

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Division of the Specifications. However, these requirements are applicable to the work of this Division, and are hereby incorporated by reference.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following HVAC water-treatment systems:
 - 1. Bypass chemical-feed equipment and controls.
 - 2. HVAC water-treatment chemicals.
 - 3. Makeup water softeners for HVAC gas fired humidifier-section 238413
 - 4. RO equipment for HVAC gas fired humidifier-section 238413.

1.3 DEFINITIONS

- A. EEPROM: Electrically erasable, programmable read-only memory.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- C. RO: Reverse osmosis.
- D. TDS: Total dissolved solids.
- E. UV: Ultraviolet.

1.4 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 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.
- C. Closed hydronic systems, including glycol chilled water, glycol hot water and glycol energy recovery water, shall have the following water qualities:
 - 1. pH: Maintain a value within 9.0 to 10.5.
 - 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - 3. Boron: Maintain a value within 100 to 200 ppm.
 - 4. Soluble Copper: Maintain a maximum value of 0.20 ppm.

5. TDS: Maintain a maximum value of 10 ppm.
6. Ammonia: Maintain a maximum value of 20 ppm.
7. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
8. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 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 0 organisms/ml.
 - e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

1.5 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
 1. Bypass feeders.
 2. Water meters.
 3. Chemical test equipment.
 4. Chemical material safety data sheets.
 5. Water softeners.
 6. RO units.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.
- B. 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 the "Performance Requirements" Article above.
 2. Water Analysis: Illustrate water quality available at Project site.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sensors, injection pumps, water softeners, RO equipment, and controllers to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.9 MAINTENANCE SERVICE

- A. 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 energy recovery 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.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ampion Corp.
 2. Anderson Chemical Co, Inc.
 3. Aqua-Chem, Inc.; Cleaver-Brooks Div.
 4. Barclay Chemical Co.; Water Management, Inc.
 5. Boland Trane Services
 6. GE Betz.
 7. GE Osmonics.
 8. H-O-H Chemicals, Inc.
 9. Metro Group. Inc. (The); Metropolitan Refining Div.
 10. ONDEO Nalco Company.
 11. Watcon, Inc.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 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: 2 gal..
 2. Minimum Working Pressure: 125 psig.

2.3 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.
- B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
 - 1. Two-station rack for closed-loop systems.

2.4 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 Part 1 "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 lb of salt.
 - 2. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

2.5 HVAC MAKEUP WATER SOFTENER FOR NATURAL GAS FIRED HUMIDIFIER

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alamo Water Treatment; Ecodyne Water Treatment, Inc.
 - 2. Columbia Water Conditioning Systems, Inc.
 - 3. CSI; a division of Chandler Systems, Inc.
 - 4. Culligan International.
 - 5. CUNO Incorporated.
 - 6. Diamond Water Conditioning.
 - 7. Diamond Water Systems, Inc.
 - 8. Environmental Dynamics Corporation.
 - 9. Hungerford & Terry, Inc.
 - 10. Kinetico Incorporated.
 - 11. Marlo Incorporated.
 - 12. Parker Boiler Company.
 - 13. Plymouth Products, Inc.
 - 14. Rainsoft Div.; Aquion Partners L. P.
 - 15. Water King.
- B. Description: Twin mineral tanks and one brine tank, factory mounted on skid.
- C. Mineral Tanks:

1. Fabricate and label FRP filter tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, if indicated.
 2. Pressure Rating: 100 psig <Insert value> minimum.
 3. Wetted Components: Suitable for water temperatures from 40 to at least 100 deg F.
 4. Freeboard: 50 percent, minimum, for backwash expansion above the normal resin bed level.
 5. Support Legs or Skirt: Constructed of structural steel, welded or bonded to tank before testing and labeling.
 6. Finish: Hot-dip galvanized on exterior and interior of tank after fabrication.
 7. Upper Distribution System: Single-point type, fabricated from galvanized-steel pipe and fittings.
 8. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, nonclogging PE strainers; arranged for even-flow distribution through resin bed.
- D. 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 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.
- E. Brine Tank: Combination measuring and wet-salt storing system.
1. Tank and Cover Material: Fiberglass a minimum of 3/16 inch thick; or molded PE 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.
- F. Factory-Installed Accessories:

1. Piping, valves, tubing, and drains.
 2. Sampling cocks.
 3. Main-operating-valve position indicators.
 4. Water meters.
- G. Water Test Kit: Include water test kit in wall-mounting enclosure for water softener.
- H. Capacities and Characteristics:
1. Continuous Service Flow Rate: coordinate with the humidifier manufacturer requirements.
- 2.6 RO EQUIPMENT FOR NATURAL GAS FIRED HUMIDIFIER
- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alamo Water Treatment; Ecodyne Water Treatment, Inc.
 2. Columbia Water Conditioning Systems, Inc.
 3. CSI; a division of Chandler Systems, Inc.
 4. Culligan International.
 5. CUNO Incorporated.
 6. Diamond Water Conditioning.
 7. Environmental Dynamics Corporation.
 8. Hungerford & Terry, Inc.
 9. Kinetico Incorporated.
 10. Marlo Incorporated.
 11. Plymouth Products, Inc.
 12. Rainsoft Div.; Aquion Partners L. P.
 13. Water & Power Technologies, Inc.
 14. Water King.
- B. Description: Factory fabricated and tested with RO membrane elements in housings, high-pressure pumps and motors, controls, valves, and prefilter; mounted on skid.
- C. Skid Assembly: Welded-steel frame coated with epoxy protective finish.
- D. RO Membrane and Housing:
1. Element: Thin-film composite with U-cup brine seal with minimum 98 percent salt rejection based on 2000-ppm water supplied at 225 psig and 77 deg F.
 2. Housing: ASTM A 666, Type 304 stainless steel with PVC end caps held in place with stainless-steel straps.
- E. High-Pressure Pumps and Motors (where required):
1. Pump:
 - a. Vertical, multistage centrifugal operating at 3500 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.
 2. Motor: NEMA-standard, C-faced TEFC motor supported on the pump-bearing frame. General requirements for motors are specified in Division 23, Common Motor Requirements for HVAC Equipment.
- F. Controls:
1. Microprocessor-based controller with LCD 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.
- G. 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.
- H. Prefilter:
1. Housing: Polypropylene with built-in relief or vent valve.
 2. Element: Spun-wound polypropylene.
- I. Inlet Water Tempering Valve: Thermostatic water-tempering valve to maintain 77 deg F inlet water temperature to RO unit.
- J. Activated Carbon Filter:
1. Media Tank: Fiberglass-reinforced polyester rated for minimum 150 psig with internal backwash distributor and filtered water collector.
 2. Media: 12 x 40-mesh, bituminous coal-based activated carbon.
 3. Backwash Valve: Piston-operated control valve with drain-line, flow-control orifice.
 4. Backwash Control: Seven-day time clock.
- K. 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.
- L. Water Test Kit: Include water test kit in wall-mounting cabinet for RO unit.
- M. Capacities and Characteristics:

1. RO Product Flow Rate: coordinate with the humidifier manufacturer requirements

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 water testing equipment on wall near water chemical application equipment.
- C. Install interconnecting control wiring for chemical treatment controls and sensors.
- D. Mount sensors and injectors in piping circuits.
- E. Bypass Feeders: Install in closed hydronic systems, including **[glycol chilled water, glycol hot water and glycol energy recovery water]**, and equipped with the following:
 1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 2. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 3. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 4. Install a swing check on inlet after the isolation valve.
- F. Install equipment for gas fired steam humidifier and include the following:
 1. Install makeup water softener/ dechlorinator..
 2. Install RO/ DI system.

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 brine lines and fittings furnished by equipment manufacturer but not factory installed.
- C. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.
- D. 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.
- B. Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure. Refer to Division 23, Vibration and Seismic Controls for HVAC Piping and Equipment 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. Install piping adjacent to equipment to allow 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, Hydronic Piping.
- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23, General-Duty Valves for HVAC Piping.
- E. Refer to Division 22, Domestic Water Piping Specialties for backflow preventers required in makeup water connections to potable-water systems.
- F. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.
- G. Ground equipment according to Division 26, Grounding and Bonding for Electrical Systems.
- H. Connect wiring according to Division 26, Low-Voltage Electrical Power Conductors and Cables.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 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 systems' 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.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. At eight-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 Part 1 "Performance Requirements" Article.
- F. 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 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. Refer to Division 01, Demonstration and Training.
- B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION

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