

**SECTION 236500
COOLING TOWERS**

PART 1 GENERAL

1.01 SUMMARY

- A. This section provides the general requirements for cooling towers and related equipment's to be installed at [Bayamon Judicial Center](#).

1.02 1.02 SCOPE OF WORK:

- A. Furnish and install one (1) factory-assembled cooling tower with vertical air discharge, conforming in all aspects to the specifications. Three (3) modules with 750 gpm each and 98°F to 87°F. Equal to Baltimore AirCoil Model S3E-8518-05L COOLING TOWER.
- B. Design, furnish and install a steel structural frame to support of new cooling towers equipment.
- C. Furnish and install safety switch devices for each motor in cooling towers.
- D. Furnish and install VFD devices for each motor in cooling towers or Install one VFD of 120% of the total capacity of cooling towers motors.
- E. Furnish and install temperature sensor for each VFD for each cooling tower.
- F. Furnish and install any other accessories necessary for proper operation of cooling towers (valves, balancing valves, switches, others) as indicated by Engineer or recommended by manufacturer.

1.03 SECTION INCLUDES

- A. Open circuit, induced draft, crossflow cooling towers.

1.04 1.03 RELATED WORK:

- A. Section 23 05 54 - Mechanical identification.
- B. Section 23 05 23 - Valves
- C. Section 23 20 00 - HVAC Piping System
- D. Section 23 05 93 - Testing, Adjusting and Balancing
- E. Section 26 05 27 - Grounding
- F. Section 26 05 21 - Conductors and Cables
- G. Section 26 28 23 - Disconnects
- H. Section 26 05 81 -Motors
- I. Section 23 05 14 – Variable Frequency Motor Controllers

1.05 REFERENCE STANDARDS

- A. ASHRAE 90.1-2019 – Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2018.
- D. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2018.

- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2018b.
- F. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- G. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015.
- H. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings 2014.
- I. CTI STD-201 OM - Operations Manual for Thermal Performance Certification of Evaporative Heat Rejection Equipment 2017.
- J. CTI STD-201 RS - Performance Rating of Evaporative Heat Rejection Equipment 2017.
- K. CTI STD-111 - Gear Speed Reducers for Application on Industrial Water Cooling Towers; 2009. (Only for gear-driven products)
- L. ISO 9001 - Quality management systems -- Requirements 2015.
- M. NEMA MG 1 - Motors and Generators 2017.
- N. ASCE/SEI 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

1.06 SUBMITTALS

- A. 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.
- B. Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.
- C. Manufacturer's Certificate: Certify that cooling tower performance, based on CTI STD-201 meets or exceeds specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.
- D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- E. Operation and Maintenance Data: Include start-up instructions, maintenance data, controls, and accessories.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 20 years of documented experience and ISO 9001 certification.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum 20 years of experience and approved by manufacturer.
- C. Product Performance:
 1. Cooling tower must have a minimum energy rating of 67.69 per ASHRAE 90.1, 189 and CA Title 24.
 2. Structural and Seismic Performance: The structure will be designed, tested and certified in accordance with IBC regulations to meet a minimum unrestricted seismic design SDS = 2.22 g with an Importance Factor of 109 psf and wind load of 138 psf. **Units not provided with a certificate of IBC compliance will not be an acceptable alternative.**

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Equipment will be factory-assembled, including a cold water basin, heat transfer section, water distribution, fan drive system, and casing panels. For shipping, disassemble into as large as practical sub-assemblies to minimize field work for re-assembly.
- B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.09 WARRANTY

- A. One-year warranty after start-up, or eighteen months from date of shipment, whichever occurs first. Warranty to include coverage for defects in material and workmanship.
- B. Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of five (5) years or seven (7) years, if motor space heater is properly wired.
- C. For direct drive fan system: Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of seven (7) from date of shipment. Included VFD will have 5-year warranty.

PART 2 PRODUCTS

2.01 COOLING TOWERS:

- A. Open Circuit, Induced Draft, Crossflow Cooling Towers:
- B. Rectangular shape:
 - 1. Overall, dimension shall not exceed approximately 17'-2" long x 18'-1" wide, with an overall height not exceeding 10'-3".
 - 2. Operational weight shall be limited to less than existing cooling towers. For reference existing cooling tower weight is around 35,000 lbs.
- C. Capacity:
 - 1. Cooling Tower shall be guaranteed by the manufacturer to remove heat of 1500 gpm of water from 98°F to 87°F at 80°F wb
 - 2. Minimum cooling towers performance shall be 38.2 gpm/hp (ASHRAE 90.1 2018)

2.02 ACCEPTABLE MANUFACTURERS ARE:

- A. SPX Marley Cooling Towers
- B. Baltimore AirCoil Co.
- C. Other similar after PBA Engineer approval, only Buy American Act.

2.03 COMPONENTS

- A. Cold Water Basin:
 - 1. **Type 304 welded stainless steel panels and structural members.** A removable anti-vortexing hood will be provided to prevent air entrainment. Large area lift out strainers will be provided with perforated openings sized smaller than the water distribution system nozzles. Sloped with depressed section with drain/clean-out connection. Basins with bolted seams or constructed of 301 stainless steel are not acceptable.

2. Equalizer Connection: An equalizer connection will be built into the cold water basin on the [bottom, side] with a pipe diameter appropriate for the design flowrate of the tower. See drawings for connection type.
- B. Water Distribution System
1. The hot water distribution basins will be gravity-fed and accessible from the outside of the unit for service or inspection while unit is in operation. Included weir dams will accommodate a flow range of 50% to 100% of the design flow rate. Lift-off distribution covers will be constructed of steel and designed to withstand a 50 psf (244 kg/m²) live load or 200 pound (90.7 kg) concentrated load.
- C. Casing Panels and Framework:
1. Casing panels, framework, and fasteners will be constructed of Type 304 stainless steel. Type 301 stainless steel is **not** an acceptable alternative.
- D. Air Inlet Louvers
1. Steel Louvers: Air inlet louvers will be separate from the fill and removable to provide easy access for inspection of the air/water interface at the louver face. Louvers will prevent water splash out during fan cycling. Material of construction must match steel grade of casing panels.
- E. Fans: Multi blade, axial type. Fans must factory test-mounted, balanced, and aligned to ensure reliable operation and ease of maintenance. Fan type will be selected to meet sound ratings published on equipment schedule.
- F. Motors:
1. Single speed (1800 rpm) premium efficiency, cooling tower duty motor mounted on adjustable steel base. Fan motors will be inverter duty type designed per NEMA Standard MG1, Section IV Part 31. Motors will include an internal space heater that can be wired to remove condensation when motor is not in use.
- G. Fan Drive System:
1. Gear Drive with Internal Motor: Industrial duty, right angle gear designed in accordance with CTI STD-111. Gear must be rated for service factor of 2.0 with forward and reverse operation. Oil level fill port and sight glass are located on the gear. Gear connected to motor by flexible coupling.
 2. Propeller shall be heavy duty, axial flow, with corrosion resistant blades selected to provide optimum cooling tower thermal performance with minimum sound levels.
 3. Fan and Shaft shall be supported by heavy-duty, self aligning, grease-packed ball bearing with moisture-proof seals and integral slinger rings, designed for minimum L10 life of 40,000 hr (280,000 Hr Avg. Life)
 4. In case of increment HP of actual rated, the contractor shall be responsible for electrical replacement utilities.
 5. The fans, fan shaft, bearings, mechanical equipment support and fan motor shall be warranted against defects in materials and workmanship for a period of five years from date of startup. Submit warranty certificate.
- H. Fan Guard:
1. Welded stainless steel rod and wire guard, placed over fan discharge.
- I. Motor Removal Davit: The unit will be equipped with a mechanical equipment removal davit. The motor will lower from the mechanical equipment supports down to grade. Davit will

attach to the unit without the need for tools. If tools are required for davit installation or removal, provide (1) davit for each motor provided.

- J. Gravity-fed Distribution: Hot water basins will have removable covers for inspection while unit is in operation, weir dams and metering nozzles for at least 50 percent turndown capability. Gravity flow nozzles will be snap-in type for easy removal. Pressurized nozzles are not acceptable.
- K. Bolts, nuts and washers:
 - 1. Any fastening component shall be Stainless Steel 304 (**include evidence in submittal**).
- L. Fill:
 - 1. The fill and integral drift eliminators will be formed from self-extinguishing (per ASTM-568) polyvinyl chloride (PVC) having a flame spread rating of 5 per ASTM E84 and will be impervious to rot, decay, fungus and biological attack. The fill is suitable for entering water temperatures up to and including 130°F (54.4°C). The fill must be manufactured, tested and rated by the cooling tower manufacturer and are elevated above the cold water basin floor to facilitate cleaning. If louvers are attached to fill, a spare set of fill sheets are required in case of icing and scaling damage.
- M. Drift Eliminators: Three-pass design made of PVC material. Primary eliminators will be integrated into the fill media.
- N. Basin Water Level Control:
 - 1. Corrosion resistant PVC make-up valve with plastic float for easy adjustment of operating water level.
 - 2. Each cell shall include a make up valve and float operated.
- O. Connection Piping Arrangement:
 - 1. Each tower cell shall be furnished with a single water inlet connection complete with the means to balance the flow rate to the hot water distribution basins.
 - 2. Water return outlet connection shall be flange type.
 - 3. Cooling tower shall be connected with equalization pipe with valve.
- P. Internal Safety:

2.04 ACCESSORIES

- A. Vibration Switch
 - 1. Provide a mechanical local reset vibration switch. The mechanical vibration cutout switch will be guaranteed to trip at a point so as not to cause damage to the cooling tower. To ensure this, the trip point will be set in a frequency range of 0 to 3,600 RPM and a trip point of 0.2 to 2.0 g's.
- B. Access Packages: See submittal documents for access package requirements. Platforms and ladders must ship assembled from cooling tower manufacturer.
 - 1. Plenum Access: Two hinged access doors must be provided for access into the plenum section. Include an internal walkway for inspection and maintenance. All working surfaces will be able to withstand 50 psf (244 kg/m²) live load or 200 pound (90.7 kg) concentrated load. Other components of the cooling tower, i.e. basin and fill/drift eliminators, will not be considered an internal working surface. Cooling tower designs that utilize these surfaces as working platforms will not be acceptable. Cooling tower manufacturers that promote these surfaces to be used as a working platform will

provide a two-year extended warranty to the PBA to repair any damage to these surfaces caused during routine maintenance.

2. Fan Deck Ladder with Handrails: An aluminum ladder with steel safety cage and safety gate will be provided for access to the fan deck. Access door or service platforms are not acceptable. 1-1/4 inch (32 mm) galvanized steel pipe handrail will be provided around the perimeter of the cooling tower cells. The handrails will be provided with knee and toe rails and will conform to OSHA requirements applicable at the time of shipment.
3. Safety Gates: All handrail access openings will be provided with a self-closing safety gate for increased safety.

PART 3 EXECUTION

3.01 WORK PREPARATION

- A. Contractor shall protect built top roofing around the existing cooling towers.
 1. Protection area include 10 ft from the edge of each concrete supports.
- B. Contractor shall to coordinate any work with PBA representative and Engineer.
- C. Contractor shall coordinate any work to be executing out of regular offices hours.
- D. Contractor shall be responsible by all necessary permissions and taxes in the transportation from distributor or fabrication facilities to installation site.
- E. Contractor shall remove the existing old cooling tower.
 1. Removing includes electrical connection and piping connections not necessary for futures works or new cooling tower. Consult Engineer or PBA representative for complete scope of removing scope.
 2. Final disposition of removed equipment and material shall be according with Puerto Rico environmental standards and regulations, and EPA.
 3. Contractor shall remove any part, accessories or material required or necessary for PBA buildings, before disposal.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of one eight-hour day per tower.
- C. Install tower on structural steel beams as instructed by manufacturer.
 1. New structural base shall be designed and sealed by Puerto Rico Licensed Professional Engineer. Include drawings and calculations in Submmital.
- D. Contractor shall paint the steel frame with protecting finishing.
 1. One coat of devflex 4020 pf direct to metal primer and flat finish – white
 2. One coat of devflex 4020 pf direct to metal primer and flat finish – tinted red
 3. Two coat of devthane 379h aliphatic urethane gloss enamel – white
 4. Two coat of devthane 379h aliphatic urethane gloss enamel – safety red.
- E. Connect condenser water piping to tower. Pitch condenser water supply to tower and condenser water suction away from tower.
- F. Use existing concrete pad to support of steel frame. Construct any other pad if necessary.

- G. Connect make-up water piping to tower. Pitch to tower.
- H. Connect overflow and drain to acceptable discharge point as required by jurisdiction.
- I. Contractor shall to install roofing protection prior to beginning works.
- J. Contractor shall repair any area of build top roof affected by personnel walking, material storage or installation works. Photos shall be record to compare from beginning to end of works and determine any damage.

3.03 FIELD QUALITY CONTROL

- A. See Section Quality Requirements, for additional requirements.
- B. Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

3.04 PERFORMANCE:

- A. The cooling tower manufacturer shall guarantee that the equipment supplied and installed will meet the performance conditions indicated in drawings and schedules.
- B. In case of poor thermal performance or suspected thermal performance deficiency, PBA will order to contractor to conduct an on-site thermal performance test. Lack of heat rejection capability will be the first indicator of poor thermal performance. Cooling tower heat rejection will be calculated using the actual condensing pump capacity (after balancing) and water temperature rise. When thermal performance deficiency is determined:
 - 1. Contractor will subcontract a third party to conduct performance test.
 - 2. Performance test will be conducted in accordance with CTI or ASME standards.
 - 3. Performance test will be conducted under supervision of PBA representative.
 - 4. Performance test will be conducted within 30 days after deficiency determination.
 - 5. Any cost related to performance shall be to contractor and manufacturer expenses.
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 - 6. Any cost to repair or fit cooling tower performance shall be to manufacturer expenses.
- C. Use the Cooling Towers Institute (CTI) or Associated Air Balance Council (AABC) standards for balancing works.
- D. Balancing and adjustment shall be within 5% of design parameters.
- E. Contractor shall submit four (4) copies of results of balancing test and adjustment.

3.05 START-UP

- A. Start-up tower in presence of and instruct Owner's operating personnel.
- B. A service factory trained representative shall be available on site for start-up of cooling towers.
- C. Contractor's personnel and factory representative shall adjust and balance water flow to design conditions indicated in this specifications and/or drawings.
- D. The factory representative shall train four (4) employees of PBA in the operation, maintenance and troubleshooting of cooling towers.
- E. Contractor shall submit four (4) maintenance and operation manual to PBA representative or Engineer.

F. SCHEDULES

- 1. Cooling Towers

- a. Manufacturer: BALTIMORE AIRCOIL BAC
- b. Model Number: S3E-8518-05L
- c. Cooling Capacity
 - 1) Water Flow Rate: 2250 GPM
 - 2) Entering Water Temperature: 98F
 - 3) Leaving Water Temperature: 87F
- d. Entering Air WB Temperature: 80F
- e. Number of Fan Motors: (3)
- f. Motor Size: 15x3-45 HP total
- g. Motor Electrical Characteristics: 460 Volts, Three-Phase, 60 Hz.

END OF SECTION