SECTION 232519 - WATER TREATMENT FOR STEAM SYSTEM FEEDWATER

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

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.

Stainless steel pipes and fittings.

Chemical-treatment test equipment.

Chemicals.

* + - * 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. RO: Reverse osmosis.
				2. TDS: Total dissolved solids.
				3. 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.

TSS controllers.

Chemical solution tanks.

Injection pumps.

Chemical-treatment test equipment.

Chemical material safety data sheets.

* + - * 1. Shop Drawings: Pretreatment and chemical-treatment equipment, showing tanks, maintenance space required, and piping connections to steam 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 Piping and Equipment." 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.
			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. Steam System Water-Treatment Service Provider Qualifications: An experienced steam system 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. HVAC WATER-TREATMENT 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 steam systems shall minimize corrosion and scale buildup for optimum efficiency of steam and condensate equipment without creating a hazard to operating personnel or the environment.
				2. Base steam system feedwater treatment on quality of water available at Project site, steam and condensate 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.

Retain "Steam Condensate" paragraph below if chemical treatment is required for condensate piping system. Chemicals that carry over from boiler to treat the condensate-water piping may make steam unfit for humidification or foodservice.

Steam Condensate:

pH: Maintain a value within <**8.5 to 9.5 pH units**>.

Alkalinity: Maintain a value no higher than <**5 to 50**> 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.

Ammonia: Maintain a value of <**20**> ppm.

<**Insert other requirements if necessary**>.

Steam boiler operating at 100 psig and less shall have the following water qualities:

Silica: Maintain a value no higher than <**0.20**> ppm as SiO(2).

TSS: Maintain a value no higher than <**15**> ppm.

TDS: Maintain a value no higher than <**3500**> ppm.

Total Alkalinity: Maintain a value no higher than <**700**>ppm as CaCO(3).

pH: Maintain a value within <**9.5-11.5**> pH.

<**Insert other applicable requirements**>.

* + - 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 and DDC system.

* + - * 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 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, 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; and 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.

* + - * 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.

Retain "TDS Controller" paragraph below for steam boilers when TDS controller is required.

* + - * 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:

Steam Boilers: Motorized ball valve, steel body, and TFE seats and seals.

Retain "TSS Controller" Paragaph below for steam boilers 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. 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. 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.

Retain "Two-Piece, Full-Port, Stainless Steel Ball Valves" or "Three-Piece, Full-Port, Stainless Steel Ball Valves" paragraph below.

* + - * 1. 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.
				2. 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 rating and 600-psig cold working-pressure rating.
			1. CHEMICAL-TREATMENT TEST EQUIPMENT
				1. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounted 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.

Retain "Sample Cooler" paragraph below for steam boilers.

* + - * 1. Sample Cooler:

Tube: Sample.

Size: NPS 1/4 tubing.

Material: ASTM A666, Type 316 stainless steel.

Pressure Rating: Minimum 2000 psig.

Temperature Rating: Minimum 850 deg F.

Shell: Cooling water.

Material: ASTM A666, Type 304 stainless steel.

Pressure Rating: Minimum 250 psig.

Temperature Rating: Minimum 450 deg F.

Capacities and Characteristics:

Tube: Sample.

Flow Rate: [**0.25 gpm**] <**Insert value**>.

Entering Temperature: [**400 deg F**] <**Insert value**>.

Leaving Temperature: [**88 deg F**] <**Insert value**>.

Pressure Loss: [**6.5 psig**] <**Insert value**>.

Shell: Cooling water.

Flow Rate: [**3 gpm**] <**Insert value**>.

Entering Temperature: [**70 deg F**] <**Insert value**>.

Pressure Loss: [**1.0 psig**] <**Insert value**>.

* + - * 1. 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.

[**Two**] <**Insert number**>-station rack for closed-loop systems.

[**Four**] <**Insert number**>-station rack for open-loop 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 that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.
				2. Cleaning chemicals:

Alkaline Boil-out Cleaning Solution for Boiler System: alkaline boil-out cleaning solution at an acceptable concentration which is capable of removing oil, grease and rust from metal surfaces of boiler. Cleaning solution shall include:

Low foaming non-ionic surfactant for penetrating oil and grease deposits.

Phosphate and soda ash to provide alkalinity.

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 on concrete bases, 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.

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

* + - * 1. Install water-testing equipment on wall near water-chemical-application equipment.
				2. Install interconnecting control wiring for chemical-treatment controls and sensors.
				3. Mount sensors and injectors in piping circuits.
				4. Install automatic chemical-feed equipment for steam boiler and steam condensate systems, and include the following:

Install makeup-water softener.

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 when contacts close at water meter in makeup-water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.

Install test equipment and furnish test kit to Director’s Representative.

Do not retain first subparagraph below if RO unit is not specified in Part 2.

Install RO unit for makeup water.

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 shall cycle, to maintain maximum TSS concentration.

Retain subparagraph below for steam condensate treatment with amines.

Install inhibitor injection timer with injection pumps and solution tanks.

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.

* + - * 1. Install automatic chemical-feed equipment for [**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. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.

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 TSS controller with sensor and bleed valves.

Bleed valves shall 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.

* + - 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 steam system water-treatment equipment and dissimilar-metal piping with dielectric fittings. Comply with requirements in Section 232113 "Hydronic Piping" 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. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
				2. 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 Advisor**]:

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 steam system water-treatment system into operation and calibrate controls during the preliminary phase of steam system's 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. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Director’s Representative of changes necessary to adhere to "Performance Requirements" Article for each required characteristic. Sample boiler water at [**four**] [**six**] [**eight**] <**Insert number**>-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.
				2. Comply with ASTM D3370 and with the following standards:

Silica: ASTM D859.

Steam System: ASTM D1066.

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 [**heating, steam and condensate piping**] [**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 steam system 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 steam and condensate-treatment systems and equipment.

END OF SECTION 232519