

## University of Houston Master Specification

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### SECTION 23 2500 - WATER TREATMENT 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.

Delete hidden text after this Section has been edited for the Project.

#### 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.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
  - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
  - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

##### 1.2 DESCRIPTION OF WORK

- A. Work Included: Perform water analysis and provide water treatment products, holding reservoirs, equipment, and labor for testing, cleaning, flushing, and dispensing products to control water quality for each system specified as follows:
  - 1. Chilled water system.
  - 2. Heating water system.
  - 3. Condenser water system.
  - 4. Steam boiler feedwater system.
  - 5. Glycol system.
- B. Chemicals: Provide, at no change in Contract amount, chemicals required for operating and testing water treatment systems prior to acceptance by the Owner.
- C. Instructions: Provide operation and maintenance instructions for each water treatment system; include one set in each Owner's Manual and deliver one set to Owner's operating personnel.
- D. Testing Equipment and Reagents: Furnish suitable water treatment testing equipment for each system, complete with apparatus and reagents necessary for operation until acceptance by the Owner.
- E. Service Representative: Furnish the services of a qualified service representative to instruct Owner's operating personnel in proper operation and maintenance of water treatment equipment, systems, and tests required. Service representative shall return to the site biweekly during first 2 months of

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operation and monthly during the remainder of the guarantee period. At such times, service representative shall check and adjust water treatment system operation, check efficiency of chemicals and chemical applications, and instruct and advise operating personnel.

- F. Replacement and Rework: Replace defective or nonconforming materials and equipment with new materials and equipment, at no change in Contract amount, for one year after successful start-up of the system. All warranty work shall be FOB as installed at the project site.
1. Guarantee: Provide system by manufacturer willing to execute the required guarantee.
  2. Agreement to Maintain: Provide system by manufacturer willing to execute (with the Owner) the required agreement for continued maintenance of the system.

### 1.3 QUALITY ASSURANCE

- A. Qualifications: To perform work under this Section, the Contractor shall have:
1. Research and development facilities.
  2. Regional laboratories capable of making water analysis.
  3. A service department and qualified technical service representatives located within a reasonable distance of the project site.
  4. Service representatives who are Registered Engineers or factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.

#### [SELECT ONE OF THE FOLLOWING]

- B. **[Manufacturers: Provide water treatment chemicals and products manufactured by one of the following:**
1. **DuBois.**
  2. **Mitco.**
  3. **Mogul.**
  4. **Morr.**
  5. **Nalco.**
  6. **Uniloc.]**

#### [OR]

- C. **[Manufacturers: Vendor for water treatment chemicals and treatment shall be [Nalco] [\_\_\_\_\_] to insure compatibility with the existing water systems which are being extended under this project.]**
- D. Chemicals: Chemicals shall meet all requirements of federal, state and local pollution requirements and all other applicable laws and governing regulations. In addition, all chemicals shall be fully compatible with all components and parts of the particular system being treated. All chemical containers and labeling shall be in accordance with applicable regulations.
- E. Packaging and Labeling: Supply water treatment chemicals in metal drums, fiber drums with plastic liners, or plastic lined "liqui-paks" as best suited to the materials. Paper bags or unlined cardboard cartons will not be acceptable. Chemicals in domestic water systems, and biocides, regardless of

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where used, shall be registered with the U.S. Department of Agriculture (USDA) or the U.S. Environmental Protection Agency (EPA) and labeled as required by law.

- F. Electrical Standards: Provide electrical products which have been tested, listed, and labeled by Underwriters' Laboratories, Inc. (UL) and comply with National Electrical Manufacturers' Association (NEMA) standards.
- G. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.

### 1.4 SUBMITTALS

- A. Shop Drawing submittals shall include, but not be limited to, the following:
  - 1. A water analysis, including the name and address of the company performing the analysis.
  - 2. Cut sheets on all proposed chemical treatments [and a statement of compatibility with existing treatment chemicals and systems].
  - 3. A list of proposed chemicals and their application.
  - 4. Cut sheets on all water treatment system components and accessories which are being furnished and control panel elevations.
  - 5. Installation details for water treatment system components including, but not limited to: wiring diagrams, piping diagrams, injector coupling installation details and other information required for proper system installation.
  - 6. Submit written guarantee, signed by the manufacturer and countersigned by the installer and Contractor, agreeing to adjust or replace the system or portions thereof, as required to achieve the required performance, during a one year period following the final start-up for continued operation.
  - 7. Additional information as required in Section 23 0100 "Mechanical General Provisions."
- B. Agreement to Maintain: Prior to final acceptance, the manufacturer of the condenser water treating system shall submit four copies, to the Owner's for possible acceptance, of an "Agreement for Continued Service" to furnish chemicals and provide continued testing and servicing, including replacement of materials and equipment, for a one year period with option for renewal of the Agreement by the Owner.

### 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver water treatment products in factory-fabricated water-resistant wrapping.
- B. Handle water treatment products carefully to avoid damage to material component, enclosure and finish.
- C. Store water treatment products in a clean, dry space and protect from the weather.

## PART 2 - PRODUCTS

### 2.1 GENERAL

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- A. Water Analysis: Determine which chemicals to use from the results of a water sample analysis per ASTM D596 on a water sample taken from the building site by the system manufacturer. Provide ingredients necessary to achieve the desired water conditions.
- B. Boilout Chemicals: Use chemicals for boilout as recommended by the boiler manufacturer for removing internal coatings and preservatives added during the manufacturing process. Chemicals shall be equal to Nalco No. 2567 boilout compound.
- C. Pretreatment: Treat each piping system with chemicals to remove and permit flushing of mill scale, oil, grease, and other foreign matter. Chemicals shall be equal to Nalco No. 2569 prepping compound [and shall be compatible with existing water treatment systems, where in use.] Pretreatment and flushing shall be complete before system treatment is added to the system. Refer to Section 230300, "Basic Materials and Methods", for additional requirements.
- D. FDA and USDA Approval: Use only FDA and USDA-approved products in systems with direct connection to domestic water systems.
- E. Governing Laws: Ensure that neither products, waste, blowdown, nor other effluents violate local, state, EPA, or other agency regulations in effect in the project area.

### 2.2 CHILLED WATER AND HEATING WATER SYSTEMS

[SELECT ONE OF THE FOLLOWING]

- A. **[Chemicals: Provide water treatment products which contain inhibitors that perform the following:**
  - 1. **Form a protective film to prevent corrosion and scale formation.**
  - 2. **Scavenge oxygen and protect against scale.**
  - 3. **Remain stable throughout operating temperature range.**
  - 4. **Are compatible with pump seals and other elements in the system.**
  - 5. **The inhibitor shall be a boron nitrate scale inhibitor compound, equal to Nalco No. 2536.**
  - 6. **Water treatment products shall be exactly the same as the chemicals used to treat the existing water system which is being expanded. Provide initial water treatment for the expanded water system with new water piping installed.]**
- B. **[Equipment: For each system, provide a 5 gallon pot-type feeder constructed of materials which are impervious to the products dispensed. Feeder shall be designed for not less than 200 psig operating pressure.]**

[OR]

- C. **[Equipment: The existing water treatment equipment shall be used to inject new water treatment chemicals into the expanded water system.]**
- D. Chemicals: Furnish a [one] [two] year supply of closed system chemical treatment for prevention of corrosion in the system, including consulting services of a water treatment service engineer as described hereinabove. Coordinate delivery of chemicals with the Owner's representative.
- E. Test Kit: Provide test kit and a [one] [two] year supply of reagents for determining proper water conditions.

### 2.3 CONDENSER WATER SYSTEM

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- A. General: Provide a complete factory-fabricated automatic condenser water treatment system designed to monitor, record, and control:
1. System alkalinity in a pH range that is noncorrosive.
  2. Total dissolved solids (TDS).
  3. System blowdown.
  4. Scaling and corrosion.
  5. Eliminate microbiological growth.
- B. Program: Use EZ-Board or Factory-Board mounted Nalco CW-Biopac and CW-G.2, Mogul WC-7.1, or an approved equal treatment program with a solid state impulse timer, a pH controller, a single channel event controller and a conductivity controller. The impulse timer shall be activated by an electric contact register water meter after a fixed volume of make-up water enters the system and shall proportionately control chemical feed to inhibit the formation of scale and corrosion. Acid feed for pH control shall be controlled independently by the pH controller using a system pH sensor. Total dissolved solids will be monitored as conductivity by the conductivity controller and shall be controlled through bleed-off. Biocide and algacide feed shall be controlled to inhibit biological growth.
- C. Equipment: Provide water treatment equipment including, but not limited to, the following:
1. A prewired NEMA 1 control panel including:
    - a. One solid state timer.
    - b. A pH meter with 0-14 pH range control output contacts with adjustable ranges, alarm contacts with adjustable ranges and a measure/standby switch.
    - c. A single channel event recorder with a one year supply of chart paper with selector switch for recording pH or conductivity.
    - d. An adjustable conductivity controller with a 0-5000 MMHO range.
    - e. Chemical pump starters.
    - f. A main power switch and input fuse.
    - g. HOA Switches for each system facility.
    - h. Door mounted indicating lamps for power on, inhibitor feed, acid feed and bleed-off.
  2. A pH probe with mounting assembly and connecting cable.
  3. A TDS (conductivity) probe with mounting assembly and connecting cable.
  4. Corrosion resistant chemical feed pumps with tubing and extended foot valve assemblies and level sensors (total of four).
  5. In-line sample pump, interlocked with the condenser water pumps.
  6. Makeup water meter with electric contacting register.
  7. Corporation stop and injection assembly.
  8. Solenoid valves for bleed-off and system isolation.
  9. A flow indicator manual control valve for bleed-off.
  10. Bleed-off water meter.
  11. Chemical drum level gauges.

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12. A test kit, consisting of four 10 ml burettes, all necessary glassware, pH color comparator, and a **[one] [two]** year supply of reagents to perform the following analyses:
  - a. M Alkalinity.
  - b. Chloride.
  - c. Calcium hardness.
  - d. pH.
  - e. Inhibitor.
13. A **[one] [two]** year supply of condenser water treatment to inhibit the formation of scale, corrosion and algae, including consulting services of a water treatment service Engineer as described hereinabove. Coordinate delivery of chemicals with the Owner's representative.

### 2.4 GLYCOL SYSTEM TREATMENT

- A. Chemicals: Provide water treatment products which contain inhibitors that perform the following:
  1. Form a protective film to prevent corrosion and scale formation.
  2. Scavenge oxygen and protect against scale.
  3. Remain stable throughout operating temperature range.
  4. Are compatible with pump seals and other elements in the system.
  5. The inhibitor shall be a boron nitrate scale inhibitor compound, equal to Nalco No. 2536 and shall be compatible with the proposed glycol solution to be used.
- B. Equipment: For each system, provide a 5 gallon pot-type feeder constructed of materials which are impervious to the products dispensed. Feeder shall be designed for not less than 200 psig operating pressure.
- C. Test Kit: Provide test kit and a one year supply of reagents for determining proper water conditions.

### 2.5 GLYCOL SYSTEM FILLING

- A. General: Furnish and install provisions to allow glycol to be added to the closed loop glycol piping system and to allow system samples to be taken for analysis.
- B. Glycol: Add glycol to the filled and treated piping system to provide a 30% glycol/water solution suitable to protect the system from freezing at temperatures down to 5°F. Glycol used for system filling shall be commercial ethylene glycol, Union Carbide Ucartherm, Dow Chemical Dowtherm SR-1, Texaco E.G. Heat Transfer Fluid 100 or an approved equal
- C. Test Kit: Provide a test kit for determining the percentage of glycol in the system.

### 2.6 STEAM BOILER FEEDWATER TREATMENT

- A. General:
  1. Provide chemical treatment as required to provide a protective film to prevent corrosion and scale formation, to scavenge oxygen and to protect against scale.
  2. Provide a boiler feedwater treatment system to proportionately control chemical treatment and dissolved solids. An impulse timer shall be actuated by an electric contact register water meter after a fixed volume of make-up water passes into the boiler feed system. The impulse

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timer shall control the pumping of chemical treatment to the boiler, and proportionately control dissolved solids through blowdown.

- B. Equipment: Furnish and install water treatment equipment including, but not limited to, the following:
1. A prewired NEMA 1 control panel including:
    - a. One solid state timer.
    - b. A three channel event recorder with a one year supply of chart paper with selector switch for recording pH or conductivity.
    - c. An adjustable conductivity controller with a 40-6000 MMHO range.
    - d. Chemical pump starters.
    - e. A main power switch and input fuse.
    - f. HOA Switches for each system facility.
    - g. Door mounted indicating lamps for power on, oxygen scavenger feed, scale control feed and bleed-off for each boiler.
    - h. Blowdown Test Switch for each boiler.
  2. A TDS (conductivity) probe with mounting assembly and connecting cable for each boiler.
  3. Corrosion resistant chemical feed pumps with tubing, extended foot valve assemblies and tank assembly.
  4. Pre-piped blowdown assembly with throttling valve, for each boiler.
  5. Boiler injection nozzles.
  6. Prefabricated corrosion test coupon bypass assembly.
  7. A flow indicator manual control valve for bleed-off, for each blowdown bypass.
  8. De-aerator injection nozzle.
  9. Water meter with electric contact register for [de-aerator] [boiler] make-up.
  10. Chemical tank level gauges.
  11. A test kit, consisting of four 10 ml burettes, all necessary glassware, pH color comparator, and a **[one] [two]** year supply of reagents to perform the following analyses:
    - a. Phosphates.
    - b. M Alkalinity.
    - c. Chloride.
    - d. Calcium hardness.
    - e. pH.
    - f. Inhibitor.
    - g. Neutralizing amines.
  12. Furnish **[one] [two]** year's supply of the chemical treatment to prevent oxygen pitting corrosion in the steam boiler and feedwater piping system. This oxygen scavenger formula will be separate formula fed directly to the feedwater storage section of the de-aerating heater system. The chemical formula provided will be compatible with system materials of

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construction and operating conditions and will comply with all applicable regulatory agencies. Coordinate delivery of chemicals with the Owner's Representative.

13. A **[one] [two]** year supply of chemical treatment to inhibit the formation of scale, corrosion and algae, including consulting services of a water treatment service engineer as described hereinabove. Coordinate delivery of chemicals with the Owner's representative.

### PART 3 - EXECUTION

#### 3.1 PIPING SYSTEMS PREPARATION

- A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the Work. Refer to Section 23 0300 "Basic Materials and Methods" for additional treatment and flushing requirements.
- B. Testing: Perform test procedures and submit a written report of test conditions and results to the Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

#### 3.2 BOILER BOILOUT:

- A. General: Perform boiler boilout using procedures and products as recommended by boiler manufacturer.

#### 3.3 FLUSHING:

- A. General: Drain preparation and boilout products from systems. Flush with clean water until system tests prove systems are free of preparation and boilout products and other contaminants prior to administering system water treatment as specified. Refer to Section 230300 for additional requirements.

#### 3.4 CHILLED WATER AND HEATING WATER SYSTEMS

- A. General: Install chemical feed and sampling connections in system piping as detailed on the Drawings and as required.
- B. Verification: Verify that pretreatment and flushing have been completed as specified in Section 23 0300 "Basic Materials and Methods."
- C. Treatment: Install initial treatment in closed systems.

#### 3.5 CONDENSER WATER SYSTEM

- A. Installation:
  1. Verify that pretreated and flushing have been completed in accordance with Section 23 0300 "Basic Materials and Methods."
  2. Install an extra heavy steel coupling in the circulating water line, welded at 30°F to 45°F angle with inboard end pointing in direction of flow.
  3. Install the corporation stop and injection assembly in the steel coupling with the PVC injector tube inserted completely with discharge end at the center of the circulating water line.
  4. Install the chemical pumps and control panel near the injection point and connect pump discharge line to the injection point.
  5. Install water meter with shut-off valves and bypass.

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6. Install a bleed-off line with gate valve, solenoid valve, and control valve from the circulating water line, discharging into an open funnel which is connected to a floor drain.
  7. Install a 3/4" by-pass line for control sensors across the circulating pump with shut-off valves, solenoid valve, pH probe and housing, conductivity probe and housing and flow indicator.
  8. Provide a 120 volt manual starter (manual reset type) at the control panel and interlocked with the condenser water pumps to prevent pumping treatment and bleed-off without circulation. Wire the control panel to the water meter, chemical pumps, sensing probes and solenoid valves. The 120 volt power supply to the manual starter will be furnished under Division 26.
  9. Provide a 1/2" Schedule 80 A106 pipe for acid from the acid feed pump to the cooling tower basin.
- B. Start-up Procedures: During condenser cooling water system start-up, operate condenser water treating system (after charging with specified chemicals) to maintain the required steady-state characteristics of cooling water. Demonstrate system operation to Owner's operating personnel.
- C. Reports: Prepare certified test report for each required water performance characteristic. Comply with following ASTM standards, where applicable:
1. ASTM D859 - Tests for Silica in Water and Waste Water.
  2. ASTM D1067 - Tests for Acidity or Alkalinity of Water.
  3. ASTM D1068 - Tests for Iron in Water and Waste Water.
  4. ASTM D1126 - Tests for Hardness in Water.
  5. ASTM D1128 - Identification of Types of Microorganisms and Microscopic Matter in Water and Waste.
  6. ASTM D3370 - Sampling Water.
- D. Water Chemistry: Where water chemistry substantiates that pH control is not necessary, chemical feed shall be based on water make-up quantities. Water analysis shall be based on the full parameters of operation and all possible supplies. A water meter on the make-up water shall be used in conjunction with a TDS bleed control. pH control may be omitted where "M" alkalinity does not exceed 500 PPM and pH range is 8.2 to 9.4. Total hardness will be the determining factor along with the technical limitations of the inhibitors.
- 3.6 GLYCOL SYSTEM
- A. General: Install chemical/glycol feed and sampling connections in system piping as detailed on the Drawings and as required.
  - B. Verification: Verify that pretreatment and flushing have been completed as specified in Section 23 0300 "Basic Materials and Methods."
  - C. Treatment: Install initial treatment and initial glycol fill in system
- 3.7 STEAM BOILER FEEDWATER SYSTEM
- A. Installation:
    1. Verify that pretreated and flushing have been completed in accordance with Section 23 0300 "Basic Materials and Methods."
    2. Install the de-aerator injection nozzle.
    3. Install the boiler injection nozzles.

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4. Install the chemical pumps and control panel near the injection points and connect pump discharge lines to the injection points.
5. Install water meter with shut-off valves and bypass.
6. Install a blowdown line with gate valve, solenoid valve, bypass and control valve for each steam boiler, discharging into the boiler blowdown separator which is connected to a floor drain.
7. Provide a 120 volt manual starters (manual reset type) at the control panel and interlocked with the boiler feed water pumps to prevent pumping treatment and bleed-off without circulation. Wire the control panel to the water meter, chemical pumps, sensing probes and solenoid valves. The 120 volt power supply to the manual starter is specified under Division 26 Sections.
8. Provide a corrosion test coupon assembly and bypass which will periodically be analyzed by the water treatment company and reports shall be provided to the Owner.

### 3.8 CHEMICAL STORAGE AREA

- A. Install water treatment chemicals and equipment inside a curb or slab recess area with floor drain and hose bibb, as shown on the Drawings or required.

### 3.9 FIELD SERVICE

- A. Operator Training: Train Owner's personnel in use and operation of water treating systems, including testing, preparation of chemical solution, if applicable, and charging of the chemical solution reservoir. A Program Administration Manual shall be furnished encompassing all systems covered in this Section of the Specifications.
- B. Service Engineer: Furnish the services of a qualified water treatment service engineer to supervise start-up and initial treatment of each system and to instruct the Owner's operating personnel in proper operation and maintenance of the water treatment equipment.
- C. Service Systems and Required Tests: The service engineer shall visit the site on a biweekly basis for the first 2 months of system operation and then on a monthly basis for the remainder of the warranty period **[12 months] [24 months]** past final acceptance).
- D. Start-up: None of the water systems to be treated shall be put into operation until initial treatment and operating treatment have been completed. Refer to Section 23 0300 "Basic Materials and Methods" for pipe cleaning and initial treatment.

### 3.10 IDENTIFICATION

- A. Refer to Section 23 0300 "Basic Materials and Methods" for applicable painting, nameplates, and labeling requirements.

END OF SECTION 23 2500

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