PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. Open Loop Chemical Treatment Systems.
2. Closed Loop Chemical Treatment Systems.
3. Chemical treatment test equipment.
4. HVAC water-treatment chemicals.

1.2 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 [hot-water heating] [and] [chilled water] [system water] [dual-temperature 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. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 10 ppm.
9. 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.

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

1. pH: Maintain a value within 8.4 to 9.0.
2. "P" Alkalinity: Maintain a maximum value of 100 ppm.
3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
5. TDS: Maintain a maximum value of 10 ppm.
6. Ammonia: Maintain a maximum value of 20 ppm.
7. Free "OH" Alkalinity: Maintain a maximum value of 0 ppm.
8. Microbiological Limits:
   a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/ml.
   b. Total Anaerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
   c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
   d. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

1.3 SUBMITTALS

A. Product Data: Include plan describing methods and chemicals proposed for use in system(s) cleaning and treatment. Include treatment system schematics showing connection locations to loop systems, testing procedures, manufacturer's literature for controllers, chemical feed pumps and chemicals. Include Material Safety Data Sheets for all proposed chemicals.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Chemicals: Treatment chemicals used in systems that are “bled” to sewer on a regular basis shall comply with all applicable waste control standards. All biocides must be EPA registered in the name of the Water Treatment Firm for application into the HVAC water system(s). All products shall have all ingredients listed on the storage container label and Material Safety Data Sheets.

B. HVAC Water-Treatment Service Provider Qualifications: An HVAC water-treatment service provider with a minimum of five years local experience, capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section. Approved water treatment firms:

C. 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.

1.5 WARRANTY

A. Special Guarantee: Provide a guarantee that the treated systems will remain scale and algae free for a period of one year when the provided chemicals are used as directed. If scaling or fouling occurs when the provided chemicals are used as directed the Water Treatment Firm shall clean the system(s) at no cost to the Owner.

B. Provide all parts and labor required to maintain the chemical treatment systems in good working order during the warranty period.
PART 2 - PRODUCTS

2.1 OPEN LOOP (COOLING TOWER) SYSTEMS

A. Chemical Controller: Bleed-and-feed type conductivity controller complete with watertight enclosure, 2 electrode, 0-5,000 µS conductivity sensor, plumbing, dry contact for flow switch, power cord and relays for chemical feed pumps and bleed valve. Controller shall be 120 VAC.

1. Products: Subject to compliance with requirements, provide the following:
   a. Lakewood Model 101.
   b. Approved Equal.

B. Chemical Controller: Microprocessor based pH and conductivity controller with watertight enclosure, 4-electrode 0-5,000 µS conductivity sensor with fouling compensation and alarm, differential 0-14 pH sensor with diagnostics, plumbing, flow switch, power cord and relays for control of bleed valve and chemical feed pumps, LCD display, interface for pH and conductivity monitoring by building control system. Controller shall be 120 VAC.

1. Products: Subject to compliance with requirements, provide the following:
   a. Lakewood Model 2412.
   b. Approved equal.

C. Chemical Solution Tanks:

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 50 gal.

D. Chemical Solution Injection Pumps:

1. Products: Subject to compliance with requirements provide one of the following:
   a. IWAKI EZ series.
   b. LMI Model 151.
   c. Pulsafeeder Model C Plus.
2. Electronic metering pump.
3. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
4. Minimum Capacity: 0.5 gallons per hour.
5. Adjustable flow rate.
6. Metal and thermoplastic construction.
8. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 22 Section "Common Motor Requirements for HVAC Equipment."

E. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints.
F. Injection Assembly:
   1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
   2. Ball Valve: Two-piece, stainless steel; selected to fit quill.
   3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
   4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

G. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, hardness; and oxidizing biocide test.
   1. Provide TDS meter with 0-5,000 µS range.
   2. Provide daily test log sheets with recommended ranges for use by plant personnel.

H. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, 2 pre-weighed C1010 mild steel coupons and 2 pre-weighed CDA 110 copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

I. 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.
   1. Scale Inhibitor: Liquid organo-phosphate maintained between 8 and 10 ppm concentration in open loop system.
   2. Biocide: EPA registered, non-chlorine type, maintained at sufficient concentrations to prevent formation of slime and growth of algae.
   3. Acid: Sulfuric acid to maintain tower water pH between 8.4 and 9.0.

J. Bleed Valve: Solenoid controlled, tower water bleed valve with built-in flow control. Provide one valve per controller.

2.2 CLOSED LOOP SYSTEMS

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall mounted cabinet for testing inhibitor concentrations.

B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, 1 pre-weighed C1010 mild steel coupon, and 1 pre-weighed CDA 110 copper coupon.

C. Chemicals:
   1. Cleaner: Alkaline based cleaner designed for the removal of oil, corrosion and other contaminants from closed loop piping systems and equipment.
   2. Corrosion Inhibitor: Boron-nitrate type, designed to prevent corrosion in closed loop piping.
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 storage tanks on 4-inch thick, reinforced concrete bases, level and plumb. Bases shall extend 6 inches beyond tank on all sides. Anchor chemical tanks to nearest wall or support to prevent tipping.

B. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible.

C. Furnish to and coordinate with Mechanical Contractor all items specified herein that are installed in piping systems.

D. Install water testing equipment on wall near water chemical application equipment.

E. Install interconnecting control wiring for chemical treatment controls and sensors. Coordinate conduit requirements with Electrical Contractor.

F. Mount sensors and injectors in piping circuits. Coordinate with Mechanical Contractor.

G. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.

H. Install automatic chemical-feed equipment for [condenser] [fluid-cooler spray] water and include the following:
   1. Install chemical controller in bypass circuit around pumps.
   2. Install inhibitor injection pumps and solution tanks.
      a. Pumps shall be controlled by chemical controller. Injection pump shall discharge into condenser water return piping to cooling tower.
      b. Bleed valves shall cycle to maintain maximum TDS concentration.
   3. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Unless otherwise indicated, connect piping with unions and shut-off valves to allow equipment to be disconnected without draining piping.
D. Confirm applicable electrical requirements in Division 16 Sections for connecting electrical equipment.
E. Ground equipment according to Division 16.
F. Connect wiring according to Division 16.
G. Interconnect flow switch dry contactors in Controller with condenser water pump starter. Open loop system bleed and chemical pump to be disabled when condenser pumps are not operating.

3.4 CLEANING
A. Provide cleaner as required to maintain the manufacturer’s recommended concentration for cleaning of the closed loop systems.
B. Circulate the cleaning solution for a minimum of 48 hours.
C. Drain and flush the system until all cleaning chemicals and suspended materials have been flushed from the system.

3.5 CHEMICAL ADDITION
A. Open Loop Systems:
   1. Add the required amount of scale inhibitor to reach an initial concentration of 8-10 ppm.
   2. Add the required amount of biocide to reach the manufacturer’s recommended concentration to prevent the formation of slime and the growth of algae.
   3. [Add the required amount of acid to set the pH between 8.4 and 9.0.]
   4. Install the corrosion coupons in the coupon rack after the initial chemical addition.
B. Closed Loop Systems:
   1. Immediately after system testing, cleaning and flushing, add the required amount of corrosion inhibitor to reach the manufacturer’s recommended concentration.
   2. Install the corrosion coupons in the coupon rack after the initial chemical addition.

3.6 FIELD QUALITY CONTROL
A. Perform tests and inspections and prepare test reports.
B. 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. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
4. 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.

5. 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.

6. 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.

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

C. Operational Test: After the systems have been filled with water and the condenser pump(s) are operating, measure chemical treatment levels and verify proper operation of controller, chemical pumps and automatic bleed valve. Set the bleed and chemical feed rates to maintain the appropriate chemical levels.

D. Remove and replace malfunctioning units and retest as specified above.

E. At one-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 after each test. Advise Owner of changes necessary to adhere to Part 1 “Performance Requirements” Article.

F. Comply with ASTM D 3370 and with the following standards:


G. Corrosion Coupons:

1. Remove and replace the corrosion coupons at 90 day intervals.
2. Deliver the removed coupons to a certified laboratory for testing.
3. Return the coupons and certified analysis to the Owner’s representative.
4. [If the coupon(s) from the closed loop system(s) show any noticeable metal loss the system water shall be tested and the appropriate action taken to prevent additional metal loss.]
5. [If the coupon(s) from the open loop system show a metal loss of greater the 3.0 mils per year for steel and/or 0.5 mils per year for copper the system water shall be tested and the appropriate action taken to reduce the metal loss below those values.]

3.7 TRAINING

A. Train the Owner’s representative(s) in the proper methods for testing the system(s)’ water, chemical handling, adding chemicals to the system(s), adjustment, and use and maintenance of the controller(s) and chemical feed pumps. Training may be done during each of the regularly required visits.
3.8 SUPPLIES

A. Provide all chemicals, testing supplies, log sheets, laboratory analysis, and other consumables required to maintain the proper chemical balance in the system(s) during the warranty period.

END OF SECTION