

Part 1 General

1.1 REFERENCES

- .1 ASME B31.9-2011 - Building Services Piping.
- .2 ASTM A53/A53M-12 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

1.2 SYSTEM DESCRIPTION

- .1 Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- .2 Use grooved mechanical couplings and fasteners in accessible locations.
- .3 Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- .4 Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- .5 Provide pipe hangers and supports to MSS SP-69 unless indicated otherwise.
- .6 Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.
- .7 Use lug end butterfly valves to isolate equipment.
- .8 Use 20 mm, ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor or roof drain.

1.3 SUBMITTALS FOR REVIEW

- .1 Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.4 SUBMITTALS FOR INFORMATION

- .1 Installation Data: Manufacturer's special installation requirements including hanging and support methods, joining procedures.

1.5 CLOSEOUT SUBMITTALS

- .1 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- .2 Record Documentation: Record actual locations of valves.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to ASME B31.9 code for installation of piping system.
- .2 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.
- .3 Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- .2 Provide temporary protective coating on cast iron and steel valves.
- .3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

Part 2 Products

2.1 CONDENSER WATER PIPING, ABOVE GROUND

- .1 Steel Pipe: ASTM A53, Schedule 40, galvanized.
 - .1 Fittings: ASTM B16.3, galvanized malleable iron or ASTM A234, galvanized forged steel welding type.
 - .2 Joints: Threaded, or AWS D1.1 welded.

2.2 PIPE HANGERS AND SUPPORTS

- .1 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
- .2 Vertical Support: Steel riser clamp.
- .3 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.3 UNIONS, FLANGES, AND COUPLINGS

- .1 Flanges for Pipe Over 50 mm:
 - .1 Ferrous Piping: 1034 kPa forged steel, slip-on.
 - .2 Copper Piping: Bronze.

- .3 Gaskets: 1.6 mm thick preformed neoprene.
- .2 Grooved and Shouldered Pipe End Couplings:
 - .1 Housing Clamps: Malleable iron galvanized to engage and lock, designed to permit some angular deflection, contraction, and expansion.
 - .2 Sealing Gasket: C-shape elastomer composition for operating temperature range from -34 degrees C to 10 degrees C.
 - .3 Accessories: Steel bolts, nuts, and washers.
- .3 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.4 BUTTERFLY VALVES

- .1 Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
- .2 Disc: stainless steel.
- .3 Operator: Infinite position lever handle with memory stop.

Part 3 Execution

3.1 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- .2 Remove scale and dirt on inside and outside before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.
- .4 Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- .5 After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

3.2 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Install condenser water piping to ASME B31.9.
- .3 Route piping in orderly manner, parallel to building structure, and maintain gradient.
- .4 Install piping to conserve building space, and not interfere with use of space.
- .5 Group piping whenever practical at common elevations.
- .6 Sleeve pipe passing through partitions, walls and floors.
- .7 Slope piping and arrange to drain at low points.
- .8 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
- .9 Pipe Hangers and Supports:

- .1 Install to ASTM B31.9.
- .2 Support horizontal piping as scheduled.
- .3 Install hangers to provide minimum 13 mm space between finished covering and adjacent work.
- .4 Place hangers within 300 mm of each horizontal elbow.
- .5 Use hangers with 38 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- .6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .7 Provide sheet lead packing between hanger or support and piping.
- .8 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- .10 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.
- .11 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- .12 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- .13 Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 10.
- .14 Install valves with stems upright or horizontal, not inverted.

3.3 SCHEDULES

- .1 Hanger Rod:

PIPE SIZE	MAX. HANGER SPACING	DIAMETER
100-150mm	300 mm	15 mm
200-300mm	425 mm	22 mm

END OF SECTION

Part 1 General

1.1 SUBMITTALS FOR REVIEW

- .1 Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
- .2 Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

1.2 SUBMITTALS FOR INFORMATION

- .1 Installation Data: Manufacturer's special installation requirements including placement of equipment in systems, piping configuration, and connection requirements.
- .2 Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
- .3 Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

1.3 CLOSEOUT SUBMITTALS

- .1 Maintenance Contracts:
 - .1 Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.
 - .2 Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
 - .3 Provide laboratory and technical assistance services during this maintenance period.
 - .4 Include two (2) hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.
 - .5 Provide onsite inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.
- .2 Record Documentation: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- .3 Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials: Provide sufficient chemicals for treatment and testing during warranty period.

1.5 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.
- .2 Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

Part 2 Products

2.1 MATERIALS

- .1 System Cleaner:
 - .1 Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tripoly phosphate and sodium molybdate.
 - .2 Biocide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.
- .2 Condenser Water System Treatment (Cooling Towers):
 - .1 Sequestering agent to inhibit scaling; phosphonates, sodium polyphosphates, lignin derivatives, synthetic polymer polyelectrolytes, or organite phosphates.
 - .2 Acid to reduce alkalinity and pH; sulphuric acid.
 - .3 Corrosion inhibitor; zinc-phosphate, phosphonate-phosphate, phosphonate-molybdate and phosphonate-silicate, sodium tolyltriazole, or low molecular weight polymers.
 - .4 Biocide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.
- .3 Open System Treatment (Humidifiers, Air Washers, Evaporative Condensers, Small Cooling Towers, Liquid Coolers):
 - .1 Sequestering agent to inhibit scaling and corrosion inhibitor; polyphosphate.
 - .2 Biocide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

Part 3 Execution

3.1 PREPARATION

- .1 Systems to be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

- .2 Place terminal control valves in open position during cleaning.
- .3 Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

- .1 Concentration:
 - .1 As recommended by manufacturer.
- .2 Use neutralizer agents on recommendation of system cleaner supplier and approval of Consultant.
- .3 Flush open systems with clean water for one (1) hour minimum. Drain completely and refill.
- .4 Remove, clean, and replace strainer screens.
- .5 Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

- .1 Install to manufacturer's written instructions.

3.4 OPEN SYSTEM TREATMENT - COOLING TOWERS

- .1 Provide two (2) glass mesh feeder bags per unit, suspended in sump, filled with sequestering agent.

3.5 CONDENSER WATER SYSTEMS - COOLING TOWERS

- .1 Introduce algacide to tower by intermittent slug feed.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CTI STD-201-04 - Standard for the Certification of Water-Cooling Tower Thermal Performance.

1.2 PERFORMANCE REQUIREMENTS

- .1 This section is based on specific selections of equipment. These selections relate to the selection of related equipment.
- .2 In substituting equipment, ensure that performance selection criteria matches that specified or that the selection of related equipment is acceptable or is revised to suit.

1.3 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
- .2 Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.

1.4 SUBMITTALS FOR INFORMATION

- .1 Installation Data: Manufacturer's special installation requirements.
- .2 Manufacturer's Certificate: Certify that cooling tower performance, based on CTI STD-201 meet or exceed specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.

1.5 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Spare Parts:
 - .1 Provide two (2) sets of matched fan belts.
 - .2 Provide two (2) spray nozzles for each cell.
 - .3 Provide two (2) gaskets for each access door.
 - .4 Provide one (1) valve seat for each make-up or control valve.

1.7 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

- .3 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience.

1.8 REGULATORY REQUIREMENTS

- .1 Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Factory assemble entire unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.
- .2 Comply with manufacturer's installation written instructions for rigging, unloading, and transporting units.

1.10 WARRANTY

- .1 Provide a five (5) year warranty to include coverage for cooling tower package materials only.

Part 2 Products

2.1 MANUFACTURERS

- .1 Manufacturers:
 - .1 Balitmore Air Coil Product: 1500 Series.

2.2 MANUFACTURED UNITS

- .1 Provide units for outdoor use, factory assembled, sectional, counterflow, vertical discharge, blow thru design, with fan assemblies built into pan and casing.

2.3 COMPONENTS

- .1 Pan and Casing: Galvanized steel, 1.8 mm for casing and 4.0 mm for reinforcing angles and channels with access doors at both ends of tower to air plenum.
- .2 Fans: Multi blade, axial type, with direct or belt drive.
- .3 Motor:
 - .1 Single speed, mounted on adjustable steel base.
 - .2 Motor Enclosure: Totally enclosed air over (TEAO), with epoxy or polyurethane finish.
 - .3 Energy Efficiency: NEMA Premium Efficient.
 - .4 Service Factor: 1.15.
 - .5 Insulation: Class H.
 - .6 Variable-Speed Motors: Inverter-duty rated.
 - .7 Severe-duty rating with the following features:
 - .1 Rotor and stator protected with corrosion-inhibiting epoxy resin.

- .2 Double-shielded, vacuum-degassed bearings lubricated with premium, moisture-resistant grease suitable for temperatures between -29 and 149 degrees C.
- .4 Motor Base: adjustable or other suitable provision for adjusting belt tension.
- .5 Belt Drive: Designed for minimum 150% motor nameplate power.
- .6 Fan Guard: Welded steel rod and wire guard, hot dipped galvanized after fabrication.
- .7 Safety: Safety railings, reuse existing stair and access platforms.
- .8 Distribution Section: Polyvinyl chloride piping header and branches with ABS plastic spray nozzles.
- .9 Fill: Self supporting fluted polyvinyl chloride plastic suitable for entering-water temperatures up through -49 degrees C.
- .10 Drift Eliminators: Two or three pass PVC or FRP, drift loss limited to 0.2% of total water circulated.
- .11 Float Valves: Brass or bronze make- up valve with plastic or copper float.
- .12 Hardware: Galvanized steel nuts, bolts, and washers, stainless steel nuts, bolts, washers, and nails; assemble with phenolic epoxy coated, cadmium plated washer head fasteners.
- .13 Finish of steel components: G210, hot dipped galvanized steel with zinc chromated aluminum paint.

2.4 ACCESSORIES

- .1 Electric Immersion Heaters: In pan suitable to maintain temperature of water in pan at 5 degrees C when outside temperature is -17 degrees C and wind velocity is 25 kph; immersion thermostat and float control operate heaters on low temperature when the pan is filled.
- .2 Electric Temperature Controller: In pan; with sensor to cycle fans.
- .3 Time Delay Relay: Limits fan motor starts to not more than six (6) per hour.

2.5 NON-CHEMICAL WATER TREATMENT FOR COOLING TOWERS

- .1 Furnish and install a non-chemical Condenser Water Treatment System on the re-circulating water system of each cooling tower. System shall be Evapco Pulse Pure.
- .2 The Non-Chemical Water Treatment System shall have the ability to maintain the following re-circulated water parameters:
 - .1 Conductivity range of 300 to 5,000 μ S/cm.
 - .2 pH range of 6.5 to 9.0.
 - .3 Total bacteria count (TBC) of less than 10,000 CFU's/ml.
 - .4 Keep condenser water system scale free and corrosion to levels acceptable by AWT guidelines.
- .3 The Non-Chemical Water Treatment System shall meet the following electrical requirements:

- .1 The system shall operate on a single 120V single, 1 Ø input as standard.
 - .2 The system shall have a Total Harmonic Distortion (THD) of less than 15%.
 - .3 The system shall meet UL and cUL specifications for electrical components.
 - .4 The system shall have a shielded cable to minimize susceptibility to external electro-magnetic field interference.
 - .5 All water sensors for conductivity shall be torodial type.
- .4 The Non-Chemical Water Treatment System shall meet the following construction requirements:
 - .1 The Electrical Pulse Panel shall be a powder coated NEMA 4X enclosure.
 - .2 The use of cooling fans to remove heat from the electrical pulse panel shall not be acceptable.
 - .3 The system shall have remote start-up and monitoring capabilities via a control relay wired from the pump or through the building management system using a MODBUS protocol.
 - .4 The Chamber shall contain two separate coil sections housing a minimum of four low frequency and two high frequency coils per chamber.
 - .5 The Conductivity controller shall be integral to the chamber control panel to allow for simplified calibration and single source power. This single panel shall have a USB port which allows up to 60 days of operational data to be downloaded.
 - .1 Bleed Valve
 - .2 Panel operation
 - .3 Output contact
 - .4 System Conductivity
 - .5 Make-up/bleed metering
 - .6 This single control panel per chamber shall have the capability of receiving input from local make-up and bleed water meters and activating a 120 volt contact.
- .5 The Non-Chemical Water Treatment System provides physical water treatment by:
 - .1 Changing surface scale formation to bulk solution powder formation.
 - .2 Keeping the system free from mineral scale on all heat transfer surfaces (including fill, coils, pipes, heat exchangers, valves and other components in the system).
 - .3 Controlling the population of microorganisms such as bacteria to 10,000 CFU/ml or below when measured using plate count agar at 35°C.
 - .4 In addition, the non-chemical water treatment system shall provide:
 - .1 A system operating with a reduced blow down volume resulting in water and energy savings.
 - .2 Blow down containing no added chemicals and conforms to all sewer discharge regulations.
 - .3 FIFRA compliance per EPA requirements for Pesticide Programs of Title 40 CFR Subchapter E.
 - .5 Installation: Remote installation from Cooling Tower, refer to drawings.

2.6 CONTROLS

- .1 Control Package: Factory installed and wired, and functionally tested at factory before shipment.
 - .1 NEMA 250, enclosure with removable internally mount backplate.
 - .2 Control-circuit transformer with primary and secondary side fuses.
 - .3 Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
 - .4 Microprocessor-based controller for automatic control of fan based on cooling tower leaving-water temperature with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.
 - .5 Factory-installed and -wired, collection basin electric/electronic level controller.
 - .6 Electric basin heater temperature control and low-water-level safety switch.
 - .7 Vibration switch for each fan.
 - .8 Single-point, field-power connection to a fused disconnect switch.
 - .1 Branch power circuit to each motor and electric basin heater and to controls with a disconnect switch or circuit breaker.
 - .2 Motor controller, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller with manual bypass and line reactors for each variable-speed motor indicated.
 - .9 Factory-installed wiring outside of enclosures shall be in metal raceway, except make connections to each motor and electric basin heater with liquid-tight conduit.
 - .10 Visual indication of status and alarm for each motor.
 - .11 Audible alarm and silence switch.
 - .12 Visual indication of elapsed run time, graduated in hours for each motor.
 - .13 Hardware to enable control system to remotely monitor and display the following:
 - .1 Operational status of each motor.
 - .2 Cooling tower leaving-fluid temperature.
 - .3 Fan vibration alarm.
 - .4 Collection basin high and low water-level alarms.

2.7 PERFORMANCE

- .1 Capacity:
 - .1 Water Flow: 41 L/sec.
 - .2 Entering Water Temperature: 35 degrees C.
 - .3 Leaving Water Temperature: 29.4 degrees C.
 - .4 Entering Air WB Temperature: 20 degrees C.

2.8 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- .1 Electrical Characteristics:
 - .1 2.24 kW.
 - .2 575 volts, three phase, 60 Hz.
 - .3 Refer to Section 26 05 80.
- .2 Disconnect Switch: Factory mount disconnect switch.

Part 3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Install tower on structural steel beams as instructed by manufacturer.
- .3 Install tower on vibration isolators. Refer to Section 23 05 48.
- .4 Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. Refer to Section 23 21 00.
- .5 Connect make-up water piping with flanged or union connections to tower. Pitch to tower. Refer to Section 22 10 00.
- .6 Connect overflow, bleed, and drain, to storm sewer.
- .7 Non-chemical water treatment for cooling towers:
 - .1 For open tower systems the components shall be mounted by the mechanical contractor.
 - .2 Supply all components (coils, transformers, conductivity meters, blowdown valves etc) necessary for a completely automated stand alone system. Blowdown valves shall be motorized ball valves power open, spring return.
 - .3 Immediately after hydrostatic testing of piping is completed, systems shall be drained, flushed, cleaned and passivated. Subsequent to the cleaning process, each system shall be re-filled with clean water prior to the system being placed into operation. Once filled the condenser water pump and cooling tower fans shall be operated until conductivity set point is achieved.

3.2 FIELD QUALITY CONTROL

- .1 Test for capacity under actual operating conditions and verify specified performance.

3.3 MANUFACTURER'S FIELD SERVICES

- .1 Section 01 78 10: Prepare and start components.
- .2 Inspect tower after installation and submit report prior to start-up, verifying installation is to specifications and manufacturers recommendations.

- .3 Start-up tower in presence of and instruct Departmental Representative's operating personnel.

END OF SECTION