, steel body, and TFE seats and seals.

E. Biocide Feeder Timer:

1. Microprocessor-based controller with digital display in NEMA 250, Type 12 enclosure with gasketed and lockable door
2. Twenty four (24) hour timer with fourteen (14) day skip feature to permit activation any hour of day.
3. Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.
4. Solid-state alternator to enable use of two (2) formulations.
5. Twenty four (2) hour display of time of day.
6. Fourteen (14) day display of day of week.
7. Battery backup so clock is not disturbed by power outages.
8. Hand-off-auto switches for biocide pumps.
9. Biocide A and Biocide B pump running indication.

F. Chemical Solution Tanks: <Edit for Project>

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110% containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: [30 gal.] [50 gal.]. <Select for project>

G. Chemical Solution Injection Pumps:

1. Self-priming, positive displacement; rated for intended chemical with minimum 25% safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Specification Section "Motor Requirements for HVAC Equipment."
 - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

I. Injection Assembly:

1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25% of pipe diameter.
2. Ball Valve: Two (2) piece stainless steel, as described in "Stainless-Steel Pipes and Fittings" Article; selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200°F.

2.6 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TSS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers; and oxidizing biocide test for open cooling systems.

B. Sample Cooler:

1. Tube: Sample.
 - a. Size: NPS 1/4 tubing.
 - b. Material: ASTM A 666, Type 316 stainless steel.
 - c. Pressure Rating: Minimum 2,000 psig.
 - d. Temperature Rating: Minimum 850°F.
2. Shell: Cooling water.
 - a. Material: ASTM A 666, Type 304 stainless steel.
 - b. Pressure Rating: Minimum 250 psig.
 - c. Temperature Rating: Minimum 450°F.

C. Corrosion Test Coupon Racks: <Delete if not Required for Project >

1. General: Corrosion Test Coupon Racks shall be provided for HVAC Hydronic Water Systems by the Basis of Design Water Treatment Company or approved equal. Racks shall be complete with piping, removable sample holders, corrosion coupons (mild steel and copper), flow indicator, and backboard with mounting brackets. Locate copper coupon downstream from mild steel coupon in the rack.

2. Hydronic System HVAC Requirements: Systems with maximum fluid temperatures less than or equal to 300°F and the maximum pressure at the coupon rack is less than 185 psi:

- a. Basis of Design Manufacturer: Advantage Controls Model ACR with the following components and options based on the manufacturer's pub-lished data:

- 1) Components:
 - a) Number of Holders: Two (2) holders, 16 inches tall x 22 inches wide x 8 inches deep.
 - b) Material: 3/4 - inch Black Iron Sch 40 pipe; 185 PSI @ 300°F.
 - 2) Options:
 - a) Flow Indicator: 8.5 inches long, 1-10 GPM, 230 psi @ 300°F.
 - b) Ball Valves: Omit valves.
3. HVAC Hydronic System Requirements: Systems with maximum fluid temperatures less than or equal to 100°F and the maximum pressure at the coupon rack is less than 100 psi:
- a. Basis of Design Manufacturer: Advantage Controls Model ACR with the following components and options based on the manufacturer's published data:
 - 1) Components:
 - a) Number of Holders: Two (2) holders, 16 inches tall x 22 inches wide x 8 inches deep.
 - b) Material: 3/4 - inch PVC Schedule 80 pipe, 120 PSI @ 125°F.
 - 2) Options:
 - a) Flow Indicator: 7.5 inches long, 1-10 GPM, 100 PSI @ 125°F max.
 - b) Ball Valves: Omit valves.
4. External Components: The following external components shall be furnished and installed by the mechanical contractor:
- a. Isolation Valves: 3/4 - inch ball valves.
 - b. Balancing Valve: 3/4 - inch ball valve with memory stop. Install the valve for operating while observing the Flow Indicator.
 - c. See Division 23 Specification Section – “Valves for HVAC Piping Systems and Accessories” for valve requirements.
5. Applicable system(s):
- a. Heating systems: Use steel racks.
 - b. Cooling systems: Steel, unless PVC is allowed below.
 - c. Contractor's option:

<Engineer: list only systems below in the project that are within the applicable temperature and pressure limits listed above in paragraphs 2 and 3>

- 1) Chilled water

- 2) Condensing
water
- 3) Glycol

2.7 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.
- B. Water Softener Chemicals:
 1. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock. Resin exchange capacity minimum 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lbs. of salt.
 2. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are unacceptable.

2.8 HVAC MAKEUP-WATER SOFTENER

- A. Description: Twin mineral tanks and one brine tank, factory mounted on skid.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fabricate supports and attachments to tanks with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure as recommended in writing by manufacturer.
- D. Mineral Tanks:
 1. Fabricate and label steel filter tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.
 2. Fabricate and label Fiber Reinforced Plastic filter tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, if indicated.
 3. Pressure Rating: 100 psig minimum.
 4. Wetted Components: Suitable for water temperatures from 40°F to at least 100°F.
 5. Freeboard: 50%, minimum, for backwash expansion above the normal resin bed level.
 6. Support Legs or Skirt: Constructed of structural steel, welded, or bonded to tank before testing and labeling.
 7. Finish: Hot dip galvanized on exterior and interior of tank after fabrication.
 8. Upper Distribution System: Single-point type, fabricated from galvanized-steel pipe and fittings.

9. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, nonclogging polyethylene strainers; arranged for even-flow distribution through resin bed.
- E. Controls: Automatic; factory mounted on mineral tanks and factory wired.
1. Adjustable duration of regeneration steps.
 2. Push-button start and complete manual operation override.
 3. Pointer on pilot-control valve shall indicate cycle of operation.
 4. Means of manual operation of pilot-control valve if power fails.
 5. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:
 - a. Slow opening and closing, nonslam operation.
 - b. Diaphragm guiding on full perimeter from fully open to fully closed.
 - c. Isolated dissimilar metals within valve.
 - d. Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
 - e. Float-operated brine valve to automatically measure the correct amount of brine to the softener and refill with fresh water.
 - f. Sampling cocks for soft water.
 6. Flow Control: Automatic control of backwash and flush rates over variations in operating pressures that do not require field adjustments. Equip mineral tanks with automatic-reset-head water meter that electrically activates cycle controller to initiate regeneration at preset total in gallons and that automatically resets after regeneration to preset total in gallons for next service run. Include alternator to regenerate one mineral tank with the other in service.
- F. Brine Tank: Combination measuring and wet salt storing system.
1. Tank and Cover Material: Fiberglass a minimum of 3/16 inch thick; or molded polyethylene a minimum of 3/8 inch thick.
 2. Brine Valve: Float operated, and plastic fitted for automatic control of brine withdrawn and freshwater refill.
 3. Size: Large enough for at least four regenerations at full salting.
- G. Factory-Installed Accessories:
1. Piping, valves, tubing, and drains.
 2. Sampling cocks.
 3. Main-operating-valve position indicators.
 4. Water meters.
- H. Water Test Kit: Include in wall-mounting enclosure for water softener.

2.9 RO EQUIPMENT FOR HVAC MAKEUP WATER – ELECTRIC BOILERS ONLY

- A. Description: Factory fabricated and tested with RO membrane elements in housings, high-pressure pumps and motors, controls, valves, and prefilter; mounted on skid.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fabricate supports and attachments to tanks with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure as recommended in writing by manufacturer.
- D. Skid Assembly: Welded-steel frame coated with epoxy protective finish.
- E. RO Membrane and Housing:
 - 1. Element: Thin-film composite with U-cup brine seal with minimum 98% salt rejection based on 2,000-ppm water supplied at 225 psig and 77°F.
 - 2. Housing: ASTM A 666, Type 304 stainless steel with PVC end caps held in place with stainless-steel straps.
- F. High-Pressure Pumps and Motors:
 - 1. Pump:
 - a. Vertical, multistage centrifugal operating at 3,500 rpm with ASTM A 666, Type 304 stainless-steel casing, shaft, impellers, and inlet and discharge casting.
 - b. Bearings shall be tungsten carbide and ceramic.
 - c. Cast-iron frame and flanged suction and discharge connections.
 - d. Motor: NEMA-standard, C-faced totally enclosed, fan cooled motor supported on the pump-bearing frame. General requirements for motors are specified in "Common Motor Requirements for HVAC Equipment."
- G. Controls:
 - 1. Microprocessor-based controller with digital display.
 - 2. Interlock for remote start/stop control.
 - 3. Membrane flush sequence when pumps shut down.
 - 4. Run time indicator.
 - 5. Low-pressure safety cutoff.
 - 6. Panel-mounted gages as follows:
 - a. Product and concentrate.
 - b. Inlet, cartridge filter outlet, RO feed, RO concentrate, and RO product pressures.
 - c. Product conductivity monitor.

H. Valves:

1. Stainless-steel pump, concentrate, and recycle throttling valves rated for minimum 300 psig.
2. Automatic inlet shutoff valve, diaphragm type; solenoid actuated, normally closed, and constructed of glass-reinforced noryl thermoplastic.
3. PVC valves with EPDM seats and seals for isolation at inlet, and check and sample valves at product and concentrate. Sample valves at cartridge filter outlet, concentrate, and product outlet.

I. Prefilter:

1. Housing: Polypropylene with built-in relief or vent valve.
2. Element: Spun-wound polypropylene.

J. Inlet Water Tempering Valve: Thermostatic water-tempering valve to maintain 77°F inlet water temperature to RO unit.

K. Activated Carbon Filter:

1. Media Tank: Fiberglass-reinforced polyester rated for minimum 150 psig with internal backwash distributor and filtered water collector.
2. Media: Twelve (12) by forty (40) mesh, bituminous coal-based activated carbon.
3. Backwash Valve: Piston-operated control valve with drain-line, flow-control orifice.
4. Backwash Control: Seven (7) daytime clock.

L. Atmospheric Storage Tank:

1. Tank: Polyethylene single piece with closed top and flat bottom with manway in top, 0.2-micron filter vent, inlet, discharge, and drain piping connections, and bulkhead fittings for level controls.
2. Control: Level switches start and stop RO unit. Low-level limit shall stop repressurization pumps and signal an alarm.

M. Repressurization Pumps:

1. Pumps: Two close-coupled, single-stage centrifugal pumps with mechanical seals. Wetted components ASTM A 666, Type 316 stainless steel.
2. Controls: NEMA-4X pump control panel constructed of fiberglass to control pumps, one operating and one standby, with automatic alternator and fail-over control.
3. Motor: Open, drip proof motor supported on the pump-bearing frame. General requirements for motors are specified in Division 23 Specification Section "Motor Requirements for HVAC Equipment."

- a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

N. Water Test Kit: Include in wall-mounting cabinet for RO unit.

2.10 FILTRATION EQUIPMENT

A. Multimedia Filters:

1. Description: Factory-fabricated and tested, simplex, multimedia filter system of filter tank, media, strainer, circulating pump, piping, and controls for removing particles from water.
 - a. Filter Tank: Corrosion resistant with distribution system and media.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - a. Fabricate and label FRP filter tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, if indicated.
 - b. FRP Tank Pipe Connections NPS 2-1/2 and Larger: Type A, integral; Designation E, 125-psig or Designation F, 150-psig pressure category flanges of grade same as tank material according to ASTM D 5421.
 - c. Motorized Valves: Flanged or grooved-end, ductile-iron butterfly type with EPDM valve seat and stem seal; with ASTM B 148 aluminum bronze disc.
 - d. Strainer: Basket type mounted on pump suction.
 - e. Piping: ASTM A 53/A 53M, Type S, F, or E; Grade B, Schedule 40 black steel, with flanged, grooved, or threaded joints and malleable, steel welding, or ductile-iron fittings.
 - f. Safety Valves: Automatic pressure relief.
 - g. Circulating Pump: Overhung impeller, close coupled, single stage, end suction, centrifugal. Comply with UL 778 and with HI 1.1-1.2 and HI 1.3.
 - 1) Casing: Radially split, cast iron.
 - 2) Pressure Rating: 125 psig minimum.
 - 3) Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
 - 4) Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
 - 5) Seal: Mechanical.
 - 6) Motor: ODP motor supported on the pump-bearing frame. General requirements for motors are specified in "Common Motor Requirements for HVAC Equipment."

- h. Controls: Automatic control of circulating pump and tank backwash; factory wired for single electrical connection.
 - 1) Panel: NEMA 250, enclosure with time clock and pressure gages.
 - 2) Pump: Automatic and manual switching; manual switch position bypasses safeties and controls.
 - 3) Backwash: Automatic; with time clock and differential pressure switch.
 - 4) Backwash Valve: Tank mounted with valves interlocked to single actuator.
 - i. Support: Skid mounting [Fabricate supports and base and attachment to tank with reinforcement strong enough to resist filter movement during a seismic event when filter base is anchored to building structure.]
- B. [Bag] [Cartridge]-Type Filters: <Edit for Project>
- 1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Cycron Corporation.
 - b. Eden Equipment Company.
 - c. Filter Specialists, Inc.
 - d. Filtration Systems; a division of Mechanical Mfg. Corporation.
 - e. Hayward Flow Control Systems, Inc.
 - f. Parker Hannifin Corp.; Process Filtration Div.
 - g. Pentair, Inc.
 - h. PEP Filters, Inc.
 - i. Rain Soft; a division of Aquion Water Treatment Products.
 - j. Rosedale Products, Inc.
 - k. RPA Process Technologies.
 - l. Shelco Filters.
 - m. Siemens Water Technologies.
 - 2. Description: Floor-mounting housing with filter [bags] [cartridges] for removing particles from water.
 - a. Housing: Corrosion resistant; designed to separate inlet from outlet and to direct inlet through [bag] [cartridge]-type water filter; with [bag support and] base, feet, or skirt.
 - 1) Pipe Connections NPS 2 and Smaller: Threaded according to ASME B1.20.1.
 - 2) Steel Housing Pipe Connections NPS 2-1/2 inch and Larger: Steel, Class 150 flanges according to ASME B16.5 or grooved according to AWWA C606.

- 3) Plastic Housing Pipe Connections NPS 2-1/2 inch and Larger: 150-psig plastic flanges.
- b. [Bag] [Cartridge]: Replaceable; of shape to fit housing.
 - c. Housing:
 - 1) Material: [Carbon steel] [Plastic].
 - 2) Pressure Rating: <Insert psig>.
 - 3) Seal Material: [Nitrile Rubber] <Insert material>.
 - 4) Diameter: <Insert inches>.
 - 5) Height or Length: <Insert inches>.
 - 6) Inlet and Outlet Size: <Insert NPS>.
 - 7) Drain Size: <Insert NPS>.
 - 8) Bag Support Basket Material: Stainless steel.
 - d. [Bag] [Cartridge]:
 - 1) Number Required: <Insert number>.
 - 2) Nominal Diameter: <Insert inches>.
 - 3) Nominal Length: <Insert inches>.
 - 4) Media Material: [Cotton] [Polyester] [Polypropylene].

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. See Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems" for seismic restraints.
- C. Install water-testing equipment on wall near water-chemical-application equipment.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.

- F. Bypass Feeders: Install in closed hydronic systems, including [hot-water heating] [chilled water] [and] [glycol cooling], and equipped with the following:
1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 2. Install water meter in makeup-water supply.
 3. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 4. Install a full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 5. Install a swing check on inlet after the isolation valve.
- G. Install automatic chemical-feed equipment for steam boiler and steam condensate systems and include the following:
1. Install makeup-water softener.
 2. Install water meter in makeup-water supply.
 3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.
 - a. Pumps shall operate for timed interval when contacts close at water meter in makeup-water supply connection.
 4. Install test equipment and furnish test-kit to Owner.
 5. Install RO unit for makeup water.
 6. Install TSS controller with sensor and bleed valves.
 - a. Bleed valves shall cycle to maintain maximum TSS concentration.
 7. Install inhibitor injection timer with injection pumps and solution tanks.
 - a. Pumps shall operate for timed interval on contact closure at water meter in makeup-water supply connection. Injection pump shall discharge into main steam supply header.
- H. Install automatic chemical-feed equipment for [condenser] [fluid-cooler spray] water and include the following:
1. Install makeup-water softener.
 2. Install water meter in makeup-water supply.
 3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.
 - a. Pumps shall operate for timed interval on contact closure at water meter in makeup-water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.

4. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
5. Install TSS controller with sensor and bleed valves.
 - a. Bleed valves shall cycle to maintain maximum TSS concentration.
6. Install pH sensor and controller with injection pumps and solution tanks.
 - a. Injector pumps shall operate to maintain required pH.
7. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.
 - a. Injection pumps shall operate to feed biocide on an alternating basis.
8. Install ozone generator with diffusers in condenser-water piping.
 - a. Ozone generator shall operate continuously with condenser-water flow.
9. Install UV-irradiation lamps in condenser-water piping.
 - a. UV lights shall operate continuously with condenser-water flow.

3.3 WATER SOFTENER INSTALLATION

- A. Install water softener equipment on concrete bases level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure. See Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems" for seismic restraints.
- C. Install brine lines and fittings furnished by equipment manufacturer but not factory installed.
- D. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.
- E. Install water-testing sets on wall adjacent to water softeners.

3.4 RO UNIT INSTALLATION

- A. Install RO unit and storage tank on concrete bases level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor RO unit and storage tank with pumps to substrate.

<Retain first paragraph below for Project in a seismic area. Add special requirements for seismic restraints here or indicate on Drawings.>

- B. Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure. See Division 23 Specification Section "Vibration and Seismic Controls for HVAC Systems" for seismic restraints.
- C. Install interconnecting piping and controls furnished by equipment manufacturer but not factory installed.
- D. Install water-testing sets on wall adjacent to RO unit.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.
- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Specification Section "HVAC Piping Systems and Specialties."
- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Shutoff valves are specified in Division 23 Specification Section "Valves for HVAC Piping Systems."
- E. See Division 22 Specification Section "Domestic Water Piping and Specialties" for backflow preventers required in makeup-water connections to potable-water systems.
- F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- G. Ground equipment according to Division 26 Specification Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Specification Section "Low-Voltage Electrical Power Conductors and Cables."

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC system's startup procedures.
 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- C. Equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Add to or delete tests to suit Project. For definitions of terms used in sampling and testing, see ASTM D 1129, "Terminology Relating to Water."
- F. Sample boiler water at one-week intervals after boiler startup for a period of five (5) weeks and prepare test report advising Owner of changes necessary to adhere to "Performance Requirements" Article for each required characteristic. Sample boiler water at four week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.
<Delete if not required>
- G. At four (4) week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.
- H. Comply with ASTM D 3370 and with the following standards:
1. Silica: ASTM D 859.
 2. Steam System: ASTM D 1066.
 3. Acidity and Alkalinity: ASTM D 1067.
 4. Iron: ASTM D 1068.

5. Water Hardness: ASTM D 1126.

3.7 MAINTENANCE SERVICE

- A. Verify with Owner that maintenance service is required for Project.
- B. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping, heating, hot-water piping, heating, steam and condensate piping, steam and condensate system for humidifiers, and condenser-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:
 1. Initial water analysis and HVAC water-treatment recommendations.
 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 3. Periodic field service and consultation.
 4. Customer report charts and log sheets.
 5. Laboratory technical analysis.
 6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 232500