SECTION 232516 - WATER TREATMENT FOR OPEN-LOOP HYDRONIC SYSTEMS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

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

1. GENERAL
   * + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
      1. SUMMARY
         1. Section includes the following HVAC water-treatment systems:

Automatic chemical-feed equipment.

Ozone-generator biocide equipment.

Stainless steel pipes and fittings.

UV biocide equipment.

Chemical-treatment test equipment.

Chemicals.

TDS controllers.

TSS controllers.

* + - * 1. Related Requirements:

Retain subparagraph below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 232533 "HVAC Makeup-Water Filtration Equipment" for water treatment of water softeners, RO equipment, and filtration equipment.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. EEPROM: Electrically erasable, programmable read-only memory.
        2. PPM: Parts per million.
        3. RO: Reverse osmosis.
        4. TDS: Total dissolved solids consist of salts and other materials that combine with water as a solution.
        5. TSS: Total suspended solids include both organic and inorganic solids that are suspended in the water. These solids may include silt, plankton, and industrial wastes.
      1. SUBMITTALS
         1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
         2. Manufacturer’s installation instructions shall be provided along with product data.
         3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
         4. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:

Water meters.

Inhibitor injection timers.

pH controllers.

TDS controllers.

Biocide feeder timers.

Chemical solution tanks.

Injection pumps.

Ozone generators.

UV-irradiation units.

Chemical-treatment test equipment.

Chemical material safety data sheets.

* + - * 1. Shop Drawings: Pretreatment equipment and chemical- [**and ozone-generator-biocide-**] [**and UV-irradiation-biocide-**]treatment equipment, showing tanks, maintenance space required, and piping connections to HVAC systems.

Include plans, elevations, sections, and attachment details.

Include diagrams for power, signal, and control wiring.

Retain "Seismic Qualification Certificates" paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Water-Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.

Retain "Water-Treatment Program" paragraph below if retaining "Maintenance Service" Article.

* + - * 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.

Retain "Passivation Confirmation Report" paragraph below for open systems that contain a galvanized cooling tower or an evaporative or a fluid cooler.

* + - * 1. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Director’s Representative.
      1. CLOSEOUT SUBMITTALS
         1. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.
      2. QUALITY ASSURANCE
         1. 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.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. MANUFACTURERS

Retain this article to require a single-source responsibility for all water-treatment equipment and materials.

* + - * 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Anderson Chemical Company.

Aqua-Chem, Inc.

Barclay Water Management, Inc.

Boland Trane Services.

Approved equivalent.

* + - 1. PERFORMANCE REQUIREMENTS

The companies listed above supply water-treatment chemicals. They will also furnish and install all required hardware and provide a complete on-site HVAC water-treatment program.

* + - * 1. Provide all hardware, chemicals, and other material necessary to maintain HVAC water quality in all systems, as indicated in this Specification. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of equipment without creating a hazard to operating personnel or the environment.
        2. 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.

Desirable water-quality values differ widely, depending upon raw water conditions, piping system materials, and service conditions. Recommendations from water-treatment companies vary. Specified target values must be determined by careful consideration of all operating conditions and with the assistance of a qualified water chemistry expert.

* + - * 1. Open hydronic systems, including [**condenser**] [**and**] [**fluid-cooler spray**] water, shall have the following water qualities:

pH: Maintain a value within <**6.5 to 8.5 pH units**>.

Alkalinity: Maintain a maximum value of <**100**> ppm as CaCO(3).

Silica in Cooling Towers: Maintain a value no higher than <**100**> ppm.

Silica in Evaporative Condensers: Maintain a value no higher than <**100**> ppm.

Hardness in Cooling Towers: Maintain a value no higher than <**1,200**> ppm as CaCO(3).

Hardness in Evaporative Condensers: Maintain a value no higher than <**750**> ppm as CaCO(3).

Steel Corrosion Inhibiters: Provide sufficient inhibitors to limit mild steel corrosion to <**0.50**> mils per year. Maintain soluble iron concentrations at or below <**0.10**> ppm.

Yellow Metal Corrosion Inhibitor: Provide sufficient copper and brass corrosion inhibitors to limit copper corrosion to <**0.10**> mils per year. Maintain soluble copper concentrations at or below <**0.20**> ppm.

Scale Control: [**Provide softened water for initial fill and makeup.**] [**Provide sufficient scale inhibitors to prevent formation of scale, and maintain all scale-forming material in solution.**]

Dispersants: Provide sufficient dispersants to prevent sedimentation of fine particulate matter.

Microbiological Limits:

Total Aerobic Plate Count: Maintain a maximum value of <**10,000**> organisms/mL.

Total Anaerobic Plate Count: Maintain a maximum value of <**1,000**> organisms/mL.

Nitrate Reducers: Maintain a maximum value of <**100**> organisms/mL.

Sulfate Reducers: Maintain a maximum value of <**zero**> organisms/mL.

Iron Bacteria: Maintain a maximum value of <**zero**> organisms/mL.

<**Insert other applicable requirements**>.

Retain "Passivation for Galvanized Steel" paragraph below for cooling towers, evaporative coolers, or other equipment with galvanized-steel components, to avoid white rust. All galvanized-steel component surfaces exposed to cooling water must be properly passivated in accordance with manufacturer's instructions during initial startup. Water quality, especially pH and alkalinity, must be maintained within manufacturer's required parameters during the passivation period and during later operation to avoid serious damage to galvanized surfaces.

* + - * 1. Passivation for Galvanized Steel:

Passivation of all galvanized-steel cooling towers and other system components must be conducted strictly in accordance with manufacturer's instructions in order to validate warranties. During the required passivation period, all water-quality parameters must be maintained in accordance with manufacturer's specifications, and all other requirements must be observed.

* + - 1. AUTOMATIC CHEMICAL-FEED EQUIPMENT

Retain one or more of "Water Meter, Oscillating Piston," "Water Meter, Turbine Type, Threaded," and "Water Meter, Turbine Type, Flanged" paragraphs below. If retaining more than one paragraph, indicate on Drawings where meters are to be installed. Coordinate type of meter signal with controllers.

* + - * 1. Water Meter, Oscillating Piston:

AWWA C700, oscillating-piston, magnetic-drive, totalization meter.

Body: Bronze.

Minimum Working-Pressure Rating: 150 psig.

Maximum Pressure Loss at Design Flow: 3 psig.

Registration: Gallons.

End Connections: Threaded.

[**Controls: Flow-control switch with normally open contacts, rated for maximum 10 A, 250-V ac, that will momentarily close at adjustable increments of total flow.**]

[**Electronic or digital interface for flow rate indication at central workstation compatible with DDC system, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC." Low-voltage signal must be capable of transmitting 1000 feet.**]

[**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.**]

* + - * 1. Water Meter, Turbine Type, Threaded:

AWWA C701, turbine-type, totalization meter.

Body: Bronze.

Minimum Working-Pressure Rating: 100 psig.

Maximum Pressure Loss at Design Flow: 3 psig.

Registration: Gallons.

End Connections: Threaded.

[**Controls: Flow-control switch with normally open contacts, rated for maximum 10 A, 250-V ac, that will momentarily close at adjustable increments of total flow.**]

[**Electronic or digital interface for flowrate indication at central workstation compatible with DDC system, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC." Low-voltage signal must be capable of transmitting 1000 feet.**]

[**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.**]

* + - * 1. Water Meter, Turbine Type, Flanged:

AWWA C701, turbine-type, totalization meter.

Body: [**Bronze**] [**Epoxy-coated cast iron**].

Minimum Working-Pressure Rating: 150 psig.

Maximum Pressure Loss at Design Flow: 3 psig.

Registration: Gallons.

End Connections: Flanged.

[**Controls: Flow-control switch with normally open contacts, rated for maximum 10 A, 250-V ac, that will momentarily close at adjustable increments of total flow.**]

[**Electronic or digital interface for flow rate indication at central workstation compatible with DDC system, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC." Low-voltage signal must be capable of transmitting 1000 feet.**]

[**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.**]

* + - * 1. Inhibitor Injection Timers:

Microprocessor-based controller with digital display in NEMA 250, Type 12 enclosure with gasketed and lockable door.[**Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."**]

Programmable timers, with infinite adjustment over full range, mounted in cabinet with hand-off-auto switches and status lights.

Test switch.

Hand-off-auto switch for chemical pump.

Illuminated legend to indicate feed when pump is activated.

Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.

Digital display makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.

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.

* + - * 1. pH Controller:

Microprocessor-based controller, 1 percent 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.[**Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."**]

Digital display and touch pad for input.

Sensor probe adaptable to sample stream manifold.

High, low, and normal pH indication.

High- or low-pH-alarm-light trip points, field adjustable; with silence switch.

Hand-off-auto switch for acid pump.

Internal adjustable hysteresis or deadband.

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.

* + - * 1. TDS Controller:

Microprocessor-based controller, 1 percent accuracy in a range from zero to 5000 micromhos. Incorporate solid-state integrated circuits and digital display in NEMA 250, Type 12 enclosure with gasketed and lockable door.[**Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."**]

Digital display and touch pad for input.

Sensor probe adaptable to sample stream manifold.

High, low, and normal conductance indication.

High- or low-conductance-alarm-light trip points, field adjustable; with silence switch.

Hand-off-auto switch for solenoid bleed-off valve.

Bleed-off valve activated indication.

Internal adjustable hysteresis or deadband.

Bleed Valves:

Forged-brass body, globe pattern, general-purpose solenoid with continuous-duty coil, or motorized valve.

Retain "TSS Controller" paragraph below for open systems, cooling towers, and fluid coolers when TSS controller is required.

* + - * 1. TSS Controller:

Microprocessor-based controller, 1 percent accuracy in a range from 0.001 mg/L to 50 g/L. Incorporate solid-state integrated circuits and digital display in NEMA 250, Type 4X enclosure.[**Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."**]

[**Forms of digital communication:**] [**MODBUS RS-232**] [**MODBUS RS-485**] [**Profibus DP**]

Digital display and touch pad for input.

Sensor probe adaptable to sample stream manifold.

High- or low-value-alarm-light trip points, field adjustable; with silence switch.

Hand-off-auto switch for solenoid bleed-off valve.

Bleed-off valve activated indication.

Internal adjustable hysteresis or deadband.

* + - * 1. Biocide Feeder Timer:

Microprocessor-based controller with digital display in NEMA 250, Type 12 enclosure with gasketed and lockable door.[**Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."**]

24-hour timer with 14-day skip feature to permit activation any hour of day.

Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.

Solid-state alternator to enable use of two different formulations.

24-hour display of time of day.

14-day display of day of week.

Battery backup, so clock is not disturbed by power outages.

Hand-off-auto switches for biocide pumps.

Biocide A and Biocide B pump running indication.

* + - * 1. Chemical Solution Tanks:

Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.

Molded cover with recess for mounting pump.

Capacity: [**30 gal.**] [**50 gal.**] [**120 gal.**] <**Insert value**>.

* + - * 1. Chemical Solution Injection Pumps:

Self-priming, positive displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.

Adjustable flow rate.

Metal and thermoplastic construction.

Built-in relief valve.

Motor characteristics, such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency, are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, add subparagraphs below to suit Project.

Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

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.

* + - * 1. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints, except ASTM A269, Type 304 stainless steel for steam boiler injection assemblies.
        2. Injection Assembly:

Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.

Ball Valve: [**Three**] [**Two**]-piece stainless steel, as described in "Stainless Steel Pipes and Fittings" Article; selected to fit quill.

Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.

Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

* + - 1. OZONE-GENERATOR BIOCIDE EQUIPMENT
         1. Corona discharge generator with stainless steel generating cells, and transformer housed in a NEMA 250, Type 4 enclosure. Assembly shall be suitable for continuous duty. Include factory-mounted site glasses to verify proper operation of generator.
         2. Water-cooled generators shall be provided with cooling water at maximum [**70 deg F**] <**Insert value**> and [**35 psig**] <**Insert value**>.
         3. Generator vessels shall be constructed in accordance with 2017 ASME Boiler and Pressure Vessel Code, bear an ASME label, and be equipped with pressure relief valve.
         4. External air compressor or induced airflow through a cleanable prefilter shall supply concentrated oxygen through a molecular sieve, with minus 62 deg F dew point to avoid the formation of nitric acid.
         5. Controls: Microprocessor based with software in EEPROM, surge protection, high-temperature cutout, and operational status lights.[**Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."**]
         6. Ozone Contactors:

Bubble diffusers.

Induction injection nozzle.

Injectors with static mixers.

* + - * 1. Ozone Detector and Alarm Devices:

Detector:

Sensor: Metal dioxide semiconductor.

Concentration Range: [**0 to 10**] <**Insert range**> ppm.

Accuracy: Plus or minus 0.01 ppm.

Sensitivity: 0.01 ppm.

Response Time: Maximum 10 seconds.

Operating Temperature: 50 to 100 deg F.

Relative Humidity: 15 to 90 percent, noncondensing over the operating temperature range.

Horns:

Electric-vibrating-polarized type.

24-V dc, with provision for housing the operating mechanism behind a grille.

Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

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.

Visible Alarm Devices:

Xenon strobe lights listed in UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate.

Rated Light Output: [**75**] [**110**] <**Insert number**> candela.

Strobe Leads: Factory connected to screw terminals.

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.

Retain paragraph below when Ozone system is included in project.

* + - * 1. Self-Contained Breathing Apparatus: Open-circuit, pressure-demand, compressed air includes completely assembled, portable, self-contained devices designed for hazardous breathing environment application.

Face Piece: EPDM or silicone rubber construction material, one-size-fits-all with double-sealing edge, stainless steel speaking diaphragm and lens retainer, five adjustable straps to hold face piece to head (two straps on each side and one on top), exhalation valve in mask, close-fitting nose piece to ensure no CO(2) buildup, and perspiration drain to avoid skin irritation and to prevent eyepiece, spectacle, and lens fogging.

Backplate: Orthopedically designed of [**chemical and impact-resistant, glass-fiber composite**] [**aluminum**].

Harness and Carrier Assembly: Large triangular back pad, backplate, and adjustable waist and shoulder straps; modular in design, detachable components, and easy to clean and maintain. Shoulder straps are padded with flame-resistant material, reinforced with stainless steel cable, and attached with T-nuts, washers, and screws.

Air Cylinder: [**30**] [**45**] [**60**]-minute, low-pressure, air-supply-loaded [**fiberglass**] [**aluminum**] [**steel**] cylinders fitted with quick-fill assembly for refilling and air transfer.

Wall-Mounting Cabinet: Leakproof, corrosion-resistant, clear, plastic case.

Tested and Certified: By the National Institute for Occupational Safety and Health and by the Mine Safety and Health Administration, in accordance with 42 CFR 84, Subpart H.

* + - 1. STAINLESS STEEL PIPES AND FITTINGS
         1. Stainless Steel Tubing: Comply with ASTM A269, Type 316.
         2. Stainless Steel Fittings: Comply with ASTM A815, Type 316, Grade WP-S.
         3. Two-Piece, Full-Port, Stainless Steel Ball Valves: ASTM A351, Type 316 stainless steel body; ASTM A276, Type 316 stainless steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig steam working-pressure rating and 600-psig cold working-pressure rating.
         4. Three-Piece, Full-Port, Stainless Steel Ball Valves: ASTM A351, Type 316 stainless steel body; ASTM A276, Type 316 stainless steel stem and vented ball, threaded body design with adjustable stem packing, threaded ends, and 150-psig steam working pressure and 600-psig cold working pressure rating.
      2. UV BIOCIDE EQUIPMENT
         1. Target Irradiation: Minimum 30 mJ x s/sq. cm.
         2. Light Source Vessels:

ASTM A666, Type 304 stainless steel.

Construct for minimum [**150 psig**] <**Insert value**> at [**150 deg F**] <**Insert value**> in accordance with 2017 ASME Boiler and Pressure Vessel Code, and equip with pressure-relief valve.

Light Source Sleeve: Quartz, with EPDM O-ring seals.

Light Source: Replaceable UV lamp producing a minimum target irradiation of 254-nm wavelength light.

* + - * 1. Controls: Interlock with pumps to operate when water is circulating.
      1. CHEMICAL-TREATMENT TEST EQUIPMENT
         1. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounted 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.
         2. 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.

[**Four**] <**Insert number**>-station rack for open systems.

* + - 1. CHEMICALS

Revise this article to suit local conditions and recommendations of chemical-treatment manufacturer.

* + - * 1. Chemicals shall be as recommended by water-treatment system manufacturer, compatible with piping system components and connected equipment, and able to attain water quality specified in "Performance Requirements" Article.
        2. Cleaning chemicals:

Deposit Removal Cleaning Solution: blended neutral pH cleaning solution which is capable of removing scale and iron deposits, destroying bacteria, and passivating the metal surfaces of system.

* + - * 1. Chemical treatment chemicals:

Chemical Treatment: corrosion and scale inhibitors which contains the following components, in the form of separate chemicals:

Sulphite as an oxygen scavenger.

Phosphate as a scale inhibitor.

Caustic as an alkalinity builder.

Neutralizing amine as a corrosion control agent

1. EXECUTION
   * + 1. WATER ANALYSIS

Delete this article if water analysis has been or will be performed by Owner.

* + - * 1. Perform an analysis of supply water to determine quality of water available at Project site.
      1. INSTALLATION

Coordinate this article with Drawings.

* + - * 1. Install chemical-application equipment level and plumb. Maintain manufacturer's recommended clearances. Arrange units, so controls and devices that require servicing are accessible. Install all chemical application equipment within a spill-containment area without floor drains.
        2. Install water-testing equipment on wall near water-chemical-application equipment.
        3. Install interconnecting control wiring for chemical-treatment controls and sensors.
        4. Mount sensors and injectors in piping circuits.
        5. Install automatic chemical-feed equipment for open [**condenser**] [**fluid-cooler spray**] water, and include the following:

Install water meter in makeup-water supply.

Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.

Pumps shall operate for timed interval on contact closure at water meter in makeup-water supply connection.

Install test equipment and provide test kit to Director’s Representative. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.

Install TDS controller with sensor and bleed valves.

Bleed valves to cycle, to maintain maximum TDS concentration.

Install TSS controller with sensor and bleed valves.

Bleed valves to cycle, to maintain maximum TSS concentration.

Install pH sensor and controller with injection pumps and solution tanks.

Injector pumps shall operate to maintain required pH.

Retain one of three subparagraphs below.

Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.

Injection pumps shall operate to feed biocide on an alternating basis.

Install ozone generator with diffusers in condenser-water piping.

Ozone generator shall operate continuously with condenser-water flow.

Install UV-irradiation lamps in condenser-water piping.

UV lights shall operate continuously with condenser-water flow.

* + - 1. OZONE-GENERATOR INSTALLATION
         1. Install ozone generator and equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units, so controls and devices that require servicing are accessible.

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

* + - * 1. Pipe ozone from ozone generator to condenser water with stainless steel pipe and fittings with welded joints.
        2. Install [**two**] [**three**]-piece, stainless steel ball valve in ozone supply to condenser water.
        3. Pipe cooling water to ozone generator and to air-gap drain fitting with stainless steel pipe and fittings with welded joints where enclosed in ozone-generator room.
        4. Install [**two**] [**three**]-piece, stainless steel ball valve in cooling water supply to ozone generator.
        5. Mounting supports for ozone generator shall be ASTM A666, Type 316 stainless steel.
        6. Mount breathing apparatus outside ozone-generator room.
        7. Mount and install ozone detector, warning lights, and audible alarm inside ozone-generator room. Mount another set of warning lights and audible alarm just outside the main entrance to ozone-generator room.
      1. UV-IRRADIATION UNIT INSTALLATION
         1. Install UV-irradiation units on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units, so controls and devices that require servicing are accessible.

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

* + - 1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Where installing piping adjacent to equipment, allow space for service and maintenance.
        2. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Comply with requirements in Section 232116 "Hydronic Piping Specialties" for dielectric fittings.
        3. Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.
        4. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.
      1. ELECTRICAL CONNECTIONS
         1. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.
         2. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
         3. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
      2. FIELD QUALITY CONTROL

Retain "Manufacturer's Field Service" paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Service Advisor to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform the following tests and inspections[**with the assistance of a Company Service Adviso**r]:

Inspect field-assembled components and equipment installation, including piping and electrical connections.

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.

Place HVAC water-treatment system into operation, and calibrate controls during the preliminary phase of HVAC systems' startup procedures.

Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.

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.

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.

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.

Repair leaks and defects with new materials, and retest piping until no leaks exist.

* + - * 1. Equipment will be considered defective if it does not pass tests and inspections.
        2. Prepare test and inspection reports.

Add to or delete tests to suit Project. For definitions of terms used in sampling and testing, see ASTM D1129.

* + - * 1. At [**four**] [**six**] [**eight**] <**Insert number**>-week intervals following Substantial Completion, perform separate water analyses on HVAC 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 Director’s Representative of changes necessary to adhere to "Performance Requirements" Article.
        2. Comply with ASTM D3370 and with the following standards:

Silica: ASTM D859.

Acidity and Alkalinity: ASTM D1067.

Iron: ASTM D1068.

Water Hardness: ASTM D1126.

* + - 1. MAINTENANCE SERVICE

Verify with Owner that maintenance service is required for Project.

* + - * 1. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above, to inhibit corrosion, scale formation, and biological growth for [**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:

Initial water analysis and hydronic water-treatment recommendations.

Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.

Periodic field service and consultation.

Customer report charts and log sheets.

Laboratory technical analysis.

Analyses and reports of all chemical items concerning safety and compliance with government regulations.

* + - 1. DEMONSTRATION
         1. [**Engage a Company Service Advisor to train**] [**Train**] Director’s Representative's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

Retain paragraph below when Ozone system is included in project.

* + - * 1. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION 232516