SECTION 23 25 00
HVAC WATER TREATMENT

SPEC WRITER NOTE:
1. Delete between //-----// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
2. References to pressure in this section are gage pressure unless otherwise noted.
3. Provide the year of latest edition to each publication given in Paragraph 1.5 APPLICABLE PUBLICATIONS.

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies cleaning and treatment of circulating HVAC water systems, including the following.

1. Cleaning compounds.
2. Chemical treatment for closed loop heat transfer systems.
3. Chemical treatment for open loop systems.
4. Glycol-water heat transfer systems.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

D. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

E. Section 23 21 13, HYDRONIC PIPING.

F. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.

DESIGNER NOTE: The designer shall consult with local water treatment specialists to determine the appropriate water treatment strategy for the HVAC systems included in the project.

1.3 QUALITY ASSURANCE

A. Refer to paragraph, QUALITY ASSURANCE in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

SPEC WRITER NOTE: Evaluate the extent of technical services on a case by case basis.

B. Technical Services: Provide the services of an experienced water treatment chemical engineer or technical representative to direct flushing, cleaning, pre-treatment, training, debugging, and acceptance testing operations; direct and perform chemical limit control during

construction period and monitor systems for a period of 12 months after acceptance, including not less than 6 service calls and written status reports. Emergency calls are not included. //During this period perform monthly tests of the cooling tower for Legionella pneumophila and submit reports stating Legionella bacteria count per millimeter. These tests shall be conducted in a certified laboratory and not by a technician in the field.// Minimum service during construction/start-up shall be 6 hours.

SPEC WRITER NOTE: Delete following paragraphs C and D when no cooling tower water treatment is required.

C. Field Quality Control and Certified Laboratory Reports: During the one year guarantee period, the water treatment laboratory shall provide not less than 12 reports based on on-site periodic visits, as stated in paragraph 1.3.B, sample taking and testing, and review with VA personnel, of water treatment control for the previous period. In addition to field tests, the water treatment laboratory shall provide certified laboratory test reports. These monitoring reports shall assess chemical treatment accuracy, scale formation, fouling and corrosion control, and shall contain instructions for the correction of any out-of-control condition.

D. Log Forms: Provide one year supply of preprinted water treatment test log forms.

E. Chemicals: Chemicals shall be non-toxic approved by local authorities and meeting applicable EPA requirements.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data including:

1. Cleaning compounds and recommended procedures for their use.
2. Chemical treatment for closed systems, including installation and operating instructions.
3. Chemical treatment for open loop systems, including installation and operating instructions.
4. Glycol-water system materials, equipment, and installation.

C. Water analysis verification.

D. Materials Safety Data Sheet for all proposed chemical compounds, based on U.S. Department of Labor Form No. L5B-005-4.

E. Maintenance and operating instructions in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

SPEC WRITER NOTE: Insert the year of approved latest edition of the publications between the brackets and delete the brackets //----// if applicable to this project.

1.5 APPLICABLE PUBLICATIONS

A. The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):
70-//2017//.....National Electric Code (NEC)

C. American Society for Testing and Materials (ASTM):
F441/F441M-02-//2018// . Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

PART 2 - PRODUCTS

2.1 CLEANING COMPOUNDS

A. Alkaline phosphate or non-phosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.

B. All chemicals to be acceptable for discharge to sanitary sewer.

C. Refer to Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING, PART 3, for flushing and cleaning procedures.

2.2 CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS

A. Inhibitor: Provide sodium nitrite/borate, molybdate-based inhibitor or other approved compound suitable for make-up quality and make-up rate and which will cause or enhance bacteria/corrosion problems or mechanical seal failure due to excessive total dissolved solids. Shot feed manually. Maintain inhibitor residual as determined by water treatment laboratory, taking into consideration residual and temperature effect on pump mechanical seals.

B. pH Control: Inhibitor formulation shall include adequate buffer to maintain pH range of 8.0 to 10.5.

C. Performance: Protect various wetted, coupled, materials of construction including ferrous, and red and yellow metals. Maintain system

essentially free of scale, corrosion, and fouling. Corrosion rate of following metals shall not exceed specified mills per year penetration; ferrous, 0-2; brass, 0-1; copper, 0-1. Inhibitor shall be stable at equipment skin surface temperatures and bulk water temperatures of not less than 121 degrees C (250 degrees F) and 52 degrees C (125 degrees Fahrenheit) respectively. Heat exchanger fouling and capacity reduction shall not exceed that allowed by fouling factor 0.0005.

D. Pot Feeder: By-pass type, complete with necessary shut off valves, drain and air release valves, and system connections, for introducing chemicals into system, cast iron or steel tank with funnel or large opening on top for easy chemical addition. Feeders shall be 18.9 L (five gallon) minimum capacity at 860 kPa (125 psig) minimum working pressure.

DESIGNER NOTE: The designer shall increase the pump capacity by 5 percent while selecting the pump.

E. Side stream Water Filter for Closed Loop Systems: Stainless steel housing, and polypropylene filter media with // polypropylene // stainless steel // core. Filter media shall be compatible with antifreeze and water treatment chemicals used in the system. Replaceable filter cartridges for sediment removal service with minimum 20 micrometer particulate at 98 percent efficiency for approximately five (5) percent of system design flow rate. Filter cartridge shall have a maximum pressure drop of 13.8 kPa (2 psig) at design flow rate when clean, and maximum pressure drop of 172 kPa (25 psig) when dirty. A constant flow rate valve shall be provided in the piping to the filter. Inlet and outlet pressure gauges shall be provided to monitor filter condition.

SPEC WRITER NOTE: Provide water treatment for all condenser water systems. The type and configuration of the system shall be based on actual water samples obtained by the local VA facility.

2.3 CHEMICAL TREATMENT FOR OPEN LOOP SYSTEM(S)

A. General: Provide the following:

1. A factory-fabricated and tested packaged, self-contained, chemical feed/blow-down monitoring, controlling and alarming system, containing all except specified or indicated remote components, and requiring only terminal sample stream and chemical piping/tubing

connections, remote component electrical connection and power supply.

2. System shall be suitable for a broad spectrum make-up water supply and chemical treatment program. Components, except those specified or indicated otherwise, shall be housed in one or more joined or divided steel enclosures.

B. System Functions:

1. Automatically maintain a predetermined, selectable, total dissolved solids concentration through a continuously monitoring conductivity controller, maintain a predetermined, selectable, scale/corrosion inhibitor and dispersant residual, through a continuously make-up monitoring meter/counter/timer and inhibitor/dispersant ratio controller; achieve a predetermined, selectable, peak concentration of one or two microbiocides as needed on an alternating basis, through a programmable timer controller. De-energize controller or stagger feed chemicals that would degrade or could be incompatible if fed simultaneously.
2. Automatically maintain a predetermined, selectable, pH level through a continuously monitoring pH controller. For systems with make up water alkalinity in excess of 125 PPM or hardness above 300 PPM, provide acid feed limit timer and audible/visual alarm actuated on low pH.

C. Main control panel and accessories:

1. Housed in a NEMA Type 4X enclosure:
   a. Hinged key lock door with viewing window.
   b. Hard wire connected to power source.
   c. Provide minimum of three (3) 115V, 1 Ph, 60 Hz receptacles located on enclosure for electrical connection and control of chemical pumps.
   d. Prewired for ease of installation.
2. Provide an external combination mounted flow switch with transparent sight tube.
   a. Disable control outputs upon loss of water flow to prevent chemical feeding.
   b. Provide complete with 3/4 IN connections and combination conductivity and temperature electrode.
3. Keypad or remote control: Access all measurements and set points through chemical resistant key pad or remote.

a. Security code to prevent unauthorized access.

4. Utilize microprocessor technology.
5. Menu driver programs.
6. Liquid crystal display (LCD).
7. Provide temperature corrected measurements by reading water temperature and adjusting conductivity values according to known temperature curve.
   a. Range: 0-100 degC (32-212 degF) with an adjustable high alarm.
8. Provide real-time clock.
9. Conductivity monitor:
   a. Provide linear measurements of full range.
   b. Provide two scales for selection of high and low in field to assure accurate measurements.
   c. Provide increments of 1 microohm/cm with adjustable hysteresis.
   d. Provide bleed-off control in following manner:
      1) Standard operation-controller actuates a bleed off solenoid valve when dissolved solids level is exceeded by trip point.
      2) Provide an adjustable bleed limit timer to prevent excessive bleed off.
      3) An alarm contact shall close when timer has timed out.
10. Biocide operation:
    a. Provide a programmable 28 day biocide timer for accurate addition of algaecide.
    b. Provide a secondary bleed off timer to lower conductivity in system prior to biocide feed.
    c. Lock out cooling water bleed-off during biocide feed period.
11. Chemical feed control: Provide three timers that are capable of operating in one of following field programmable modes.
    a. Counter-timer-chemical feed proportioned to make-up water rate.
       1) Controller shall send low voltage signal to a contacting head water meter.
       2) Low voltage signal will ensure long contact life.
       3) Water meter shall read in gallons.
12. Alarms:
    a. Provide alarm LEDs with silence button for high and low conductivity, 10-60 minute bleed-off, chemical feed limit timers, and chemical drum level. Provide remote output relay to indicate

alarm condition to Building Control System specified under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

13. Controller operating data history:
    a. Retain in memory all operating data for following parameters:
        1) Standard memory shall allow acquisition and storage of all analog inputs for a one-week period.
        2) A three (3) hour minimum, maximum average of all conditions shall be stored for a one-week period.
        3) A minute-by-minute account of operating conditions shall be available for latest three-hour period.
14. Electrode: Combination temperature and conductivity type.
    a. Quick disconnect.
    b. Supplied in flow switch assembly.
15. Ph monitor:
    a. Sensor for monitoring purposes only.
    b. Acid shall not be used to control pH.

//16. Remote communication: Provide open protocol BACnet/IP interface to perform the following functions:
    a. Access Real-time system values.
    b. Change operating parameters.
    c. Controller diagnostics.
    d. Obtain history files.
    e. Alarm condition notification.//

D. Impulse water meter:
1. General:
    a. Measure in gallons.
    b. Sized to meter peak make up rates.
    c. Equipped with an electrical contacting register.
    d. Totalize flow at main control panel.
2. Provide at following locations:
    a. Cooling tower make up line.
    //b. Cooling tower bleed off line. //

E. Provide CPVC injection nozzles, ASTM F441 with corporation stop to inject chemical into main circulating water line.
1. Pressure rating: 700kPa (100 PSI)
2. Size: DN20 (3/4 IN) NPT.
3. Quantity: Three (3).

F. Provide chemical feed pumps operated by a 115V, 60 cycle, single PH motor.
   1. Provide separate stroke and stroke frequency setting capabilities.
   2. Positive displacement type pump
      a. Provide with anti-siphon/pressure relief valve installed on pump head which provides anti-siphon protection and aids in priming under pressure.
      b. Capacity: As determined by Water Treatment Vendor.
      c. Complete with discharge check valves, foot valves, polyethylene suction and discharge tubing.
   3. Quantity: Provide one pump for each chemical provided.

G. Bleed-off piping assembly:
   1. Inlet shut-off valve.
   2. Wye strainer.
   3. Strainer blowdown valve.
   4. Throttling valve.
   5. Brass solenoid valve compatible with main control panel.
   6. Assembly shall be sized by Water Treatment Vendor.

SPEC WRITER NOTE: Utilize the pallet dimensions below to determine floor space required for chemical treatment drums. Two pallets are required. Maintain access in front of pallets to allow replacement of drums and proper service.

H. Secondary containment spill pallets for chemical drums:
   1. Material: Polyethylene.
   2. Capacity: 250 L (66 GAL) each.
   3. Dimensions each: DN135 (53 IN) length x DN74 (29 IN) wide X DN43 (17 IN) high.
   4. Provide each pallet with grating and drain plug.
   5. Provide one portable loading ramp.
   6. Quantity: Two (2).

I. Provide liquid level switch assemblies with a CPVC bung hole adapter, ASTM F441, to mount directly into 200 L (55 GAL) chemical drum bung hole.
   1. Interface with main control panel.
   2. Quantity: Three (3).

J. Corrosion monitor rack:
   1. Materials: Corrosion resistant.

2. Construction: ASME specifications.

3. Number of coupons: four (4).

4. Coupon holders: quick disconnect type.

K. Provide test kits for monitoring inhibitor levels, total dissolved solids, chlorides, alkalinity and closed system inhibitors.

SPEC WRITER NOTE: For small systems (single towers/coolers, less than 50 tons), an erosion type chemical feeder may be desired instead of using liquid bromine or chlorine. Bromine and chlorine are popular types of biocide. Although bromine or chlorine tablets are more expensive than liquid, the labor and maintenance costs are less. Verify with Owner and Owner's Water Treatment Vendor if an erosion chemical feeder is desired. If used, only two of the three liquid chemical feed pumps will likely be used. The third pump can be delivered to the Owner as spare parts if not connected.

//L. Erosion chemical feeder:

1. Completely enclosed.

2. Materials: Corrosion resistant.

3. External, non-clog inlet control valve.

4. Bottom drain valve.

5. Inlet and outlet connections to allow for recirculating water.

6. Suitable for use with chlorine or bromine tablets.//

M. Provide one (1) year's supply of chemical treatment including quantity of chemicals necessary to chemically treat system to control scale, corrosion and biological fouling. Provide water treatment products that perform the following:

1. Inhibitor to protect against corrosion and scale formation.

2. Two liquid biocides for prevention of slime, bacteria and algae.

3. Chromate based chemical are unacceptable.

4. Water treatment chemicals to remain stable throughout operating temperature range.

5. Are compatible with pump seals and other elements in the systems.

SPEC WRITER NOTE: Although pH is monitored, chemical is typically not added to reduce pH. This requires the use of acids, which many Owners and chemical suppliers avoid due to safety concerns. As a result, cooling tower systems typically operate at a higher pH (8 – 9) than they have in the past. This

is one of the reasons stainless steel and fiberglass cooling towers have increased in popularity.

//6. Maintain required pH balance to prevent precipitation and/or breakdown of circulating fluid. //

//7. Where analysis justifies addition of pH control, provide alteration of chemical formulation.//

N. Chemicals: // Except for acid, // provide sufficient chemicals for start-up and testing and twelve months operation from date of project acceptance.

1. Scale/corrosion inhibitor: Provide a concentrated liquid organic corrosion/scale/ fouling inhibiting formation without phosphates, chromates, zinc and other materials in excess of allowable, local, effluent limits. Feed automatically. Maintain residual as determined by water treatment laboratory.
2. Dispersant: Provide a concentrated liquid organic/polyelectrolyte formulation. Feed automatically. Maintain residual as determined by water treatment laboratory.
3. pH Control: Depending upon local water conditions, provide 60 or 66 degree Baume technical grade, concentrated sulfuric acid for acidic treatment or sodium hydroxide (NaOH) for basic treatment to maintain pH in the range of 7.0 to 8.0 automatically. Provide one initial 47 L (12.5 gallon) carboy of acid or base and one spare carboy of acid or base, if required.
4. Microbiocides: Provide two different, one oxidizing and one non-oxidizing, concentrated algaecide-biocide formations containing no heavy metals and which are effective at maximum encountered pH. Alternate solutions as needed to effectuate selective kill without build-up of immunity. Period treatment with a chlorine releasing agent is permissible within allowable, local, effluent limits. Feed automatically. Develop peak concentration and maintain for minimum period as determined by water treatment laboratory.
5. All chemicals to be acceptable for discharge to sanitary sewer.

O. Water Analysis: Confirm raw water analysis or provide analysis if none is furnished:

Description Year (Avg.)

Silica (SiO_2) _____

Iron & Aluminum _____

Calcium (Ca) _____

Magnesium (Mg) _____

Sodium (Na) & Potassium (K) _____

Carbonate (C03) _____

Bicarbonate (HC03) _____

Sulfate (S04) _____

Chloride (C1) _____

Nitrate (N03) _____

Turbidity _____

pH _____

Residual Chlorine _____

Total Alkalinity _____

Non Carbonate Hardness _____

Total Hardness _____

Dissolved Solids _____

P. Conduct performance test to prove capacity and performance of treatment system.

1. Raw water total hardness, PPM
2. Concentration cycles
3. Raw water, pH
4. System water, pH
5. Chemical solution used
6. Acid solution used
7. Quantity or chemical solution injected into system per cycle
8. Quantity of acid injected into system per cycle
9. Make up water required
10. Waste to drain requirement

SPEC WRITER NOTE: Specify propylene glycol for all glycol systems.

Q. Centrifugal Solid Separator:

1. Material: The separator shall be fabricated of carbon steel with shell material and head material of 0.135 inch wall or heavier. Maximum operating pressure shall be 10.3 bar (150 psi), unless specified otherwise.
2. Finish: Paint coating shall be acrylic urethane, spray-on, and royal blue.
3. Performance: The removal of solids from a pumped/pressurized liquid system shall be accomplished with a centrifugal-action vortex separator. Solids removal efficiency is principally predicated on

the difference in specific gravity between the solids and the liquid. Single pass test performance shall be less than 95% removal of solids 74 microns and larger. Pressure loss shall be between 0.3 - 0.8 Bar (5-12 psi).

4. Purging: Evacuation of separated solids shall be accomplished automatically, employing a timer-activated motorized ball valve. Straight-through valve design, with bronze valve body and stainless steel ball in a Teflon seat. NEMA 4 housing for indoor and outdoor installation. Valve size: 50 mm (2”).

//5. Provide a differential pressure sensor interface with DDC system.//

R. Chemical Treatment System Piping and Valves

1. Schedule 80 CPVC and fittings. Pipe size shall be 25 mm (1 inch) unless otherwise shown.
2. Ball Valves: CPVC type.

2.4 GLYCOL-WATER SYSTEM

A. Propylene glycol shall be inhibited with 1.75 percent dipotassium phosphate. Do not use automotive anti-freeze because the inhibitors used are not needed and can cause sludge precipitate that interferes with heat transfer.

B. Provide required amount of glycol to obtain the percent by volume for glycol-water systems as follows and to provide one-half tank reserve supply: // 25 // ___ // percent for // run-around coil systems // chilled water system.//hydronic system.//

SPEC WRITER NOTE: For small glycol-water systems a pot feeder may be used for make-up rather than a tank/pump system.

C. Pot Feeder Make-up Unit: By pass type for chemical treatment, schedule 3.5 mm (10 gauge) heads, 20 mm (3/4-inch) system connections and large neck opening for chemical addition. Feeders shall be 19 Liters (5 gallon) minimum size.

D. Glycol-Water Make-up System:

1. Glycol-Water storage tank: Self supporting polyethylene, minimum 90 mil thickness, with removable cover or black steel with 90 mil polyethylene insert. Capacity shall be 213 L (55 gallons), with approximate diameter of 584 mm (23 inches) and height of 914 mm (36 inches). Reinforced threaded pipe connections shall be provided for all connections. Provide identification for tank showing name of the contents.

2. Glycol-Water make-up pump: Bronze fitted, self-priming, high head type suitable for pumping a 33 percent to 50 percent glycol-water solution in intermittent service. The pump shall be provided with a mechanical shaft seal and be flange connected to a 1750 rpm NEMA type C motor. The pump capacity shall be // 11 L/m (3 gpm) // //, 345 kPa (50 psig) // discharge pressure with a suction lift capability of 127 mm (5 inches) of mercury, with a // 2.5 kW (1/3 horsepower) // _____ // drip-proof motor. The pump may be a "gear-within-a-gear" positive displacement type with built-in relief valve set for // 296 kPa (43 psig) // ____ //, or the pump may be a regenerative turbine type providing self-priming with built-in or external relief valve set for design head of the pump.
3. Back pressure regulating valve: Spring loaded, diaphragm actuated type with bronze or steel body, stainless steel trim with capacity to relieve 100 percent of pump flow with an allowable rise in the regulated pressure of 69 kPa (10 psig) above the set point. Set point shall be 103 kPa (15 psig) above system PRV setting.
4. Low water level control: Steel or plastic float housing, stainless steel or plastic float, positive snap-acting SPST switch mechanism, rated 10 amps-120 volt AC, in General Purpose (NEMA 1) enclosure. The control shall be rated for pressures to 1034 kPa (150 psig) and make alarm circuit on low water level. The alarm circuit shall be wired to an alarm light on the nearest local Temperature Control panel (LTCP).// Provide remote output relay to indicate alarm condition at the Building Control System specified under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.//

2.5 EQUIPMENT AND MATERIALS IDENTIFICATION

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

1. SPEC WRITER NOTE: Verify that electrical drawings show a circuit to the control panel and calls for wiring to blowdown valve and water meter.
2. SPEC WRITER NOTE: Training requirements shall be coordinated with the total building commissioning effort.

3.1 INSTALLATION

A. Delivery and Storage: Deliver all chemicals in manufacturer's sealed shipping containers. Store in designated space and protect from deleterious exposure and hazardous spills.

B. Install equipment furnished by the chemical treatment supplier and charge systems according to the manufacturer's instructions and as directed by the Technical Representative.

C. Refer to Section 23 21 13 HYDRONIC PIPING for chemical treatment piping, installed as follows:

1. Provide a by-pass line around water meters and bleed off piping assembly. Provide ball valves to allow for bypassing, isolation, and servicing of components.
2. Bleed off water piping with bleed off piping assembly shall be piped from pressure side of circulating water piping to a convenient drain. Bleed off connection to main circulating water piping shall be upstream of chemical injection nozzles.
3. Provide piping for the flow assembly piping to the main control panel and accessories.
   a. The inlet piping shall connect to the discharge side of the circulating water pump.
   b. The outlet piping shall connect to the water piping serving the cooling tower downstream of the heat source.
   c. Provide inlet Y-strainer and ball valves to isolate and service main control panel and accessories.
4. Install injection nozzles with corporation stops in the water piping serving the cooling tower downstream of the heat source.
5. Provide piping for corrosion monitor rack per manufacturer’s installation instructions. Provide ball valves to isolate and service rack.

//6. Provide piping for erosion chemical feeder per manufacturer’s installation instructions. Provide ball valves to isolate and service feeder.//

7. Provide installation supervision, start-up and operating instruction by manufacturer's technical representative.

D. Before adding cleaning chemical to the closed system, all air handling coils and fan coil units should be isolated by closing the inlet and outlet valves and opening the bypass valves. This is done to prevent dirt and solids from lodging the coils.

E. Do not valve in or operate system pumps until after system has been cleaned.

F. After chemical cleaning is satisfactorily completed, open the inlet and outlet valves to each coil and close the by-pass valves. Also, clean all strainers.
G. Perform tests and report results in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
H. After cleaning is complete, and water PH is acceptable to manufacturer of water treatment chemical, add manufacturer-recommended amount of chemicals to systems.
I. Instruct VA personnel in system maintenance and operation in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

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