PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Pre-Start Cleaning of HVAC Piping Systems
   2. Chemical Feeders
   3. Treatment for Closed Systems
   4. Treatment for Open Systems
   5. Corrosion Coupons

B. Related Sections:
   1. Section 15010 - Basic Mechanical Requirements
   2. Section 15050 - Basic Mechanical Materials and Methods
   3. Section 15511 - Hydronic Piping and Specialties

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Spill containment requirement for each chemical treatment station will be determined by University of Colorado at Boulder’s Facilities Management, Refrigeration Shop water treatment technician. Chemical containers will vary from 5 gallons to 55 gallons. Containments of concrete or polyethylene, holding drums 30 gallons or larger, must have a ramp to the platform level. Concrete containments must have a ramp outside and inside the containment to wheel drums into pit area.

B. Specify the following procedures.

1. Pre-Cleaning
   a. Closed Systems

   Hot and chilled water systems must be cleaned in the same manner prior to being ready for operation. The chemical cleaning must be alkaline material containing Dispersants, Detergent and Organic Corrosion inhibitors. Required system cleaner is Ashland Flushout 624L or UCB prior approved equivalent. Once system is properly dosed with chemical, circulate for 24 hours and, if possible, heating system water up to 140-180°F. Following circulation, drain down and flush. Fill, circulate 30 minutes and flush system until the water is clear and TDS of system water is +/- 50 μmhos that of city water. Once system has been properly flushed, add closed-system inhibitor (Nitrate based) to boost chilled water levels to 400-600 ppm as N0₂. Hot systems should be dosed with inhibitor to boost nitrite levels to 600-800 ppm. Required closed-system inhibitor is Ashland’s Drewgard 2808 unless prior approval is obtained by UCB.
Note: If glycol is specified in the system, and it is not pre-inhibited, (such as Dowtherm & Dowfrost as required in Section 15511) proper glycol levels are added to the system prior to adding inhibitor. Report system volume and glycol/water mixture added.

b. Open Recirculating System (Cooling-Tower Water)

With system circulating, add a phosphate-based cleaner/passivation chemical. Liquid chemical should be a blend of inorganic phosphate, organic corrosion inhibitor, dispersant and an oil emulsifier. Ashland Flushout 2624 L, Ashland equivalent or prior approved equivalent by UCB is the required product. In order for optimum passivation and cleaning system, pH must be maintained in the 6.5-7.5 range. Sulfuric acid may be gradually added to adjust pH if it increases above 7.5. Soda ash may be added if pH drops below 6.5. Sufficient Ashland Enviroplus 2503, Enviroplus 2499 should be added to raise total inorganic phosphate levels to 500 ppm minimum. Circulate for a minimum of 48 hours. Circulate and flush the system until TDS is +/- 50 μmhos that of city water. Verify all pump strainers are clean and functioning. Lay up the system dry until ready for use or begin recommended treatment program.

c. Steam Boiler

Fill the boiler and add an alkaline cleaner containing detergents, emulsifiers and organic inhibitors. Ashland L.A.C. or prior approved equivalent by UCB is the required cleaner in sufficient amount to boost system pH to 11.0 - 12.0. Fire the boiler at normal operating levels and allow system pressure to build to 1/3 normal operating pressure. Fire for 4 - 6 hours then drain to 1/2 normal operating level in site glass. Add sufficient water to refill to normal operating level. Blowdown again to 1/2 normal operating level. Repeat this procedure at least 4 times allowing system pressure to drop during each flush. Allow the boiler to cool, then drain and flush. Begin normal treatment program or layup dry.

2. Chemical-Feed Equipment

a. Inhibitor Feed and TDS Control for Cooling Towers

Provide a proportional make-up chemical feed system where chemical feed is fed in proportion to the quantity of make-up water fed to the cooling tower. A certified contacting water meter shall be provided and installed in the make-up water line. The water meter will sense the quantity of make-up water in 10 gallon increments. Send an electrical signal to a cooling tower controller. The tower control device will accept and accumulate the electrical signals from the water meter. The correct contacting water meter may be specified by the chart below:
The controller must have the capability to actuate a variable timer when a predetermined number of signals is accepted from the water meter. The controller will be capable of activating the timer when 1 to 99 pulse-signals are sent to the controller. The timer circuit will activate a 110V circuit to energize a chemical pump for feeding scale inhibitor.

Tower bleed will be controlled via a flow through TDS/conductivity sensor. The controller will read conductivity of the cooling water the 0-2000 microohms/cm range in a digital format on the front of the control device. The controller will be designed to energize a 110V circuit to open a solenoid bleed valve any time a preset conductivity is exceeded.

The controller will also include a 28-day programmable biocide time clock for feeding 2 (two) liquid biocides. The time clock shall be capable of energizing a 110V electrical outlet that can be used to energize a chemical feed pump for biocide, in 15-minute increments.

The controller will have a mounted flow assembly TDS sensor. Flow assembly will de-energize the controller when a loss of flow is sensed.

The required tower control unit is a LMI DC4500-111A, with LMI manifold (manifold contains flow switch and conductivity probe) or prior approved equivalent by UCB.

b. Inhibitor Feed and TDS Control for Cooling Towers 100 Tons and Smaller.

Provide a bleed-and-feed tower control system. Tower bleed will be controlled via a flow-through TDS/conductivity sensor. The control unit will read out in the 0-2000 micro mho/cm range in a digital format on the front of the control device. The controller will be designed to energize a 110V circuit to open a solenoid bleed valve any time preset conductivity is exceeded. While the solenoid bleed valve is open, and additional 110V circuit will energize to provide power to a chemical feed pump.

Although the system will be designed to operate in the bleed-and-feed mode, the system should have the capability of accepting pulses from a contacting water meter. The control unit should be capable of energizing a 110V circuit for 0-300 seconds following receipt of a pulse from a contacting water meter. The controller will have a mounted flow assembly/TDS sensor. Flow assembly will de-energize the controller when a loss of flow is sensed. The required tower controller is a LMI DC4500-111A controller or prior approved equivalent by UCB. See attached parts list for required controller options for each tower configuration.

<table>
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<tr>
<th>TOWER</th>
<th>CONDENSER</th>
<th>RECOMMENDED WATER METER</th>
</tr>
</thead>
<tbody>
<tr>
<td>TONNAGE</td>
<td>CIRC. RATE</td>
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<td>0-6000</td>
<td>5/8&quot;</td>
</tr>
<tr>
<td>300-400</td>
<td>900-1200</td>
<td>3/4&quot;</td>
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<tr>
<td>500-800</td>
<td>1500-2400</td>
<td>1&quot;</td>
</tr>
<tr>
<td>900-1600</td>
<td>2700-4800</td>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td>1600-3000</td>
<td>4800-9000</td>
<td>2&quot;</td>
</tr>
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</table>
c. Inhibitor Feed Pumps

An electronically-actuated diaphragm pump will be provided. The pump must be a 110V, rated at 0.24-24 GPD. Discharge pressure must be capable of overcoming the maximum pressure rating of the condenser-water pump. Materials of construction are Polypropylene/Teflon/Ceramic. An LMI Model A151-392SI series pump or UCB prior approved equivalent is required. The inhibitor will be fed using the injector supplied with LMI pump.

d. Biocide Feeders for Towers

An electronically-actuated diaphragm pump will be provided. The pump must be for 110V, rated at 0.24-24 GPD. Materials of construction are Polypropylene/Teflon/ceramic. An LMI model A151-392SI or UCB prior approved equivalent is required. The pump shall be activated by the Tower control unit.

Injection quills of 304 Stainless Steel will only be used on injection points with 4” or greater pipe diameter, all others will use injection check valve supplied with LMI A151-392SI pumps or UCB prior approved equivalent.

Sonoxide unit and solid feeders see attached sheets e and f.

e. Steam Boilers

1) TDS

Provide a TDS control unit that periodically samples boiler water by opening the blowdown line for a short sampling period. If TDS is below the trip point, the blowdown valve closes after the timed sample. If TDS exceeds preset limits, the controller overrides the timer, allowing the blowdown valve to remain open until the system returns to the desired TDS.

The control device shall provide a 0-10,000 micro-ohm or 0-6,500 ppm TDS analog readout. Trip point can be adjusted on the front panel of the control unit. An LMI DC4500 250 psi valve package is the required Boiler Control Unit.

2) Feed of Oxygen Scavenger

Sulfite based oxygen scavenger must be fed on a continuous basis. The chemical is fed using an injection quill that is positioned in the deaerator storage tank or the feed-water tank (if no deaerator exists). The injection quill should be constructed of 304 stainless steel. An electronically-actuated diaphragm pump rated at 0.24-24 gallons per day must be provided. Materials of construction are Polypropylene/Teflon/Ceramic. An LMI model A151-392SI or UCB prior approved equivalent.

3) Inhibitor Feed

Scale inhibitors are fed into the suction side of the feed water pumps using a 304 stainless steel injection quill. An electronically-actuated diaphragm pump rated at 0.24-24 GPD must be provided. Materials of construction are...
Polypropylene/Teflon/ceramic. A LMI model A151-392SI pump or UCB prior approved equivalent is required. The inhibitor pump should be wired such that it will energize when the feed pump runs or when make-up water is supplied to the boiler system. Operators must have the option of either control mode by providing a dual-receptacle plug. One plug will energize based on the feed pump the other will energize when make-up water is called for.

4) Water Softener

A water softener must be provided for all steam boilers. It shall be capable of producing a consistent supply of make-up water containing <0.5 ppm total hardness. The softener must be equipped with a salt tank and provisions for automatic regeneration based on total gallons supplied by the unit.

If the boiler is an intermittent-operating unit that shuts down at least 4 hours per day, a single softener vessel system must be provided. If the boiler runs on a continuous basis, a dual-vessel system must be provided. The dual-vessel system will regenerate the exhausted vessel as soon as the new vessel is put into service. See attached schematic WT-7A and parts list WT-7B.

f. Closed Systems

1) All hot-water or chilled-water closed-loop systems under 1,000 gallons shall have a 2 gallon bypass (pot) filter feeder installed.
2) All hot-water or chilled-water closed-loop systems over 1,000 gallons shall have a 5 gallon by-pass filter feeder installed.

A Neptune by-pass filter feeder or prior approved equivalent by UCB will be provided. The vessel will be constructed of mild steel and be capable of operating up to 200 psig. A filter bag kit should be provided to fit inside the feeder. The bag filter will remove scale, rust, chips, etc. from the system. This bag filter shall be marked “bag inside.”

The contractor installing the bypass filter feeder will be required to provide piping and valves for installation of this feeder. See attached schematic WT-D and parts list WT-D.

g. Corrosion Coupon Racks

Corrosion coupon racks shall be supplied on all process-cooling, heating water, chilled-water and water systems served by open cooling towers, such as condensers and indirect evap-cooling coils. All racks shall be constructed of 1" Sch 80 PVC Pipe with the exception of Hot Water systems which should be Sch 80 mild steel pipe. Coupon racks should be capable of accepting two corrosion test specimens. A orifice-valve must be supplied in each rack which provides a 3.0-4.0 ft/sec flow throughout the rack. A flowmeter shall be installed near the coupon rack, after orifice-valve. Flowmeter shall be within 1 foot of union.

When installing a rack in the condenser water system, the warmest water in the system should be the supply water to the coupon rack. Usually, the water exiting the condenser would be considered supply to the coupon rack.
3. Special Procedures

a. Domestic-Water Sterilization

10% bleach will be used to perform the sterilization. Bleach will be fed by injecting it into the main water supply header feeding the facility. An LMI Model A151-392SI chemical feed pump is to be used for injection of bleach. Below is the sterilization procedure.

1. Run all domestic water supply faucets at 1/2-1/4 gallon per minute.
2. Begin pumping bleach and adjust bleach injection rate such that a 1.0-2.0 ppm free Cl\textsubscript{2} residual is attained at all faucets.
3. Maintain above flow rates and free chlorine residuals for a 4-6 hour period.
4. Cease bleach injection. Monitor free Cl\textsubscript{2} residuals at faucets and observe when free Cl\textsubscript{2} residual drops below 0.2 ppm. Run all faucets for an additional two hours at a 1/2-1/4 gallon per minute rate.

System is now considered sterile and ready for operation.

1.03 QUALITY ASSURANCE

A. The Water Treatment, Chemical and Service Company shall be recognized as a specialist, active in the field of industrial water treatment for at least ten years, whose major business is in the field of water treatment, and shall have regional water analysis laboratories, development facilities and service department, plus full-time service personnel within the locale of the job site.

B. All products shall be provided by a single subcontractor to ensure there is a single source of responsibility. Sub-contractor shall be on State approved list.

C. Firms must submit a list of satisfied customer service references and evidence of qualifications and experience for acceptance to execute the work on the project.

1.04 MAINTENANCE

A. Provide the services of a fully-qualified Field Engineer and laboratory and technical assistance form a fully-qualified laboratory staff for one year warranty period. Services and assistance shall include the following:

1. A training course for the University's operating personnel, instructing them clearly and fully on the installation care, maintenance, testing, and operation of the water treatment systems length of training shall be given as needed, per system size and complexity.

2. A periodic technical service visit to the job site to perform field inspections and to make water analysis on site, in order to evaluate the condition of the treated systems.

3. The Field Engineer shall report findings to the University's operating personnel in writing on proper practices, chemical treating requirements, and any corrective actions needed to protect the water systems from scale, corrosion, and fouling.

PART 2 - PRODUCTS
2.01 WATER TREATMENT CHEMICALS

A. Supplier:

Ashland Water Technologies

2.02 CHEMICAL FEED PUMPS

A. Manufacturer:

LMI

2.03 WATER METERS/ CERTIFIED

A. Manufacturer:

LMI, Badger or Seametrics

2.04 CONDUCTIVITY METERS

A. Manufacturer:

LMI, DC4500-111A or approved LMI equivalent, with manifold (34752)

2.05 WYE STRAINERS

Threaded wye strainers shall have screens of 20 mesh maximum, watts preferred or prior approved equivalent.

2.06 SPILL CONTAINMENT

Spill containment made of polypropylene (or equivalent) or concrete shall be provided. Total volume of containment shall exceed total volume of chemical containers by 50%. Concrete containments must have ramp inside and outside. Containments using 30 drums or greater mush have ramp to drum platform level.

PART 3 - EXECUTION

3.01 INSTALLATION/APPLICATION

A. Specify the following:

1. Emergency eye wash/shower (potable water) shall be located at or in close proximity (within 10') to chemical treatment station with no obstruction or tripping hazards in between chemical containers, filter-feeders, chemical pumps and conductivity controller are considered chemical treatment station.

2. Chemical treatment station shall be located at or in close proximity to sanitary sewer floor drain or be constrained in a basin piped to sanitary drain.
3. All chemical pumps shall be mounted no higher than 5 foot above floor elevation, with 4 foot being the optimal height.

4. All chemical pumps shall be located within 5 feet of conductivity controller.

5. Wye strainers must be installed before (upstream) of all controller sensors, bleed solenoids before controller sensor can be used for both controller and coupon rack. On systems 1,500 gallons or less, wye strainer located before controller sensor can be used for both controller and coupon rack. Systems over 1,500 gallons shall have wye strainers upstream of coupon rack, one upstream of controller and one upstream of bleed solenoid.

6. Conductivity controller must be mounted on fixed walls or stands free of vibration. Controller shall not be mounted on cooling towers, duct work or air handlers. Controller must be insulated from extreme cold and heat if installed on building exterior wall. All controllers shall be mounted between 5’ & 5’ 6’’ above floor (eye level). 36” clearance in front of controller is required.

7. All chemical pumps must be secured to shelf or support to prevent any movement due to pump action or normal contact.

8. All chemical pumps and conductivity controllers must be 110 volt, 60 Hz.

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<tr>
<td>WT-B</td>
<td>Towers without Sump</td>
<td>11</td>
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<td>Boiler with less than 5000#/HR Capacity Schematic</td>
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PARTS LIST FOR SCHEMATIC

WT-A
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<td>WYE STRainers</td>
<td>2</td>
<td>Drew PART #6032-01-5</td>
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<td>FLOW METER</td>
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<td>ISOLATION BALL VALVES</td>
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PARTS LIST FOR SCHEMATIC WT-B
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<td>REFER TO UCB STANDARDS APPROVED VALUES</td>
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<td>ISOLATION BALL VALVES</td>
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## PARTS LIST FOR SCHEMATIC
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<td>3/4” BALL VALVES, APPROVED SUPPLIER FOR BRASS BODY VALVES, STAINLESS STEEL BALL AND STEM FULL PORT BALL VALUE RATED FOR SYSTEM PRESSURE MAXIMUM 600 PSIG</td>
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WATER TREATMENT SPECIFICATION: SONOXIDE

JULY 2008  UCB STANDARDS  15548-13
Water treatment Specification for cooling towers using non-chemical microbiological control systems.

Provide complete chemical treatment program including corrosion inhibitor and non-chemical mechanical system for microbiological control.

The biocide system will be Ashland Water Technologies’ SONOXIDE ultrasonic treatment. No other non-mechanical devices will be accepted.

1. The Biocide equipment for the tower water treatment shall be a complete packaged, pre-piped, pre-wired, automatic system.

2. Installation will require piping the inlet and outlet of the SONOXIDE system to the cooling tower system. Installation also requires wiring the power supply to the SONOXIDE system. Installation will be provided by others.

3. The biocide unit shall have a fail safe back up control and warning alarm in the event of operational malfunction such as loss of water flow. This output will be wired to the Andover building management system.

4. The Biocide equipment will be run independently of the bulk water inhibitor and not be connected to the conductivity control equipment.

5. All maintenance of the unit shall be the responsibility of the vendor. Any and all replacement parts to keep the unit operational will remain the responsibility of the vendor for the life of the contract.

6. 24 hour emergency response to be provided to keep unit operational.

7. The contractor is to abide by the following terms and conditions.

8. The contractor is to fill out and submit with the shop drawing submittals the following signed documents and agreements regarding terms of use/contractor acknowledgement and terms of use.

SONOXIDE Terms of Use

JULY 2008 UCB STANDARDS 15548-14
The SONOXIDE equipment provided is to be kept in good condition, normal wear and tear excepted. Additionally, an Ashland representative or an outside designee of Ashland may periodically perform an inspection or otherwise need access to the equipment. You will do everything in your power to prevent damage and reimburse Ashland for any damages that may occur while the equipment is under your control. Pricing to include all necessary items for the initial 12 month warranty period.

The SONOXIDE ultrasonic water treatment system is patented and proprietary. Therefore, embodied within the equipment is certain information of a confidential and proprietary nature, and you agree not to reverse engineer, disassemble or create an equivalent of the equipment or allow others to do so. You will also keep information not in the public domain relating to the equipment and the procedures associated with the operation thereof confidential. You further agree that you will use said information only in connection with your receipt of Ashland’s performance, and for no other reason.

The obligations contained in this section shall be binding to Ashland, the University and their legal successors.
EXAMPLES OF CORROSION TEST RACK INSTALLATIONS

FOR ALL COOLING TOWERS

NOTES:
1. WELD 1/4" HALF COUPLING TO WATER HEADERS.
2. VALVE RACK SO THAT CORROSION SPECIMEN CAN BE EXTRACTED AT ANY TIME.
3. FLOW METER IS RECOMMENDED FOR ALL INSTALLATIONS.
4. PRECEED FLOW METER WITH THROTTLING VALVE.

FLOW METER

HIGH PRESSURE

LOW PRESSURE

C.W. RETURN

C.W. RETURN

THROTTLING-INSULATION

DRAW VA.

ISOLATION VA.

FLOW METER

WATER FLOW

WATER FLOW

THROTTLING VA.

THROTTLING VA.

WATER FLOW

WATER FLOW

ISOLATION VA.

ISOLATION VA.

WATER FLOW

WATER FLOW

ISOLATION VA.

ISOLATION VA.

WATER FLOW

WATER FLOW

ISOLATION VA.
Boiler Water Level and NOT Over Blow, the Boiler.

Boiler Over Blowdown (Steam) is Recommended for Smaller Boilers with Blowdown Requirements of Less Than 7500 lbs/hr. The Boiler Water is periodically sampled for conductivity. This is done in order to maintain the boiler water level and protect the equipment.

Time Blowdown

For Boiler with less than 5000#HR Capacity

Use with Drawing WT-C