SECTION 236500 - COOLING TOWERS

This Section includes factory packaged forced draft and induced draft, cooling towers and their accessories including control packages normally supplied with towers are available in sizes up to approximately 1000 nominal cooling tons per cell.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting the requirements of this specification.

This Section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

This Section includes the term Architect/Engineer. "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See the Drawing Coordination Considerations for information needed to coordinate this specification Section with the Drawings.

1. GENERAL
	* + 1. SUMMARY
				1. Section includes packaged cooling tower with structure, casing, fill and basin, controls, heaters fans, motors and drive equipment, condensing water inlet and outlet with internal distribution and ladder and handrails.
				2. Related Sections:

Section 033000 - Cast-In-Place Concrete: Execution requirements for concrete bases specified by this section.

Section 221100 - Facility Water Distribution: Execution requirements for make up water and drain piping specified by this section.

Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for electric drive motors for placement by this section.

Section 230529 - Hangers and Supports for HVAC Piping and Equipment: Execution requirements for steel support bases specified by this section.

Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

Section 232113 - Hydronic Piping: Product requirements for condenser water piping for placement by this section.

Section 232500 - HVAC Water Treatment: Product and execution requirements for cooling tower water chemical treatment equipment.

* + - 1. REFERENCES

List reference standards included within text of this section. Edit the following for Project conditions.

* + - * 1. American Bearing Manufacturers Association:

ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

* + - * 1. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

* + - * 1. American Society of Mechanical Engineers:

ASME PTC 23 - Atmospheric Water Cooling Equipment.

* + - * 1. ASTM International:

ASTM A90 - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

* + - * 1. Cooling Technology Institute:

CTI - Acceptance Test Code.

CTI 201 - Certification Standard for Commercial Water Cooling Towers.

* + - * 1. National Electrical Manufacturers Association:

NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).

Only request submittals needed to verify compliance with Project requirements.

* + - * 1. Section 013300 - Submittal Procedures: Submittal procedures.
				2. Shop Drawings: Indicate structural steel supports including dimensions and locations for mounting-bolt holes.
				3. Product Data: Submit rated capacities, dimensions, weights and point loads, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls. Submit performance curve plotting leaving water temperature against wet bulb temperature.
				4. Field Test Reports: Indicate compliance with specified performance.
				5. Manufacturer's Certificate: Certify cooling tower performance meets or exceeds specified requirements.
				6. Manufacturer's Field Reports: Submit start-up report [**for each unit**]. Indicate compliance with field test.
			1. CLOSEOUT SUBMITTALS
				1. Section 017716 – Contract Closeout
				2. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories.
			2. QUALITY ASSURANCE
				1. Construction and rating in accordance with CTI Acceptance Test Code and CTI 201 “Certification Standard for Commercial Water Cooling Towers”.
				2. Performance Ratings: Required performance not less than prescribed by ASHRAE 90.1 “Energy Standard for Buildings Except Low-Rise Residential Buildings” when tested in accordance with CTI Acceptance Test Code and CTI 201 “Certification Standard for Commercial Water Cooling Towers”.

Include the following paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain [**one copy**] [**<\_\_\_\_\_\_\_\_> copies**] of [**each**] document on site.

Include the following paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain one copy of each document on site.
			1. QUALIFICATIONS
				1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience.
				2. Installer: Company specializing in performing work of this section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience [**and approved by manufacturer**].
			2. PRE-INSTALLATION MEETINGS
				1. Section 013000 - Administrative Requirements: Pre-installation meeting.
				2. Convene minimum [**one**] <**\_\_\_\_\_\_\_\_**> week prior to commencing work of this section.
			3. DELIVERY, STORAGE, AND HANDLING
				1. Section 016500 Materials and Equipment
				2. Follow manufacturer's installation instructions for rigging, unloading, and transporting units.
			4. WARRANTY
				1. Section 017716 – Contract Closeout
				2. Furnish [**five**] <**\_\_\_\_\_\_\_\_**>-year manufacturer's warranty for [**corrosion resistance of cooling tower structure**] [**cooling tower package**] [**fan drive**] [**motor**] [**labor only**] [**materials only**] [**labor and materials**].
			5. MAINTENANCE SERVICE
				1. Section 017716 Contract Closeout

Evaluate need for maintenance and emergency service based Project requirements. If desired, retain the following paragraphs.

* + - * 1. Furnish service and maintenance of cooling tower for [**one**] [**five**] <**\_\_\_\_\_\_\_\_**> years from Date of Substantial Completion.
				2. Examine unit components [**weekly**] [**semi-monthly**] [**monthly**] [**bi-monthly**]. Clean, adjust, and lubricate equipment.
				3. Include systematic examination, adjustment, and lubrication of unit, including fan belt replacement, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
				4. Perform work without removing units from service during building normal occupied hours.
				5. Provide emergency call back service [**at all hours**] [**during working hours**] for this maintenance period.
				6. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
				7. Perform maintenance work using competent and qualified personnel under supervision [**and in direct employ**] of manufacturer or original installer.
				8. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of [**Director’s Representative.**] <**\_\_\_\_\_\_\_\_.**>
			1. EXTRA MATERIALS
				1. Section 017716 – Contract Closeout
				2. Furnish [**two**] <**\_\_\_\_\_\_\_\_**> sets of matched fan belts.
				3. Furnish [**two**] <**\_\_\_\_\_\_\_\_**> spray nozzles for each cell.
				4. Furnish [**two**] <**\_\_\_\_\_\_\_\_**> gaskets for each access door.
				5. Furnish [**one**] <**\_\_\_\_\_\_\_\_**> valve seat for each make-up or control valve.
1. PRODUCTS
	* + 1. COOLING TOWERS

In this article, list manufacturers acceptable for this Project.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Baltimore Aircoil Company.

EVAPCO, Inc.

Marley Cooking Technologies; SPX Cooling Technologies.

Recold.

Approved equivalent.

Edit the following descriptive specifications to identify Project requirements and to eliminate conflicts with manufacturers specified above. A proprietary steel blow through tower with air introduced into and through tower by water injection process is available. To specify that tower type, remove detailed construction paragraphs in the following articles.

* + - * 1. Product Description: factory assembled, sectional, [**cross flow**] [**or**] [**counter flow**], [**blow through**] [**induced draft**] design, with fan and motor assemblies, built with pan, casing, fill and drift eliminators.
			1. STEEL COOLING TOWERS
				1. Framing, Pan and Casing: Galvanized steel, [**12 gage**] [**14 gage**] for casing and 8 gage for reinforcing angles and channels with access doors at both ends of tower to air plenum.

The casing and air inlet louvers of steel-structure induced- draft towers may also be constructed of Fiberglass Reinforced Polyester (FRP). Use paragraphs below to include this option.

* + - * 1. Casing: Fiberglass reinforced polyester panels with UV inhibitors, bolted to steel supports.
				2. Louvers: [**Corrugated glass reinforced polyester**] [**Formed galvanized steel, sight tight**] spaced to minimize air resistance and splash out. [**Fiberglass reinforced polyester with UV inhibitors, bolted to steel supports.**]
				3. Blow Through Fans: [**Multi blade, cast aluminum, axial type**] [**Forward curved centrifugal type mounted on steel shaft**], with belt drive, bearings with ABMA 9 “Load Ratings and Fatigue Life for Ball Bearings” or ABMA 11 “Load Ratings and Fatigue Life for Roller Bearings” L-10 life at 30,000 hours, with extended grease fittings.

Motor: [**Single-speed**] [**Two-speed**] [**(1800/900 rpm)**] mounted on adjustable steel base.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Induced Draft Fan: Axial cast aluminum multi-blade, [**fixed**] [**adjustable**] pitch.

Drive: Geared, right angle drive with ABMA 9 “Load Ratings and Fatigue Life for Ball Bearings” or ABMA 11 “Load Ratings and Fatigue Life for Roller Bearings” L-10 life expectancy of 40,000 hours bearings and drive shaft equipped with non-lubricated flexible couplings.

Motor: [**Single-speed**] [**Two-speed**] [**(1800/900 rpm)**] with special moisture protection, mounted on welded steel frame in fan deck.

Fan Cylinder: One-piece, welded steel, hot dipped galvanized fan assembly.

* + - * 1. Belt Drive: Designed for minimum 150 percent motor nameplate power.
				2. Fan Guard: Welded steel rod and wire guard, hot dipped galvanized after fabrication.
				3. Safety: Safety railings, and ladder [**with safety cage**] from [**grade**] [**roof**] to fan deck.
				4. Distribution Section: [**Polyvinyl chloride**] [**Galvanized steel**] piping header and branches with [**ABS**] plastic spray nozzles.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Distribution Basin: Open, gravity type distribution basin utilizing weirs and plastic metering orifices [**, with flow control valves**].
				2. Fill material: Self-supporting, fluted, polyvinyl chloride [**with ASTM E84 flame spread rating of [5] [10]**].
				3. Drift Eliminators: Two or three pass hot dipped galvanized steel, drift loss limited to [**0.7**] [**0.2**] percent of total water circulated.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Drift Eliminators: Two or three-pass polyvinyl chloride plastic to limit drift loss to [**0.7**] [**0.2**] percent of total water circulated.
				2. Float Valves: Brass or bronze [**balanced piston type**] make-up valve with plastic or copper float.
				3. Hardware: [**Galvanized steel nuts, bolts, and washers.**] [**Stainless steel nuts, bolts, and washers.**] [**Assemble with phenolic epoxy coated, cadmium plated washer head fasteners.**]
				4. Finish of steel components: Hot dipped galvanized steel with minimum 2.10 oz/sq. ft. zinc coating both sides measured in accordance with ASTM A90/A90M “Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings” and zinc chromatized aluminum paint. [**Finish with electrostatic spray, thermosetting, polymer.**]
				5. Accessories:

Electric Immersion Heaters: Maintains temperature of water in pan at 42 degrees F when outside temperature is 0 degrees F and wind velocity is 15 mph Immersion thermostat and float control operates heaters on low temperature when pan is filled.

The following accessories are for blow through operation.

Electric Temperature Controller: In pan; with sensor to cycle fans.

Time Delay Relay: Limits fan motor starts to not more than six per hour.

Capacity Control with Scroll Damper and Modulating Electronic Damper Motor: Controlled by temperature controller, sensor in pan.

Control Panel: NEMA 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)” [**Type 12**] [**Type 4**], containing:

Non-fused disconnect switch.

Combination motor controllers.

Interlocks and relays.

Use for one or identical units. When specifying units of differing sizes, use schedules.

* + - * 1. Capacity:

Water Flow: <**\_\_\_\_\_\_\_\_**> gpm.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Entering Air WB Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

External Static Pressure: <**\_\_\_\_\_\_\_\_**> inch wg.

* + - 1. FRP TOWERS
				1. Framework and Casing: Fiberglass reinforced polyester shell with UV inhibitors, cylindrically formed with bolted sections [**with galvanized steel support stand**].
				2. Louvers: [**Corrugated glass reinforced polyester**] [**or**] [**Formed galvanized steel, sight tight**] spaced to minimize air resistance and splash out.
				3. Fan: Direct driven axial multi-blade, cast aluminum adjustable pitch.
				4. Motor: [**Single-speed**] [**Two-speed**] [**(1800/900 rpm)**] [**totally enclosed air over (TEAO) type**] with special moisture protection [**with vibration switch**].
				5. Fan Guard: One piece welded steel rod and wire guard and motor mount hot dipped galvanized after fabrication.
				6. Sprinkler System: Automatic system with standpipe and rotary head with non-clogging sprinkler pipes.
				7. Fill material: [**Self-supporting fluted polyvinyl chloride plastic**] [**Self-supporting ceramic clay tile**].
				8. Collection Basin: FRP basin with integral sump and mounting feet, with openings for supply, return with strainer, overflow, make-up water, and drain.
				9. Float Valves: Brass or bronze [**balanced piston type**] make-up valve with plastic or copper float.
				10. Hardware, nuts, bolts, and washers: [**Galvanized steel**] [**Stainless steel**].
				11. Accessories:

Electric Immersion Heaters: Maintains temperature of water in basin at 42 degrees F when outside temperature is 0 degrees F and wind velocity is 15 mph Immersion thermostat and low level control to operate heaters on low temperature.

Electric Temperature Controller: In collection basin, with sensor to cycle fans.

Time Delay Relay: Limits fan motor starts to not more than six per hour.

Capacity Control with Scroll Damper and Modulating Electronic Damper Motor: Controlled by temperature controller, sensor in pan.

Control Panel: NEMA 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)” [**Type 12**] [**Type 4**], containing:

Non-fused disconnect switch.

Combination motor controllers.

Interlocks and relays.

Use the following paragraphs only when schedule is not used.

* + - * 1. Capacity:

Water Flow: <**\_\_\_\_\_\_\_\_**> gpm.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

Entering Air WB Temperature: <**\_\_\_\_\_\_\_\_**> degrees F.

External Static Pressure: <**\_\_\_\_\_\_\_\_**> inch wg.

* + - 1. ELECTRICAL CHARACTERISTICS AND COMPONENTS

Select one or more of the following subparagraphs appropriate to equipment requirements.

* + - * 1. Electrical Characteristics: In accordance with Section 260503 and the following:

[**<\_\_\_\_\_\_\_\_> hp.**] [**<\_\_\_\_\_\_\_\_> rated load amperes.**]

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

<**\_\_\_\_\_\_\_\_**> amperes maximum [**fuse size**] [**circuit breaker size**] [**overcurrent protection**].

<**\_\_\_\_\_\_\_\_**> minimum circuit ampacity.

<**\_\_\_\_\_\_\_\_**> percent minimum power factor at rated load.

* + - * 1. Motors: In accordance with Section 230513.
				2. Disconnect Switch: Factory-mount [**in control panel**] [**on equipment**].
1. EXECUTION
	* + 1. EXAMINATION
				1. Verify support is ready to accept tower.
				2. Verify dimensions of support are as shown on shop drawings.
			2. INSTALLATION
				1. Install tower on [**structural steel beams**] [**concrete base**] in accordance with manufacturer’s published instructions.
				2. Install tower on vibration isolators. Refer to Section 230548.
				3. Install condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. Refer to Section 232113.
				4. Install make-up water piping with flanged or union connections to tower. Pitch to tower. Refer to Section 221100.
				5. Install overflow, bleed, and drain, to [**floor drain.**] [**storm sewer.**] <**\_\_\_\_\_\_\_\_.**>
			3. FIELD QUALITY CONTROL

Manufacturers Certificate showing CTI certification as shown in "Part 1 General" could be used in lieu of the following optional paragraph.

* + - * 1. Test for capacity under actual operating conditions [**in accordance with CTI Acceptance Test Code**] and verify specified performance.
			1. MANUFACTURER'S FIELD SERVICES
				1. Supervise rigging, hoisting, and installation; include <**\_\_\_\_\_\_\_\_**> eight-hour days per tower.
				2. Inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer recommendations.
			2. ADJUSTING
				1. Adjust bleed, control settings and airflow.
			3. DEMONSTRATION AND TRAINING
				1. Demonstrate starting, maintenance and operation of tower.
			4. SCHEDULES

Include schedules when more than one unit is required. Complete schedule in conjunction with identification method used on Drawings or include schedules on Drawings. No units of measurement are indicated; these may be added to schedule legend or included within each insert. Coordinate equipment tags and abbreviations with project specific requirements.

Consider the following examples when developing Project schedule.

* + - * 1. Cooling Towers Schedule:

Equipment Tag: <CT-1>:

[**Manufacturer: <\_\_\_\_\_\_\_\_>.**]

[**Model: <\_\_\_\_\_\_\_\_>.**]

Location: <**\_\_\_\_\_\_\_\_**>.

Cooling Capacity: <**\_\_\_\_\_\_\_\_**>.

Water Flow Rate: <**\_\_\_\_\_\_\_\_**>.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Entering Air Wet Bulb Temperature: <**\_\_\_\_\_\_\_\_**>.

Fan Motor Number: <**\_\_\_\_\_\_\_\_**>.

External Static Pressure: <**\_\_\_\_\_\_\_\_**>.

Fan Motor Size: <**\_\_\_\_\_\_\_\_**>.

Heater Type and Number: <**\_\_\_\_\_\_\_\_**>.

Equipment Tag: <CT-2>:

[**Manufacturer: <\_\_\_\_\_\_\_\_>.**]

[**Model: <\_\_\_\_\_\_\_\_>.**]

Location: <**\_\_\_\_\_\_\_\_**>.

Cooling Capacity: <**\_\_\_\_\_\_\_\_**>.

Water Flow Rate: <**\_\_\_\_\_\_\_\_**>.

Entering Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Leaving Water Temperature: <**\_\_\_\_\_\_\_\_**>.

Entering Air Wet Bulb Temperature: <**\_\_\_\_\_\_\_\_**>.

Fan Motor Number: <**\_\_\_\_\_\_\_\_**>.

External Static Pressure: <**\_\_\_\_\_\_\_\_**>.

Fan Motor Size: <**\_\_\_\_\_\_\_\_**>.

Heater Type and Number: <**\_\_\_\_\_\_\_\_**>.

END OF SECTION 236500