

SECTION **23** 25 00 - WATER TREATMENT FOR HYDRONIC SYSTEMS

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Closed Loop Hot Water and Chilled Water Systems – Water Treatment, Freeze Protection
- B. See *Section 23 22 13 Steam and Condensate Piping* for cleaning of steam systems.

[Note to AE: Although often included in this section, cleaning of steam systems is specified in Section 23 22 13 Steam and Condensate Piping as indicated.]

1.2 RELATED SECTIONS

- A. *23 21 13 - Hydronic Piping*
- B. *23 21 16 - Hydronic Specialties*
- C. *23 25 10 – Fluid Filtration*
- D. *Section 23 05 19 - Meters and Gauges for HVAC Piping*

1.3 QUALITY ASSURANCE

- A. Products and execution shall be in compliance with all applicable codes and standards.
- B. All aspects of chemical management shall be in compliance with manufacturer's and supplier's recommendations and instructions.

1.4 SUBMITTALS

- A. Following shall be provided for chemicals including glycol.
 - 1. Product Information
 - a. Manufacturer, Product ID, Ingredients, Concentrations
 - 2. Safety Data Sheet (SDS), formerly Material Safety Data Sheet (MSDS)
 - 3. Manufacturer's Instructions and Recommendations
 - a. Storage, handling, disposal
 - b. Concentration and dosage
 - c. Mixing and introduction into system
- B. Following shall be provided for bag filters. See *Section 23 25 10 – Fluid Filtration* for requirements.
 - 1. Manufacturer's product information
 - 2. Manufacturer's IOM
- C. Chemical Discharge Request Form shall be provided.
 - 1. Form shall be submitted to Owner prior to draining.
- D. Startup report shall be provided for each system.
 - 1. Total quantity water in system
 - 2. Quantity chemical treatment or glycol Added
- E. Field service log shall be provided and maintained.
 - 1. Up-to-date on-site log with records of:
 - a. Test results

- b. Chemical adjustments
 - c. Filter bag changes
- F. Field service test reports shall be provided.
- 1. Test results shall be recorded in service log.
- G. Full Lab Analysis Reports shall be provided. See paragraph 3.7 *Sample Lab Report* for examples.
- 1. For water and glycol systems
 - 2. At system startup and at end of warranty period

1.5 QUALITY ASSURANCE

- A. Chemicals shall be provided by reputable, Owner-approved chemical treatment company.
- B. Oversight of initial cleaning and chemical treatment shall be provided by same.
- C. Service visits, testing and adjustments shall be performed by same.
- D. Full lab analysis for water system shall be performed by Owner-approved laboratory.
- E. Full lab analysis for glycol system shall be performed by glycol vendor or Owner-approved laboratory.

1.6 WARRANTY

- A. Contractor shall warrant full compliance with the following for period of one year from system startup:
 - 1. Hydronic system cleanliness and water chemistry shall be maintained within specified limits.
 - 2. No hindrance to system functionality or damage to system components shall occur as a direct or indirect result of chemical treatment and/or filtration deficiencies.

PART 2 - PRODUCTS

2.1 CLEANING AND TREATMENT CHEMICALS - CLOSED LOOP SYSTEMS

- A. Cleaning Agent
 - 1. Cleaning Solution
 - a. Cleaning solution shall be formulated to remove solder flux, cutting oils, loose mill scale, construction debris and organics.
 - b. Chemical cleaner shall typically be an aqueous solution of trisodium phosphate and caustic soda.
 - c. Cleaning solution shall not be harmful to system materials of construction.
 - d. pH of system fluid shall be maintained above 9.5 during cleaning process to assist with formation of passivating film.
- B. Chemical Treatment – Hot Water and Chilled Water Systems
 - 1. Corrosion Inhibitor
 - a. Corrosion inhibitor shall be a multi-functional blend including:
 - 1) Sodium Nitrite and/or Molybdate (inhibitor)
 - 2) Tolytriazole (copper protection)
 - 3) Borax and/or Potassium Phosphate (pH Buffer)
 - b. Concentration in system fluid shall be maintained as follows:

- 1) Nitrite: 500-800 ppm
 - 2) Molybdate: 100 ppm minimum (as applicable)
 - 3) Tolytriazole: 10 ppm minimum
 - 4) Borax: 100 ppm minimum
 - 5) Phosphate: 100-200 ppm (as applicable)
- c. pH of system fluid shall be maintained at 9.5-10.5
- d. Basis of Design:
- 1) Illinois State Mix #2900-141-0061

C. Ethylene Glycol

1. Composition

- a. Ethylene glycol: $\geq 92.4\%$ by weight
- b. Inhibitors and water: 7.6%
- c. Specific gravity, 60/60F: 1.130-1.144
- d. Dye: Florescent pink or fluorescent orange, green not allowed
- e. Reserve alkalinity (ASTM D1121): ≥ 25 ml
- f. pH 1.1 dilution: 8.5-9.0
- g. Antifoam (as required to prevent foaming at air vents)

2. Approved Manufacturers

- a. Dowtherm 4000
- b. Interstate Intercool

3. Disallowed

- a. Rocktherm
- b. Automotive antifreeze
- c. Any formulation containing silicates

4. Exception: Systems with aluminum components shall receive an alternate formulation. Silicates will typically be required.

2.2 BAG FILTERS

- A. See Section 23 25 10 – *Fluid Filtration* for requirements.

PART 3 - EXECUTION

3.1 PREOPERATIONAL CLEANING – CLOSED LOOP SYSTEMS

A. System Filling

1. Entire system shall be filled with clean water and air vented.
2. Meter shall be used during filling to determine system volume.
3. Measured system volume shall be stenciled in professional manner on exterior of insulated heat exchangers(s).

B. Leak Testing

1. Hydrostatic test of system shall be performed as specified in Section 23 21 13 *Hydronic Piping*.

C. System Cleaning

1. Devices vulnerable to damage or fouling by cleaning fluid shall be bypassed or valved off without hindering system circulation.
2. All manual isolation valves, balance valves and automatic control devices shall be placed in full open position. Procedure shall be coordinated with Temperature Control Contractor.
3. Cleaning solution shall be slowly added to system. Quantity shall be based upon metered system volume. Cleaning solution shall typically be added to system via bypass bag filter vessel (filter vessel doubles as chemical pot filter).
4. Cleaning solution shall be circulated throughout entire system for 48 hours minimum.
5. If possible, heat shall be added to system throughout circulation period. Heated water temperature shall be approximately 160F. If heat is added circulating time may be reduced to 24 hr.
6. pH of system fluid shall be maintained between 9.5 and 10.5 throughout cleaning process.
7. Fluid velocity shall be maintained at 5 ft/sec minimum through all branches and 3 ft/sec minimum within mains. Multiple pumps shall be operated and/or system shall be sectionalized as required to maintain required velocity.
8. Bypass bag filter shall be active throughout circulation period. Bags shall be changed as loaded. Startup and Maintenance procedure for filter shall be implemented as presented in Section 23 25 01 *Fluid Filtration*.
9. Once required cleaning period has been completed and while system is still being circulated, fluid shall be drained from system while clean water is added at same rate. Referred to as "flush-and-fill". Effluent shall be directed to sanitary drain.
10. Flush-and-fill process shall be continued until clean discharge fluid is achieved at all low point drains.
11. Samples of clean fluid shall drawn by Owner for analysis. Samples shall be drawn from Owner selected sites.
12. Flushing shall be continued and fluid samples drawn until Owner approval achieved.
13. All strainers shall be removed, cleaned and reinstalled. Pump start-up screens shall be removed and temporarily attached to pump/piping for later inspection.
14. Bypass piping shall be removed and components and instruments returned to operational configuration.
15. Dirty bypass filter shall be replaced with clean filter bag.

3.2 CHEMICAL TREATMENT

- A. Chemical treatment shall be slowly added to system. Quantity shall be based upon metered system volume.
- B. Chemical treatment shall typically be added to system via bypass bag filter vessel (doubles as pot feeder).
- C. System fluid shall be circulated until thoroughly mixed.
- D. Concentration of chemical components shall satisfy requirements of *2.1B Chemical Treatment* above.
- E. Post-treatment sample of system fluid shall be provided to Owner for analysis. Sample shall be drawn in presence of Owner.
- F. Adjustments shall be made by until Owner approval is achieved.

3.3 GLYCOL

- A. Ethylene glycol solution shall be added to system with portable glycol fill unit. Quantity shall be based upon metered system volume.

- B. Glycol shall be premixed with water prior to introduction into system . Requirement may be relaxed with Owner approval.
- C. System fluid shall be circulated until thoroughly mixed.
- D. Concentration of ethylene glycol shall be 30% \pm 2% by weight unless indicated otherwise in documents.
- E. Post-treatment sample of system fluid shall be provided to Owner for analysis. Sample shall be drawn in presence of Owner.
- F. Adjustments shall be made until Owner approval is achieved.

3.4 CHILLED WATER FROM CENTRAL SYSTEM – ADDITIONAL REQUIREMENTS

- A. Connections to CHWS and CHWR lines shall be provided near building service entrance as indicated in drawings. *[Note to AE: Provide detail drawing per UIUC Facilities Standards Drawing # 23 20 00-01.]*
- B. Building chilled water system shall be isolated from central system by closing service entrance valves.
- C. Temporary pumping apparatus shall be provided. Hoses/piping shall be provided and attached to pipe connections.
- D. Chemical cleaning and flushing procedures specified above for closed loop systems shall be followed.
 - 1. Given that it may not be possible to achieve specified fluid velocity in mains, velocity shall be maintained as high as practical.
 - 2. Note: When building isolation valves are closed there is no provision for thermal expansion of system fluid.

3.5 EXISTING SYSTEMS - ADDITIONAL REQUIREMENTS

- A. Existing system shall be drained prior to making new connections.
- B. System fluid shall be properly disposed of unless approved by Owner for reuse.
 - 1. Method and rate of disposal of contaminated fluids, ethylene glycol in particular, shall conform to Owner's requirements.
- C. Existing system shall be filled with clean water, flushed and drained prior to making new connections.
- D. Entire system (new and existing) shall be filled, tested, cleaned, flushed and chemically treated/filled with glycol solution as indicated above for new systems. Scope of work for existing system may be reduced as appropriate and as approved by AE and Owner.

3.6 EXPANSION TANK ADJUSTMENT

- A. Expansion tank charge shall be adjusted. Following procedure shall be followed. *[Note to AE: Many craftsmen and engineers have not been trained in proper charging procedure.]*
 - 1. Ensure system fluid is at room temperature.
 - 2. Ensure all air is vented from system.
 - 3. Close valve between expansion tank and system.
 - 4. Open bent/drain valve at expansion tank.
 - 5. Adjust air pressure to value indicated in documents. If not indicated, accomplish via approved method as follows: *[Note to AE: Provide expansion tank pressure setting on project drawings per UIUC Facilities Standards.]*
 - a. Preferred method: Provide pressure gauge at highest point in system. Adjust tank air pressure to yield 5-10 PSIG at highest point.

- b. Alternate method if preferred method is not achievable: If actual height of system is known adjust pressure to height of system above tank plus 10-20 ft. (convert to PSIG). Height of system must be known with accuracy to apply this method.
- 6. Close drain/vent at tank.
- 7. Open valve between expansion tank and system.

3.7 FIELD SERVICE

A. Frequency

- 1. Chemical treatment shall be tested and adjusted.
 - a. Quarterly throughout warranty period
 - b. Additionally as required to maintain specified system chemistry and proper system operation
- 2. Bypass bag filter shall be changed as required throughout warranty period. See Section 23 25 10 – *Fluid Filtration* for Requirements.

B. Log Sheet

- 1. Shall be provided and maintained by chemical treatment company
 - a. Shall be enclosed in protective cover attached to bypass filter
- 2. Shall include record of all on-site tests, adjustments and filter changes
 - a. Shall be dated and initialed each visit

3.8 TESTS

- A. System fluids tests shall be conducted at each field service visit. Tests shall include the following at a minimum:
 - 1. Water System - pH, conductivity, primary corrosion inhibitor levels (nitrite and/or molybdate), metal levels (iron and copper), particulate
 - 2. Glycol System - % ethylene glycol by weight, reserve alkalinity, metal levels (iron and copper), particulate

3.9 LAB ANALYSIS

- A. Full lab analysis shall be performed at system startup and at end of warranty period.
 - 1. Water system analysis shall be performed by reputable, Owner-approved laboratory.
 - 2. Glycol system analysis shall be performed by glycol vendor or Owner-approved laboratory.
 - 3. Scope of analysis for each system shall be as identified in Section 3.7 *Sample Lab Report* at minimum and shall include all line items.
 - a. Additionally:
 - (a) Test for ammonia level shall be performed.
 - b. ATP test for biological growth shall be performed if presence of ammonia is detected.

3.10 WARRANTY PERIOD

- A. Field Service and Tests shall be provided throughout warranty period as required by Paragraph 3.7 *FIELD SERVICE* and 3.8 *TESTS* above.

3.7 SAMPLE LAB REPORTS

- A. Provided on pages below are samples of lab analysis reports
 - 1. Water System – Full Lab Analysis
 - 2. Glycol System – Full Lab Analysis

WATER SAMPLE ANALYSIS

<i>Analyst:</i>	<i>Facility:</i>
<i>Sample Type:</i>	<i>Attention:</i>
<i>Location:</i>	<i>Additional Information:</i>
<i>Date Collected:</i>	

<i>Parameter</i>	<i>Value</i>	<i>Units</i>
P Alkalinity (as CaCO ₃)	135	mg/L
M Alkalinity (as CaCO ₃)	260	mg/L
Hardness (as CaCO ₃)	56 Site	mg/L
Sulfate (SO ₄)	100	mg/L
Chloride (Cl)	430	mg/L
Silica (SiO ₂)	1.6	mg/L
Iron (Fe)	0.00	mg/L
Copper (Cu)	0.34	mg/L
Zinc (Zn)	0.00	mg/L
Aluminum (Al)	0.30	mg/L
Total Suspended Solids	19	mg/L
Total Phosphate (PO ₄)	3.68	mg/L
Sodium (Na)	354.7	mg/L
Molybdenum (Mo)	0.04	mg/L
Total Dissolved Solids	1064	mg/L
Conductivity	1788	uS/cm
pH	9.89 Site	pH units
pH Temperature	26.2 Site	deg. C
Nitrite (NO ₂)	300	mg/L
Borate (B ₂ O ₄)	33	mg/L
Triazole	0.6	ppm
Ammonia (NH ₄)	8.0	mg/L

Comments

Hardness: Somewhat High at 56 mg/L.

Iron and Zinc: None, good.

Copper: Slightly High at 0.34 mg/L.

Aluminum: Somewhat High at 0.30 mg/L.

Molybdenum: Low but present at 0.04 mg/L.

Total Suspended Solids: Slightly High at 19 mg/L.

pH: Satisfactory at 9.89. Target range is > 9.5.

Nitrite: Low at 300 mg/L. Target range is 500-800 mg/L.

Borate: Low at 33 mg/L, below the target range of 300-600 mg/L.

Tolyltriazole: Extremely Low at 0.6 mg/L, recommended range is 2-5 mg/L.

Ammonia: Somewhat high at 8.0 mg/L. Recommended levels are under 20 mg/L.

Glycol Fluid Analysis

	<i>Test</i>	<i>Results</i>	<i>Recommended Levels</i>
<i>General Tests</i>	Glycol (Vol %): <i>Propylene</i>	24	25% - 65%
	Freeze Point (deg F):	+16	10 to -68
	pH:	8.90	8.0 - 9.5
	Color, Clarity, Oil:	<i>Yellow, Clear, No Oil</i>	
<i>Degradation Products</i>	Iron (Fe), ppm:	0	< 5
	Copper (Cu), ppm:	0	< 5
	Aluminum (Al), p	0	< 5
	Zinc (Zn), ppm:	0	< 5
<i>Scale Promoters</i>	Magnesium (Mg), ppm:	0	< 1
	Calcium (Ca), ppm:	0	< 1
<i>Contaminants</i>	Silica (SiO ₂), ppm:	16	< 25
	Nitrate (NO ₃), ppm:	22	< 25
	Molybdenum (Mo), ppm	0	< 25
	Lead (Pb), ppm	0	< 5
	Arsenic (As), ppm	0	< 5
<i>Corrosives</i>	Chloride (Cl), ppm:	45	< 25
	Sulfate (SO ₄), ppm:	23	< 25
	Acidity (Organic):	260	< 1000
<i>Inhibitors</i>	Phosphate (PO ₄), ppm:	3205	2250 - 3750
	Boron (B), ppm:	61	> 150
	Nitrite (NO ₂), ppm:	11	> 250
	Tolytriazole (TZ), ppm:	124	> 150
	NACAP, (MBT), ppm		> 150

Comments and Recommendations:

END OF SECTION **23** 25 00

This section of the *U of I Facilities Standards* establishes minimum requirements only.
It should not be used as a complete specification.

