

SECTION 23 65 00

ADIABATIC CLOSED CIRCUIT COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes factory-assembled and tested, closed-circuit, induced-draft, counterflow cooling towers.

1.3 DEFINITIONS

- A. SCCR: Short-circuit current rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include rated capacities, pressure drop, fan performance data, rating at selected points indicated, and furnished specialties and accessories.
 2. Maximum flow rate.
 3. Minimum flow rate.
 4. Pressure required at cooling tower supply piping connections.
 5. Pressure required at basin heater supply piping connections.
 6. Pressure required at collection basin sweeper supply piping connections.
 7. Drift loss as percent of design flow rate.
 8. Volume of water in suspension for purposes of sizing remote storage.
 9. Sound:
 - a. Sound pressure levels for operation with fan off, fan at minimum speed, and design speed. If sound requirements are indicated at a specific distance, submit performance using same distance for comparative analysis.
 - b. Sound power levels in eight octave bands for operation with fans off, fans at minimum speed, and design speed.
 10. Performance curves for the following:
 - a. Varying entering-water temperatures from design to minimum in five -degree temperature increments.
 - b. Varying ambient wet-bulb temperatures from design to minimum in five -degree temperature increments.

- c. Varying water flow rates from design to minimum in increments of 10 percent of flow rate difference between design and minimum flow rates.
- d. Varying fan operation from design to minimum speed in 5 percent speed increments, and with fan off.
11. Fan airflow at design conditions, brake horsepower, and drive losses (indicated in horsepower and percent of brake horsepower).
12. Fan motor electrical characteristics including, but not limited to, speed, voltage, phase, hertz, amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
13. Pump flow rate, head, brake horsepower, and efficiency.
14. Pump motor electrical characteristics including, but not limited to, speed, voltage, phase hertz, amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
15. Electrical power requirements for each cooling tower component requiring power.

B. Shop Drawings:

1. Manufacturer's drawings of assembled cooling towers, control panels, sections, and elevations.
2. Assembled unit dimensions.
3. Diagram showing each separate piece requiring field assembly.
4. Shipped sub-assembly dimensions and weights for field assembly.
5. Assembled unit weight without water.
6. Operating weight and load distribution.
7. Unit vibration isolation.
8. Required clearances for maintenance and operation.
9. Sizes and dimensioned locations of piping and wiring connections.
10. Diagrams for power, signal, and control wiring.
- ~~10-11.~~ Operation and maintenance data: operation and maintenance manual.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty. Dry Cooler Manufacturer shall provide the five (5) years Warranty optional

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: .
- B. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

- C. FM Global: Approval and listing in the latest edition of FM Global's "Approval Guide."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate requirements for multi-piece assembly for shipment. Limit the number of separate pieces for field installation to as few as possible.
- B. If factory assembly of multiple pieces is required for testing or other reasons, disassemble cooling tower into major assemblies as required by installation before packaging for shipment.
 - 1. Clearly label each separate package with a unique designation and include with assembly instructions for each complete cooling tower.
 - 2. Install seals on gear-drive assemblies to eliminate oil leakage during shipment if shipped with oil.
 - 2-3. The thermal performance of the base dry unit (pre-cooling system off) shall be certified by the cooling technology institute in accordance with CTI certification standard STD-201. Lacking such a certification and field performance test shall be conducted within the warranty period in accordance with CTI acceptance test code ATC-105DS.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:
 - 1. All components of ~~cooling tower~~ dry coolers.
 - 2. Fan assembly including fan, drive, and motor.
 - 3. Warranty Period: ~~Five years~~ Five years from date of Substantial Completion.

PART 2 - PRODUCTS EVAPCO

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide closed circuit coolers manufactured by one of the following:
 - 1. EVAPCO Model EAW-VA9104ZJ320P7-525AXSP12
 - 2. Approved Substitute

2.2 THERMAL PERFORMANCE

- A. Each unit shall be guaranteed to cool 125.9 GPM of 30% propylene glycol from 98.0° F to 88.0° F with an entering air dry bulb of 95.0° F, entering air wet bulb of 78.0° F, and relative humidity of 47.31%.

- B. Thermal performance of the base dry unit (pre-cooling system OFF) is certified by the Cooling Technology Institute in accordance with CTI Certification Standard STD-201. Lacking such certification, a field acceptance test shall be conducted within the warranty period in accordance with CTI Acceptance Test Code ATC-105DS, by a Licensed CTI Thermal Testing Agency.

2.3 IBC COMPLIANCE

- A. Description: Factory assembled and tested, induced draft, adiabatic closed circuit cooler complete with casing, coil, fan, motor, accessories, rigging supports and adiabatic pre-cooling system.

2.4 COMPENENTS

A. Materials of Construction

- 1. Casing, channels, structure and angle supports including coil frame support shall be constructed of heavy gauge mill hot-dip galvanized steel. Coil casement shall be constructed of Type 304 Stainless Steel and coil tube sheets shall be constructed of Aluminum. Fan cowl and guard shall be constructed of Powder Coated Steel. All galvanized steel shall be coated with a minimum of 2.35 ounces of zinc per square foot of zinc per square foot of area (G-235 Hot-Dip Galvanized Steel designation). During fabrication, all galvanized steel panel edges shall be coated with a 95% pure zinc-rich compound. Painted steel shall not be accepted.

B. Fan(s):

- 1. Fan(s) shall be direct drive high efficiency axial propeller type and integral to the motor assembly. Each fan shall be dynamically balanced and installed in a closely fitted cowl with venturi air inlet for maximum fan efficiency.

C. Heat Transfer Media

- 1. Heat transfer coil shall be constructed with 5/8" diameter Type 304L Stainless Steel tubes in a staggered arrangement. The tubing shall be roll formed, continuously welded and annealed. Tubes shall be expanded into continuous, enhanced 0.01" thick high grade aluminum fins. The fins shall have fully drawn collars completely covering the tubes for maximum heat transfer efficiency. Header connections shall be Schedule 40 Type 304L Stainless Steel. Tube sheet design shall eliminate sharp edges and minimize tube fatigue. Coil shall have a design pressure of 250 psi and shall be in compliance with ASME/ANSI B31.5, Refrigeration Piping and Heat Transfer Components. The coil assembly shall be strength tested in accordance with ASME/ANSI B31.5 and subsequently leak tested using air under water.
- 2. The heat transfer coil shall be evacuated and charged with low pressure nitrogen prior to shipment.

D. Adiabatic Pre-Cooling System

1. The adiabatic pre-cooling system shall consist of adiabatic pads, water distribution piping, pressure regulator, solenoid valves, pressure gauge, wye strainer, and drip tray. The system shall have no measurable drift and be tested in accordance to CTI ATC 140.
 - a. Adiabatic Pad
 - 1) Adiabatic pad shall be specially impregnated cellulose to prevent shrinking and deterioration by UV rays, fungus, bacteria and algae. Pad shall be made with 100% recyclable material and have high evaporation efficiency with low air pressure drop. A separate distribution pad shall be located above the cooling pad to ensure even coverage during operation.
 - b. Water Distribution
 - 1) Water distribution system shall consist of shut-off valve, wye strainer, pressure regulator, solenoid valves, pressure gauge, nozzles, and distribution tubing.
 - 2) Water distribution tubing shall be constructed of Type 304L stainless steel and copper, designed to evenly distribute water over the adiabatic pad at low flow for maximum water savings. Distribution tubing and nozzles shall be fully accessible through hinged access doors. Pressure regulator shall be adjusted in the field for maximum efficiency and minimal water use. System shall self drain when solenoid valve(s) close.
 - c. Drip Tray
 - 1) Excess water from adiabatic pads shall drain to an accessible covered drip tray designed to minimize sunlight exposure. The drip tray cover shall be easily removable for cleaning.
 - d. 2-Stage Adiabatic System
 - 1) Adiabatic System equipped with quantity two (2) slow closing solenoid valves for optimizing water usage. When the unit can no longer maintain the desired set-point while operating completely dry, the designated, primary solenoid valve will open to allow water to trickle over the adiabatic media on one side of the unit. During this time, the fan speed is modulated to maintain the desired set-point. Single-stage operation will alternate between the two sides of the unit as the Adiabatic system cycles on and off. When the ambient temperature increases such that the system can no longer maintain set-point while operating only a single stage of the Adiabatic system, the 2nd solenoid valve will open to allow water to trickle over the adiabatic media on the other side of the unit. At this time the adiabatic media on both sides of the unit will be wetted to provide peak dry-bulb depression.

E. F. Pipe Connection Type

1. Any connections provided with a Groove (GVD) or Beveled for Welding/Grooved (BFW/GVD) shall conform to standard groove specification (SGS).

2.5 MOTORS AND DRIVES

- A. General requirements for motors are specified in Division 23 Section "Motors"
- B. Fan Motor

1. Fan motor(s) shall be zero maintenance electronically commutated, ball bearing type with minimum IP55 protection degree. Motor shall be class F insulated. Motor(s) shall contain integrated PID controller, thermal overload protection, reverse polarity protection, locked-rotor protection, and Modbus connectivity. 0-10v or 4-20mA shall be the control input. Motor shall be capable of operating continuous duty within a temperature range of -13° F to 140° F.

2.6 MAINTENANCE ACCESS

A. Inspection Panel

1. Inspection panel shall be removable to inspect the internal surface of the coils.

B. Internal Step Deck

1. Unit shall be provided with moveable internal step deck with integrated handrail to aid in maintenance from the interior of the unit.

2.7 ACCESSORIES

A. Fork Lift Channels

1. Unit shall be provided with fork lift channels.

B. Header End Cover Plate

1. Unit shall be provided with a cover plate over the tube connections to the header for protection.

C. Rain & Sun Hood

1. Control panel shall be provided with protective hood to shield the panel from the elements.

2.8 ELECTRICAL

- A. Complete Closed Circuit Cooler Control System shall be provided by the Closed Circuit Cooler Manufacturer.

- B. Control panel shall be mounted and wired by the closed circuit cooler manufacturer.

~~2.9 COLLECTION BASIN~~

~~A. Factory Assembled Collection Basin:~~

- ~~1. Material: Stainless steel, Grade 316.~~
- ~~2. Hardware: stainless steel.~~
- ~~3. Joints and Seams: Sealed watertight.~~

4. ~~Welded Connections: Sealed watertight by continuous welds.~~
5. ~~Removable stainless steel strainer with openings smaller than nozzle orifices.~~
6. ~~Overflow and drain connections.~~
7. ~~Makeup water connection.~~
8. ~~Outlet Connection: Configured to mate to ASME B16.5, Class 150 flange.~~

2.10 ~~COLLECTION BASIN MAKEUP WATER ASSEMBLY~~

A. ~~Electric/Electronic, Collection Basin Water Level Controller with Makeup Water Valve:~~

1. ~~Enclosures: NEMA 250, Type 4X.~~
2. ~~Sensor: Solid state controls with multiple electrode probes and relays factory wired to a terminal strip to control makeup water valve.~~
3. ~~Electrode Probes: Stainless steel.~~
4. ~~Water Stilling Chamber: Corrosion resistant material.~~
5. ~~Makeup Water Valve:~~
 - a. ~~Slow closing.~~
 - b. ~~Valve actuator controlled and powered through level controller in response to water level set point.~~
 - c. ~~Actuator Enclosure: NEMA 250, Type 4X.~~
6. ~~Electrical Connection Requirements: 120 V ac, single phase, 60 Hz.~~

2.11 ~~COLLECTION BASIN HEATER~~

A. ~~Electric Heater:~~

1. ~~Stainless Steel Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.~~
2. ~~Heater Control Panel: Mounted on the side of each cooling tower cell.~~
3. ~~Enclosure: NEMA 250, Type 3R.~~
4. ~~Magnetic contactors controlled by a temperature sensor/controller to maintain collection basin water temperature set point. Water level probe shall monitor cooling tower water level and de-energize the heater when the water reaches low level set point.~~
5. ~~Control circuit transformer with primary and secondary side fuses.~~
6. ~~Terminal blocks with numbered and color coded wiring to match wiring diagram.~~
7. ~~Single point, field power connection to a fused disconnect switch and heater branch circuiting complying with NFPA 70.~~
8. ~~Factory Wiring Method: Metal raceway for factory installed wiring outside of enclosures, except make connections to each electric basin heater with liquidtight conduit.~~
 - a. ~~Raceway shall be corrosion resistant stainless steel or PVC coated steel.~~

2.12 ~~HOISTING ASSEMBLY~~

- ##### A. ~~Hoisting assembly consisting of pedestal base, davit arm, and winch to accommodate lowering and raising cooling tower components from their installed location to the base of cooling tower supports.~~

1. ~~— Cooling tower components serviceable by hoisting assembly shall include, but not be limited to, fan stack, fan, fan drive, and fan motor.~~
2. ~~— Hoisting assembly shall be designed to accommodate heaviest single component plus a safety factor of 1.5.~~
3. ~~— Construct cooling tower structural supports and reinforcing to accommodate lifting heaviest load with safety factor.~~

~~B. — Pedestal Base:~~

1. ~~— Equip each cooling tower cell with a pedestal base to accommodate an easily removable davit arm and winch assembly.~~
2. ~~— Position pedestal base at a location on cooling tower for hoisting assembly coverage to fan, fan motor, and fan drive assembly.~~
3. ~~— Pedestal base design shall be open socket, or comparable, design that is configured to accept and secure an inserted portable davit arm.~~
4. ~~— Fit each pedestal base with an easily removable cap or plug designed to seal the open top of the base when the davit arm is not installed.~~
5. ~~— Fasten pedestal base to cooling tower using threaded hardware.~~
6. ~~— Construct pedestal base of hot dip galvanized steel or 300L series stainless steel.~~

~~C. — Davit Arm:~~

1. ~~— Each cooling tower shall have a davit arm.~~
2. ~~— Davit arm shall be an adjustable telescoping design with angular adjustment to accommodate varying lifting conditions required by the application.~~
3. ~~— Davit arm assembly shall be portable and capable of being relocated to any cooling tower cell pedestal base.~~
4. ~~— Construct davit arm of hot dip galvanized steel or 300L series stainless steel.~~

~~D. — Winch:~~

1. ~~— Each davit arm shall have ~~[or]~~ a hand-operated winch.~~
 - a. ~~— Hand-operated winch with gear mechanism to limit force on handle to not more than 80 lb when lifting the heaviest component.~~
2. ~~— Coat winch body and exposed components with corrosion resistant finish that is rated for outdoor duty in a highly corrosive environment and exposed to direct sunlight.~~
3. ~~— Winch cable shall be stainless steel and terminated with a stainless steel hook and quick disconnecting mechanism. Cable length shall be at least 1.5 times actual length required for application.~~

~~E. — Hardware: 304 or 316 series stainless steel.~~

~~F. — Nameplate:~~

1. ~~— Stamped or engraved aluminum or stainless steel nameplate with rated load capacity on each davit arm and pedestal.~~
2. ~~— Letter size legible from a distance of 60 inches and not less than 1/2 inch.~~
3. ~~— Fasten nameplate at multiple points with stainless steel rivets or screws.~~

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine cooling towers before installation. Reject cooling towers that are damaged.
- B. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting cooling tower performance, maintenance, and operation.
 - 1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.
 - 2. Verify sizes and locations of concrete bases and support structure with actual equipment.
 - 3. Verify sizes, locations, and anchoring attachments of structural-steel support structures.
 - 4. Verify sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

~~A. — Install cooling towers dry cooler on support structure.~~

~~B.A.~~ Equipment Mounting:

- 1. Install cooling towers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."

~~C.B.~~ Install anchor bolts to elevations required for proper attachment to supported equipment.

~~D.C.~~ Maintain manufacturer's recommended clearances for service and maintenance.

~~E.D.~~ Maintain clearances required by governing code.

~~F.E.~~ Loose Components: Install components, devices, and accessories furnished by manufacturer with cooling tower, that are not factory mounted.

- 1. Loose components shall be installed by manufacturer's factory-trained service personnel .

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to cooling towers, allow space for service and maintenance.

- C. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.
- D. Install drain piping with valve at cooling tower drain connections and at low points in piping.
- E. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.
- F. Makeup-Water Piping:
 - 1. Comply with applicable requirements in Section 22 11 16 "Domestic Water Piping."
 - 2. Connect to makeup-water connections with shutoff valve, plugged tee with pressure gage, and drain connection with valve and union.
- G. Supply and Return Piping:
 - 1. Comply with applicable requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties."
 - 2. Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, and drain connection with valve.
 - 3. Connect to leaving cooling tower connection with shutoff valve thermometer, plugged tee with full port ball valve for portable field instruments, and drain connection with valve.
 - 4. Make connections to cooling tower with a flange.

H. ~~Basin Sweeper Piping:~~

- ~~1. Comply with applicable requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties."~~
- ~~2. Connect to supply connections with shutoff valve and drain connection with valve.~~
- ~~3. Connect to return connections with shutoff valve, balancing valve, and drain connection with valve.~~
- ~~4. Make connections with a flange or union.~~

3.4 ELECTRICAL POWER CONNECTIONS

- A. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.
- B. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- C. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" for grounding connections.
- D. Install nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high. Locate nameplate where easily visible.

3.5 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between cooling towers and other equipment to interlock operation as required to achieve a complete and functioning system.
- C. Connect control wiring between cooling tower control interface and DDC system for remote monitoring and control of cooling towers. Comply with requirements in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
- D. Install label at each termination indicating control equipment designation serving cooling tower and the I/O point designation for each control connection. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for labeling and identification products and installations.

3.6 STARTUP SERVICE

- A. [Manufacturer to](#) -Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping; controls; and electrical connections for proper assemblies, installations, and connections.
- C. Obtain performance data from manufacturer.
 - 1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - a. Clean entire unit including basins.
 - b. Verify that accessories are properly installed.
 - c. Verify clearances for airflow and for cooling tower servicing.
 - d. Check for vibration isolation and structural support.
 - e. Lubricate bearings.
 - f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
 - g. Verify pump rotation for correct direction, vibration, cavitation, and flow and correct problems.
 - h. Adjust belts to proper alignment and tension.
 - i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
 - j. Check vibration switch setting. Verify operation.
 - k. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
 - l. Replace defective and malfunctioning units.
- D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.
- E. Prepare a written startup report that records the results of tests and inspections.

3.7 ADJUSTING

- A. Set and balance water flow to each tower inlet.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.
 - 1. Video record the training sessions.
 - 2. Instructor shall be factory trained and certified.
 - 3. Perform not less than 8 hours of training.
 - 4. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
 - 5. Perform instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
 - 6. Obtain Owner sign-off that training is complete.
 - 7. Owner training shall be held at Project site.

END OF SECTION 23 65 00