SECTION 236333 - EVAPORATIVE REFRIGERANT CONDENSERS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
   * + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
      1. SUMMARY
         1. Section includes factory-assembled and -tested, [**forced**] [**induced**]-draft evaporative refrigerant condensers.
      2. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
        2. Low voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
        3. DDC: Direct digital control.
      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).
         4. Product Data: For each type of product.

Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for evaporative refrigerant condenser.

Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories, including:

Maximum flow rate.

Minimum flow rate.

Drift loss as percentage of design flow rate.

Retain first subparagraph below if a remote storage tank is provided.

Volume of water in suspension for purposes of sizing a remote storage tank.

Sound power levels in eight octave bands for operation with fans off, fans at minimum speed, and fans at design speed.

Performance curves for the following:

Varying entering-water temperatures from design to minimum.

Varying ambient wet-bulb temperatures from design to minimum.

Varying water flow rates from design to minimum.

Varying fan operation (off, minimum speed, and design speed).

Fan airflow, brake horsepower, and drive losses.

Retain first subparagraph below if pump is integral to closed-circuit evaporative refrigerant condenser.

Pump flow rate, head, brake horsepower, and efficiency.

Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.

Electrical power requirements for each evaporative refrigerant condenser component requiring power.

* + - * 1. Sustainable Design Submittals:

Product data subparagraph below applies to LEED 2009 EA Prerequisite 3, "Fundamental Refrigerant Management." Coordinate with requirements for equipment and refrigerants.

Product Data for EA Prerequisite 3, "Fundamental Refrigerant Management": For refrigerants, indicating compliance with refrigerant management practices.

Product Data: For energy performance.

* + - * 1. Shop Drawings: For evaporative refrigerant condensers.

Include plans, elevations, sections, and [**mounting**] [**attachment**] details.

Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Include diagrams for power, signal, and control wiring.

* + - 1. INFORMATIONAL SUBMITTALS

Retain "Coordination Drawings" paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Plans, elevations, and other details, drawn to scale, using input from Installers of the items involved.

Retain "Seismic Qualification Data" paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Certificates for evaporative refrigerant condensers, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
        2. Sample Warranties: For special warranty.
      1. CLOSEOUT SUBMITTALS
         1. Operation and Maintenance Data: For evaporative refrigerant condensers to include in emergency, operation, and maintenance manuals.
      2. COORDINATION
         1. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

Retain first paragraph below for mounting evaporative refrigerant condensers on a structural-steel support structure.

* + - * 1. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

Retain paragraph below for mounting evaporative refrigerant condenser on the roof.

* + - * 1. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
      1. WARRANTY

When warranties are required, verify with Director’s Representative's that special warranties stated in this article are not less than remedies available to Director’s Representative under prevailing local laws.

* + - * 1. Special Warranty: Manufacturer agrees to repair or replace components of evaporative refrigerant condensers that fail in materials or workmanship within specified warranty period.

Failures include, but are not limited to, the following:

Fan, motor, drive shaft, bearings, and motor supports.

Tube bundle.

External-circuit circulating pump.

<**Insert failure modes**>.

Verify available warranties and warranty periods for units and components.

Warranty Period: [**Five**] <**Insert number**> year(s) from date of Substantial Completion.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. PERFORMANCE REQUIREMENTS
         1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Retain "ASME Compliance" paragraph below if Director’s Representative prefers the security of a coil designed and fabricated according to ASME Boiler and Pressure Vessel Code or where required by state or local codes.

* + - * 1. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
        2. Comply with NFPA 70.
        3. ASHRAE Compliance:

Fabricate and label refrigeration system to comply with ASHRAE 15.

"ASHRAE Compliance" subparagraph below may be required to comply with Project requirements or authorities having jurisdiction. Sustainable design systems require compliance with requirements in ASHRAE 62.1. In addition to establishing minimum ventilation rates, ASHRAE 62.1 includes requirements for controls, surfaces in contact with the airstream, particulate and gaseous filtration, humidification and dehumidification, drain pan construction and connection, finned-tube coil selection and cleaning, and equipment access. Verify, with manufacturers, availability of units with components and features that comply with these requirements.

ASHRAE Compliance: Applicable requirements in ASHRAE 62.1.

"ASHRAE/IES Compliance" paragraph below may be required to comply with Project requirements or authorities having jurisdiction. Sustainable design systems require minimum efficiency equal to requirements in ASHRAE/IES 90.1.

* + - * 1. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

Retain "Structural Performance" paragraph below if Contractor is to design structural supports for evaporative refrigerant condensers. Delete if these supports are part of the structural design and are indicated on Drawings.

* + - * 1. Structural Performance: Evaporative refrigerant condenser support structure shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to [**ASCE/SEI 7**] <**Insert requirement**>.

Consult a structural engineer experienced in engineering evaporative refrigerant condenser structural supports and seismic and wind restraints of type indicated to quantify design loads applicable to Project. Verify compliance with codes. See the Evaluations.

Retain subparagraphs below if design loads and load combinations are not indicated on Drawings.

Dead Loads: <**Insert loads**>.

Live Loads: <**Insert loads**>.

Roof Loads: <**Insert loads**>.

Snow Loads: <**Insert loads**>.

Seismic Loads: <**Insert loads**>.

Wind Loads: <**Insert loads**>.

<**Insert loads or load combinations**>.

Deflection Limits: Design system to withstand design loads without deflections greater than the following:

<**Insert deflection limits**>.

Retain "Wind-Restraint Performance" paragraph below with "Delegated-Design Submittal" paragraph in "Action Submittals" Article for projects requiring wind-restraint design. Model building codes and ASCE/SEI 7 establish criteria for wind loads. Verify requirements of authorities having jurisdiction.

* + - * 1. Wind-Restraint Performance:

Obtain values for items in subparagraphs below from Project Structural Engineer or from ASCE/SEI 7.

Basic Wind Speed: <**Insert value**>.

Building Classification Category: [**I**] [**II**] [**III**] [**IV**].

Minimum [**10 lb/sq. ft.**] multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

Retain "Seismic Performance" paragraph below with "Seismic Qualification Data" paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Evaporative refrigerant condenser shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

Retain subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

<**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

* + - 1. FORCED-DRAFT EVAPORATIVE REFRIGERANT CONDENSERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=3563) 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](http://www.specagent.com/Lookup?uid=123457139264).

[EVAPCO, Inc](http://www.specagent.com/Lookup?uid=123457139265).

[Recold](http://www.specagent.com/Lookup?uid=123457139266).

Approved equivalent.

* + - * 1. Source Limitations: Obtain evaporative refrigerant condensers from single manufacturer.
        2. Casing and Frame:

Casing[**and Frame**] Material: [**FRP with UV inhibitors**] [**Galvanized steel, ASTM A653, G210 coating**] [**Galvanized steel, ASTM A653, G235 coating**] [**Polymer-coated galvanized steel**] [**Stainless steel**].

Retain "Frame Material" subparagraph below and delete option in subparagraph title above if frame material is different than casing.

Frame Material: [**FRP with UV inhibitors**] [**Galvanized steel, ASTM A653, G210 coating**] [**Galvanized steel, ASTM A653, G235 coating**] [**Polymer-coated galvanized steel**] [**Stainless steel**].

Fasteners: [**Galvanized**] [**Stainless**] steel.

Joints and Seams: Sealed watertight.

Welded Connections: Continuous and watertight.

Retain one of two "Collection Basin" paragraphs below. Retain first paragraph if collection basins are provided separate from evaporative refrigerant condenser.

* + - * 1. Collection Basin: Configure evaporative refrigerant condenser for installation with a field-constructed collection basin.
        2. Collection Basin:

Material: [**FRP with UV inhibitors**] [**Galvanized steel, ASTM A653, G210 coating**] [**Galvanized steel, ASTM A653, G235 coating**] [**Polymer-coated galvanized steel**] [**Stainless steel**].

Strainer: Removable[**stainless steel**] strainer with openings smaller than nozzle orifices.

Overflow and drain connections.

Makeup water connection.

Retain "Mechanically Operated, Collection Basin Water-Level Control" or "Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve" paragraph below if water-level control is to be provided with evaporative refrigerant condenser.

* + - * 1. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.
        2. Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve:

Enclosure: NEMA 250, [**Type 4**] [**Type 4X**] <**Insert type**>.

Sensor: Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to provide [**control of water makeup valve**] [**control of water makeup valve and low-level alarm**] [**control of water makeup valve and low- and high-level alarms**] [**control of water makeup valve, low- and high-level alarms, and output for shutoff of pump on low level**].

Electrode Probes: Stainless steel.

First option in "Water-Stilling Chamber" subparagraph below is less restrictive, although other options are limiting.

Water-Stilling Chamber: [**Corrosion-resistant material**] [**FRP**] [**Galvanized steel**] [**PVC pipe**] [**Stainless steel**].

Solenoid Valve: Slow closing[**with stainless steel body**]; controlled and powered through level controller in response to water-level set point.

Electrical Connection Requirements: 120 V, single phase, 60 Hz.

Retain "Electric Basin Heater," "Hot-Water-Coil Basin Heater," "Steam-Coil Basin Heater" or "Steam-Injector Basin Heater" paragraph below to require basin heaters for projects subject to freezing conditions. See the Evaluations.

* + - * 1. Electric Basin Heater:

Stainless Steel Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.

Heater Control Panel: Mounted on the side of each evaporative refrigerant condenser cell.

Enclosure: NEMA 250, [**Type 3R**] [**Type 4**] [**Type 4X**].

Magnetic contactors controlled by a temperature sensor/controller to maintain collection basin water-temperature set point. Water-level probe shall monitor evaporative refrigerant condenser water level and de-energize the heater when the water reaches low-level set point.

Control-circuit transformer with primary and secondary side fuses.

Terminal blocks with numbered and color-coded wiring to match wiring diagram.

Single-point, field-power connection to a [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**] and heater branch circuiting complying with NFPA 70.

Factory Wiring Method: Metal raceway for factory-installed wiring outside of enclosures, except make connections to each electric basin heater with liquid tight conduit.

* + - * 1. Hot-Water-Coil Basin Heater: Manufacturer's standard offering to provide capacity indicated.
        2. Steam-Coil Basin Heater: Manufacturer's standard offering to provide capacity indicated.
        3. Steam-Injector Basin Heater: Manufacturer's standard offering to provide capacity indicated.
        4. Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat exchanger coil throughout the flow range, without the need for balancing valves and for connecting individual, removable, nonclogging spray nozzles.

In "Pipe Material" subparagraph below, PVC is manufacturer's most common standard offering. Other requirements may require use of other materials.

Pipe Material: [**Fiberglass**] [**PVC**] [**Galvanized steel**] <**Insert material**>.

Spray Nozzle Material: [**Plastic**] [**Polypropylene**] [**PVC**] <**Insert material**>.

Piping Supports: Corrosion-resistant hangers and supports designed to resist movement during operation and shipment.

Retain second option in "Recirculating Piping" paragraph below if spray pump is specified in other Sections.

* + - * 1. Recirculating Piping: [**PVC**] <**Insert pipe material**>[**, with connections for separately provided, remote spray pump**].
        2. Spray Pump: Close-coupled, end-suction, single-stage, bronze-fitted centrifugal pump; with suction strainer, flow balancing valve, and mechanical seal suitable for outdoor service.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

General Requirements for Spray Pump Motor: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.

Retaining first option in "Motor Enclosure" subparagraph below allows manufacturer to choose either the second or third option. Third option provides highest degree of protection and must be used when motor is not located in the airstream.

Motor Enclosure: [**Totally enclosed**] [**Totally enclosed nonventilated (TENV)**] [**Totally enclosed fan cooled (TEFC)**] [**with epoxy or polyurethane finish**].

Energy Efficiency: [**Comply with ASHRAE/IES 90.1**] [**NEMA Premium Efficient**].

Service Factor: [**1.0**] [**1.15**] <**Insert value**>.

* + - * 1. Heat-Exchanger Coils:

Some material options in "Tube and Tube Sheet Materials" subparagraph below are limited to specific manufacturers. Consult manufacturers if Project requires specific materials.

Tube and Tube Sheet Materials: [**Copper tube with stainless steel sheet**] [**Stainless steel tube and sheet**] [**Prime-coated steel tube and sheet, with outer surface of tube and sheet hot-dip galvanized after fabrication**].

Retain "Heat-Exchanger Arrangement" or "ASME Compliance" subparagraph below. Second subparagraph is only available with hot-dip galvanized steel tubes. Coordinate with "Tube and Tube Sheet Materials" subparagraph above and "Performance" Article.

Heat-Exchanger Arrangement: [**Serpentine tubes**] [**Serpentine tubes with removable cover plate on inlet and outlet headers**] [**Straight tubes with removable header cover plate on both ends of heat exchanger for straight-through access to each tube**]; and sloped for complete drainage of fluid by gravity.

ASME Compliance: Designed, manufactured, and tested according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and bearing ASME "U" stamp; and sloped for complete drainage of fluid by gravity.

Field Piping Connections: Vent, supply, and return[**suitable for mating to ASME B16.5, Class 150 flange**].

Retain option in first paragraph below to limit placement of drift eliminators.

* + - * 1. [**Removable**]Drift Eliminator:

Material: [**FRP**] [**PVC**] [**FRP or PVC**] <**Insert material**>; with maximum flame-spread index of [**5**] [**25**] <**Insert value**> according to ASTM E84.

UV Treatment: Inhibitors to protect against damage caused by UV radiation.

Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.

Retain first paragraph below if screens are required.

* + - * 1. [**Removable**]Air-Intake Screens: [**Galvanized-**] [**Polymer-coated, galvanized-**] [**Stainless**] steel wire mesh.
        2. Centrifugal Fan: Double-width, double-inlet fan with forward-curved blades, statically and dynamically balanced at the factory after assembly.

Number of Fans: Each evaporative refrigerant condenser cell shall have a single fan or multiple fans connected to a common shaft.

Fan Wheel and Housing Materials: Galvanized steel.

Fan Shaft: Steel, coated to resist corrosion.

Protective Enclosure: Removable, galvanized-steel, wire-mesh screens complying with OSHA regulations.

Fan Shaft Bearings: Self-aligning, grease-lubricated ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of [**40,000**] [**50,000**] <**Insert value**> hours.

Grease Fittings for Bearings: Extended lubrication lines to an easily accessible location.

* + - * 1. Belt Drive:

Service Factor: [**1.5**] <**Insert value**> based on motor nameplate horsepower.

Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.

Retain one of two "Belt" subparagraphs below. Second subparagraph provides better performance.

Belt: Multiple V-belt design with a matched set of[**cogged**] belts.

Belt: One-piece, multigrooved, solid-back belt.

Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.

Belt-Drive Guard: Comply with OSHA regulations.

* + - * 1. Fan Motor:

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.

Retaining first option in "Motor Enclosure" subparagraph below allows manufacturer to choose either the second or third option. Third option provides highest degree of protection and must be used when motor is not located in the airstream.

Motor Enclosure: [**Totally enclosed**] [**Totally enclosed air over (TEAO)**] [**Totally enclosed fan cooled (TEFC)**] [**with epoxy or polyurethane finish**].

Energy Efficiency: [**Comply with ASHRAE/IES 90.1**] [**NEMA Premium Efficient**].

Service Factor: [**1.15**] <**Insert value**>.

Insulation: [**Class F**] [**Class H**] <**Insert class**>.

Variable-Speed Motors: Inverter-duty rated according to NEMA MG-1.

Retain "Dual-Fan Motors" subparagraph below for two single-speed motor options. Consult manufacturers for part-load motor horsepower ratings and options.

Dual-Fan Motors: Two single-speed motors, one sized for full-load operating conditions and one sized for part-load operating conditions, with two sets of drives and belts.

Retain first subparagraph below, based on Project conditions, to require additional protection.

Severe-duty rating with the following features:

Rotor and stator protected with corrosion-inhibiting epoxy resin.

Double-shielded, vacuum-degassed bearings lubricated with premium moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F.

First subparagraph below requires a separate, single-phase, field-power connection for heater operation.

Internal heater automatically energized when motor is de-energized.

Retain "Motor Base" subparagraph below for belt-drive units.

Motor Base: Adjustable, or other suitable provision for adjusting belt tension.

Retain "Discharge Hoods" paragraph below if evaporative refrigerant condenser requires a discharge hood. See the Evaluations.

* + - * 1. Discharge Hoods:

Hood Configuration: [**Tapered**] [**Straight**]; totally surrounding drift eliminators and constructed of same material as casing; and having factory-installed [**insulation and**]access doors.

Retain "Discharge Dampers" subparagraph below if discharge dampers are required.

Discharge Dampers: Positive-closure, automatic, isolation dampers with electric actuators.

Retain subparagraph below if evaporative refrigerant condensers are not provided with factory-installed and -wired control package.

Provide field power and controls to open dampers when pump is energized, and close dampers when pump is de-energized.

Retain "Capacity-Control Dampers" paragraph below if Project requires capacity-control dampers to improve leaving-water temperature control.

* + - * 1. Capacity-Control Dampers: [**Galvanized-steel**] [**Stainless steel**] <**Insert material**> dampers, with linkages, electric operator, controller, limit switches, transformer, and weatherproof enclosure.

Retain "Vibration Switch" paragraph below to require a vibration switch furnished with evaporative refrigerant condenser.

* + - * 1. Vibration Switch: For each fan drive.

Enclosure: NEMA 250, [**Type 4**] [**Type 4X**] <**Insert type**>.

Vibration Detection: Sensor with a field-adjustable acceleration sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Evaporative refrigerant condenser manufacturer shall recommend switch set point for proper operation and protection.

Provide switch[**with manual-reset button**] for [**field connection to a DDC system for HVAC and**]hardwired connection to fan motor electrical circuit.

Switch shall, on sensing excessive vibration,[**signal an alarm through the DDC system for HVAC and**] shut down the fan.

Retain "Controls" paragraph below if controls are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Controls: Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

Retain "Control Package" paragraph below if controls are provided with evaporative refrigerant condenser. Also, retain paragraph, based on Project conditions, to require evaporative refrigerant condenser to be equipped with factory-installed control package. Not all manufacturers offer factory-installed control packages; those that do offer control packages have limited features available with the package. Consult manufacturers for additional information.

* + - * 1. Control Package: Factory installed and wired, and functionally tested at factory before shipment.

Sixteen subparagraphs below are optional features. Retain applicable subparagraphs, based on Project conditions, to require these features and to correspond with components retained in paragraphs above.

NEMA 250, [**Type 3R**] [**Type 4**] [**Type 4X**] enclosure with removable internally mounted backplate.

Control-circuit transformer with primary and secondary side fuses.

Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.

Microprocessor-based controller for automatic control of fan[**and spray pump**] based on evaporative refrigerant condenser leaving-water temperature with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.

Fan motor sequencer for multiple-cell, two-speed, and two-motor applications with automatic lead-stage rotation.

If retaining "Mechanically Operated, Collection Basin Water-Level Control" paragraph, delete first subparagraph below.

Collection basin, electric/electronic level controller, complying with requirements in "Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve" Paragraph above.

Electric basin heaters with temperature-control and low-water-level safety switch for each cell, complying with requirements in "Electric Basin Heater" Paragraph above.

Vibration switch for each fan, complying with requirements in "Vibration Switch" Paragraph above.

Controls and wiring for two-motor, single-fan drives shall be same as that for two-speed, two-winding motors.

Power and controls to open discharge hood dampers when pump is energized and close dampers when pump is de-energized.

Single-point, field-power connection to a [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**] [**for each evaporative refrigerant condenser cell**].

Branch power circuit to each motor and electric basin heater and to controls[**with a disconnect switch or circuit breaker**].

NEMA-rated 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.

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.

Visual indication of status and alarm[**with momentary test push button**] for each motor.

Retain first subparagraph below for audible alarm. Coordinate with control sequence.

Audible alarm and silence switch.

Visual indication of elapsed run time, graduated in hours for each motor.

Retain first subparagraph below if unit controls interface with DDC system for HVAC.

Evaporative refrigerant condenser shall have hardware to enable DDC system for HVAC to remotely monitor and display the following:

subparagraphs below are optional features. Retain applicable subparagraphs, based on Project conditions, to require these features.

Operational status of each motor.

Position of dampers.

Evaporative refrigerant condenser leaving-fluid temperature.

Fan vibration alarm.

Collection basin [**high**] [**low**] [**high- and low**]-water-level alarms.

<**Insert conditions to be monitored**>.

* + - * 1. Personnel Access Components:

"Doors," "External Ladders with Safety Cages," "External Platforms with Handrails" "Handrail," and "Internal Platforms" subparagraphs below are optional components. Retain applicable subparagraphs, based on Project conditions, to require these components.

Doors: Large enough for personnel to access evaporative refrigerant condenser internal components from [**both**]evaporative refrigerant condenser end walls.[**Doors shall be operable from both sides of the door.**]

External Ladders with Safety Cages: Aluminum, galvanized- or stainless steel, fixed ladders with ladder extensions to access external platforms and top of evaporative refrigerant condenser from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.

External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at evaporative refrigerant condenser access doors when evaporative refrigerant condensers are elevated and not accessible from grade.

Handrail: Aluminum, galvanized steel, or stainless steel complete with kneerail and toeboard at platforms and around top of evaporative refrigerant condenser. Comply with 29 CFR 1910.23.

Internal Platforms: Aluminum, FRP, or galvanized-steel bar grating.

Spanning the collection basin from one end of evaporative refrigerant condenser to the other and positioned to form a path between the access doors. Platform shall be elevated, so that all parts are above the high-water level of the collection basin.

If Project has more than one type or configuration of evaporative refrigerant condenser, delete "Capacities and Characteristics" paragraph below and schedule evaporative refrigerant condensers on Drawings.

* + - * 1. Capacities and Characteristics:

Number of Cells: <**Insert number**>.

Maximum Drift Loss: [**0.005**] <**Insert number**> percent of design water flow.

Heat-Exchanger Coil(s):

Refrigerant Type: [**R-407C**] [**R-410A**] [**or**] [**HFC-134a**] <**Insert type**>.

Minimum Heat Rejection: <**Insert Btu/h**>.

Condensing Temperature: <**Insert deg F**>.

Entering-Air Wet-Bulb Temperature: <**Insert deg F**>.

Fan Location: [**Bottom**] [**Side**].

Fan Motor:

Type: [**Single speed**] [**Two speed, single winding**] [**Two speed, two winding**] [**Two single speed motors**] [**Variable speed**].

Horsepower/Cell: <**Insert number**> hp.

Full-Load Ampacity: <**Insert number**> A.

Minimum Circuit Ampacity: <**Insert number**> A.

Maximum Overcurrent Protection Device: <**Insert number**> A.

Electrical Characteristics: [**208**] [**240**] [**480**] <**Insert number**> V ac, three phase, 60 Hz.

Spray Pump and Motor:

Water Flow/Cell: <**Insert gpm**>.

Horsepower/Cell: <**Insert number**> hp.

Full-Load Ampacity: <**Insert number**> A.

Minimum Circuit Ampacity: <**Insert number**> A.

Maximum Overcurrent Protection Device: <**Insert number**> A.

Electrical Characteristics: [**120**] [**208**] [**240**] [**277**] [**480**] <**Insert number**> V ac, [**single**] [**three**] phase, 60 Hz.

Sound Pressure Level: <**Insert dBA**> at <**Insert distance in feet**> [**when measured according to CTI ATC 128**].

Retain "Basin Heater" subparagraph below for projects with basin heaters.

Basin Heater:

Basin Water Temperature: [**40 deg F**] <**Insert value**>.

Outdoor Ambient Temperature: [**0 deg F**] [**Minus 20 deg F**] <**Insert value**>.

Retain "Capacity/Cell," "Full-Load Ampacity," "Minimum Circuit Ampacity," "Maximum Overcurrent Protection Device" and "Electrical Characteristics" subparagraphs below for projects with electric basin heaters.

Capacity/Cell: <**Insert number**> kW.

Full-Load Ampacity: <**Insert number**> A.

Minimum Circuit Ampacity: <**Insert number**> A.

Maximum Overcurrent Protection Device: <**Insert number**> A.

Electrical Characteristics: [**208**] [**240**] [**480**] <**Insert number**> V ac, three phase, 60 Hz.

Retain "Capacity/Cell," "Entering-Fluid Temperature," "Fluid Flow Rate" and "Fluid Pressure Drop" subparagraphs below for projects with hot-water-coil basin heaters.

Capacity/Cell: <**Insert MBtu/h**>.

Entering-Fluid Temperature: <**Insert deg F**>.

Fluid Flow Rate: <**Insert gpm**>.

Fluid Pressure Drop: <**Insert psig**>.

Retain "Capacity/Cell," "Steam Flow," and "System Pressure" subparagraphs below for projects with steam-coil or -injection basin heaters.

Capacity/Cell: <**Insert MBtu/h**>.

Steam Flow: <**Insert lb/h**>.

Steam Pressure: <**Insert psig**>.

* + - 1. INDUCED-DRAFT EVAPORATIVE REFRIGERANT CONDENSERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=3565) 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](http://www.specagent.com/Lookup?uid=123457139268).

[EVAPCO, Inc](http://www.specagent.com/Lookup?uid=123457139269).

[Recold](http://www.specagent.com/Lookup?uid=123457139270).

Approved equivalent.

* + - * 1. Source Limitations: Obtain induced-draft evaporative refrigerant condensers from single manufacturer.
        2. Casing and Frame:

Casing[**and Frame**] Material: [**FRP with UV inhibitors**] [**Galvanized steel, ASTM A653, G210 coating**] [**Galvanized steel, ASTM A653, G235 coating**] [**Stainless steel**].

Retain "Frame Material" subparagraph below and delete option in subparagraph title above if frame material is different than casing.

Frame Material: [**FRP with UV inhibitors**] [**Galvanized steel, ASTM A653, G210 coating**] [**Galvanized steel, ASTM A653, G235 coating**] [**Polymer-coated galvanized steel**] [**Stainless steel**].

Fasteners: [**Galvanized**] [**Stainless**] steel.

Joints and Seams: Sealed watertight.

Welded Connections: Continuous and watertight.

Retain one of two "Collection Basin" paragraphs below. Retain first paragraph if collection basins are provided separate from evaporative refrigerant condenser.

* + - * 1. Collection Basin: Configure evaporative refrigerant condenser for installation with a field-constructed collection basin.
        2. Collection Basin:

Material: [**Galvanized steel, ASTM A653, G210 coating**] [**Galvanized steel, ASTM A653, G235 coating**] [**Stainless steel**].

Overflow and drain connections.

Makeup water connection.

Retain "Mechanically Operated, Collection Basin Water-Level Control" or "Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve" paragraph below if water-level control is to be provided with evaporative refrigerant condenser.

* + - * 1. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.
        2. Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve:

Enclosure: NEMA 250, [**Type 4**] [**Type 4X**] <**Insert type**>.

Sensor: Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to provide [**control of water makeup valve**] [**control of water makeup valve and low-level alarm**] [**control of water makeup valve and low- and high-level alarms**] [**control of water makeup valve, low- and high-level alarms, and output for shutoff of pump on low level**].

Electrode Probes: Stainless steel.

First option in "Water-Stilling Chamber" subparagraph below is less restrictive, although other options are limiting.

Water-Stilling Chamber: [**Corrosion-resistant material**] [**FRP**] [**Galvanized steel**] [**PVC pipe**] [**Stainless steel**].

Solenoid Valve: Slow closing[**with stainless steel body**]; controlled and powered through level controller in response to water-level set point.

Electrical Connection Requirements: 120 V, single phase, 60 Hz.

Retain "Electric Basin Heater," "Hot-Water-Coil Basin Heater," "Steam-Coil Basin Heater" or "Steam-Injector Basin Heater" paragraph below to require basin heaters for projects subject to freezing conditions. See the Evaluations.

* + - * 1. Electric Basin Heater:

Stainless Steel Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.

Heater Control Panel: Mounted on the side of each evaporative refrigerant condenser cell.

Enclosure: NEMA 250, [**Type 3R**] [**Type 4**] [**Type 4X**].

Magnetic contactors controlled by a temperature sensor/controller to maintain collection basin water-temperature set point. Water-level probe shall monitor evaporative refrigerant condenser water level and de-energize the heater when the water reaches low-level set point.

Control-circuit transformer with primary and secondary side fuses.

Terminal blocks with numbered and color-coded wiring to match wiring diagram.

Single-point, field-power connection to a [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**] and heater branch circuiting, complying with NFPA 70.

Factory Wiring Method: Metal raceway for factory-installed wiring outside of enclosures, except make connections to each electric basin heater with liquid tight conduit.

* + - * 1. Hot-Water-Coil Basin Heater: Manufacturer's standard offering to provide capacity indicated.
        2. Steam-Coil Basin Heater: Manufacturer's standard offering to provide capacity indicated.
        3. Steam-Injector Basin Heater: Manufacturer's standard offering to provide capacity indicated.
        4. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil throughout the flow range without the need for balancing valves and for connecting individual, removable, nonclogging spray nozzles.

In "Pipe Material" subparagraph below, PVC is manufacturer's most common standard offering. Other requirements may require use of other materials.

Pipe Material: [**Fiberglass**] [**PVC**] [**Galvanized steel**] <**Insert material**>.

Spray Nozzle Material: [**Plastic**] [**Polypropylene**] [**PVC**] <**Insert material**>.

Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

Retain second option in "Recirculating Piping" paragraph below if spray pump is specified in other Sections.

* + - * 1. Recirculating Piping: [**PVC**] <**Insert pipe material**>[**, with connections for separately provided, remote spray pump**].
        2. Spray Pump: Close-coupled, end-suction, single-stage, bronze-fitted centrifugal pump; with suction strainer, flow balancing valve, and mechanical seal suitable for outdoor service.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

General Requirements for Spray Pump Motor: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.

Retaining first option in "Motor Enclosure" subparagraph below allows manufacturer to choose either the second or third option. Third option provides highest degree of protection and must be used when motor is not located in the airstream.

Motor Enclosure: [**Totally enclosed**] [**Totally enclosed nonventilated (TENV)**] [**Totally enclosed fan cooled (TEFC)**] [**with epoxy or polyurethane finish**].

Energy Efficiency: [**Comply with ASHRAE/IES 90.1**] [**NEMA Premium Efficient**].

Service Factor: [**1.0**] [**1.15**] <**Insert value**>.

* + - * 1. Heat-Exchanger Coils:

Some material options in "Tube and Tube Sheet Materials" subparagraph below are limited to specific manufacturers. Consult manufacturers if Project requires specific materials.

Tube and Tube Sheet Materials: [**Copper tube with stainless steel sheet**] [**Stainless steel tube and sheet**] [**Prime-coated steel tube and sheet with outer surface of tube and sheet hot-dip galvanized after fabrication**].

Retain "Heat-Exchanger Arrangement" or "ASME Compliance" subparagraph below. Second subparagraph is only available with hot-dip galvanized-steel tubes. Coordinate with "Tube and Tube Sheet Materials" subparagraph above and "Performance" Article.

Heat-Exchanger Arrangement: [**Serpentine tubes**] [**Serpentine tubes with removable cover plate on inlet and outlet headers**] [**Straight tubes with removable header cover plate on both ends of heat exchanger for straight-through access to each tube**]; and sloped for complete drainage of fluid by gravity.

ASME Compliance: Designed, manufactured, and tested according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and bearing ASME "U" stamp; and sloped for complete drainage of fluid by gravity.

Field Piping Connections: Vent, supply, and return[**suitable for mating to ASME B16.5, Class 150 flange**].

Retain option in first paragraph below to limit placement of drift eliminators.

* + - * 1. [**Removable**]Drift Eliminator:

Material: [**FRP**] [**PVC**] [**FRP or PVC**] <**Insert material**>; with maximum flame-spread index of [**5**] [**25**] <**Insert value**> according to ASTM E84.

UV Treatment: Inhibitors to protect against damage caused by UV radiation.

Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.

* + - * 1. Air-Intake Louvers:

Material: [**FRP**] [**PVC**] [**Matching casing**].

Retain "UV Treatment" subparagraph below with FRP or PVC louvers.

UV Treatment: Treat louvers with inhibitors to protect against damage caused by UV radiation.

Louver Blades: Arranged to uniformly direct air into evaporative refrigerant condenser, to minimize air resistance, and to prevent water from splashing out during all modes of operation including operation with fans off.

* + - * 1. Axial Fan: Balanced at the factory after assembly.

Blade Material: [**Aluminum**] [**FRP**] [**Galvanized steel**].

Hub Material: [**Aluminum**] [**FRP**] [**Galvanized steel**].

"Blade Pitch" subparagraph below is an optional feature. Retain subparagraph, based on Project conditions, to require feature.

Blade Pitch: Field adjustable.

Protective Enclosure: Removable, galvanized-steel, wire-mesh screens, complying with OSHA regulations.

Fan Shaft Bearings: Self-aligning, grease-lubricated ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of [**40,000**] [**50,000**] <**Insert value**> hours.

Grease Fittings for Bearings: Extended lubrication lines to an easily accessible location.

* + - * 1. Belt Drive:

Service Factor: [**1.5**] <**Insert value**> based on motor nameplate horsepower.

Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.

Retain one of two "Belt" subparagraphs below. Second subparagraph provides better performance.

Belt: Multiple V-belt design with a matched set of[**cogged**] belts.

Belt: One-piece, multigrooved, solid-back belt.

Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.

Belt-Drive Guard: Comply with OSHA regulations.

* + - * 1. Fan Motor:

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.

Retaining first option in "Motor Enclosure" subparagraph below allows manufacturer to choose either the second or third option. Third option provides highest degree of protection and must be used when motor is not located in the airstream.

Motor Enclosure: [**Totally enclosed**] [**Totally enclosed air over (TEAO)**] [**Totally enclosed fan cooled (TEFC)**] [**with epoxy or polyurethane finish**].

Energy Efficiency: [**Comply with ASHRAE/IES 90.1**] [**NEMA Premium Efficient**].

Service Factor: [**1.15**] <**Insert value**>.

Insulation: [**Class F**] [**Class H**] <**Insert class**>.

Variable-Speed Motors: Inverter-duty rated according to NEMA MG-1.

Retain first subparagraph below, based on Project conditions, to require additional protection.

Severe-duty rating with the following features:

Rotor and stator protected with corrosion-inhibiting epoxy resin.

Double-shielded, vacuum-degassed bearings lubricated with premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F.

First subparagraph below requires a separate, single-phase, field-power connection for heater operation.

Internal heater automatically energized when motor is de-energized.

Retain "Motor Base" subparagraph below for belt-drive units.

Motor Base: Adjustable, or other suitable provision for adjusting belt tension.

* + - * 1. Fan Discharge Stack: Material shall match casing, [**manufacturer's standard**] [**velocity recovery**] design.

Retain "Stack Extension" subparagraph below if Project requires a minimum stack height to clear an obstruction.

Stack Extension: Fabricated to extend above fan deck <**Insert distance**> unless otherwise indicated.

Stack Termination: Wire-mesh, galvanized-steel screens, complying with OSHA regulations.

Retain "Vibration Switch" paragraph below to require a vibration switch furnished with evaporative refrigerant condenser.

* + - * 1. Vibration Switch: For each fan drive.

Enclosure: NEMA 250, [**Type 4**] [**Type 4X**] <**Insert type**>.

Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Evaporative refrigerant condenser manufacturer shall recommend switch set point for proper operation and protection.

Provide switch[**with manual-reset button**] for [**field connection to a DDC system for HVAC and**]hardwired connection to fan motor electrical circuit.

Switch shall, on sensing excessive vibration,[**signal an alarm through the DDC system for HVAC and**] shut down the fan.

Retain "Controls" paragraph below if controls are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Controls: Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

Retain "Control Package" paragraph below if controls are provided with evaporative refrigerant condenser. Also, retain paragraph, based on Project conditions, to require evaporative refrigerant condenser to be equipped with factory-installed control package. Not all manufacturers offer factory-installed control packages; those that do offer control packages have limited features available with the package. Consult manufacturers for additional information.

* + - * 1. Control Package: Factory installed and wired, and functionally tested at factory before shipment.

Fourteen subparagraphs below are optional features. Retain applicable subparagraphs, based on Project conditions, to require these features and to correspond with components retained in paragraphs above.

NEMA 250, [**Type 3R**] [**Type 4**] [**Type 4X**] enclosure with removable internally mount backplate.

Control-circuit transformer with primary and secondary side fuses.

Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.

Microprocessor-based controller for automatic control of fan[**and spray pump**] based on evaporative refrigerant condenser leaving-water temperature, with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.

Fan motor sequencer for multiple-cell and two-speed applications with automatic lead-stage rotation.

If retaining "Mechanically Operated, Collection Basin Water-Level Control" paragraph above, delete first subparagraph below.

Collection basin electric/electronic level controller complying with requirements in "Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve" Paragraph above.

Electric basin heaters with temperature-control and low-water-level safety switch for each cell, complying with requirements in "Electric Basin Heater" Paragraph above.

Vibration switch for each fan, complying with requirements in "Vibration Switch" Paragraph above.

Single-point, field-power connection to a [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**] [**for each evaporative refrigerant condenser cell**].

Branch power circuit to each motor and electric basin heater and to controls[**with a disconnect switch or circuit breaker**].

NEMA-rated 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.

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.

Visual indication of status and alarm[**with momentary test push button**] for each motor.

Retain first subparagraph below for audible alarm. Coordinate with control sequence.

Audible alarm and silence switch.

Visual indication of elapsed run time, graduated in hours for each motor.

Retain first subparagraph below if unit controls interface with DDC system for HVAC.

Evaporative refrigerant condenser shall have hardware to enable DDC system for HVAC to remotely monitor and display the following:

subparagraphs below are optional features. Retain applicable subparagraphs, based on Project conditions, to require these features.

Operational status of each motor.

Evaporative refrigerant condenser leaving-fluid temperature.

Fan vibration alarm.

Collection basin [**high**] [**low**] [**high- and low**]-water-level alarms.

<**Insert conditions to be monitored**>.

* + - * 1. Personnel Access Components:

"Doors," "External Ladders with Safety Cages," "External Platforms with Handrails," "Handrails," and "Internal Platforms" subparagraphs below are optional components. Retain applicable subparagraphs, based on Project conditions, to require these components.

Doors: Large enough for personnel to access evaporative refrigerant condenser internal components from both evaporative refrigerant condenser end walls. Doors shall be operable from both sides of the door.

External Ladders with Safety Cages: Aluminum, galvanized- or stainless steel, fixed ladders with ladder extensions to access external platforms and top of evaporative refrigerant condenser from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.

External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at evaporative refrigerant condenser access doors when evaporative refrigerant condensers are elevated and not accessible from grade.

Handrail: Aluminum, galvanized steel, or stainless steel, complete with kneerail and toeboard at platforms, and around top of evaporative refrigerant condenser. Comply with 29 CFR 1910.23.

Internal Platforms: Aluminum, FRP, or galvanized-steel bar grating.

Spanning the collection basin from one end of evaporative refrigerant condenser to the other and positioned to form a path between the access doors. Platform shall be elevated, so that all parts are above the high-water level of the collection basin.

Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach from collection basin platform.

If Project has more than one type or configuration of evaporative refrigerant condenser, delete "Capacities and Characteristics" paragraph below and schedule evaporative refrigerant condensers on Drawings.

* + - * 1. Capacities and Characteristics:

Number of Cells: <**Insert number**>.

Maximum Drift Loss: [**0.005**] <**Insert value**> percent of design water flow.

Heat-Exchanger Coil:

Refrigerant Type: [**R-407C**] [**R-410A**] [**or**] [**HFC-134a**] <**Insert type**>.

Minimum Heat Rejection: <**Insert Btu/h**>.

Condensing Temperature: <**Insert deg F**>.

Entering-Air Wet-Bulb Temperature: <**Insert deg F**>.

Fan Motor:

Type: [**Single speed**] [**Two speed, single winding**] [**Two speed, two winding**] [**Variable speed**].

Horsepower/Cell: <**Insert number**> hp.

Full-Load Ampacity: <**Insert number**> A.

Minimum Circuit Ampacity: <**Insert number**> A.

Maximum Overcurrent Protection Device: <**Insert number**> A.

Electrical Characteristics: [**208**] [**240**] [**480**] <**Insert number**> V ac, three phase, 60 Hz.

Spray Pump and Motor:

Water Flow/Cell: <**Insert gpm**>.

Horsepower/Cell: <**Insert number**> hp.

Full-Load Ampacity: <**Insert number**> A.

Minimum Circuit Ampacity: <**Insert number**> A.

Maximum Overcurrent Protection Device: <**Insert number**> A.

Electrical Characteristics: [**120**] [**208**] [**240**] [**277**] [**480**] <**Insert number**> V ac, [**single**] [**three**] phase, 60 Hz.

Sound Pressure Level: <**Insert dBA**> at <**Insert distance in feet**> [**when measured according to CTI ATC 128**].

Retain "Basin Heater" subparagraph below for projects with basin heaters.

Basin Heater:

Basin Water Temperature: [**40 deg F**] <**Insert value**>.

Outdoor Ambient Temperature: [**0 deg F**] [**Minus 20 deg F**] <**Insert value**>.

Retain "Capacity/Cell," "Full-Load Ampacity," "Minimum Circuit Ampacity," "Maximum Overcurrent Protection Device" and "Electrical Characteristics" subparagraphs below for projects with electric basin heaters.

Capacity/Cell: <**Insert value**> kW.

Full-Load Ampacity: <**Insert number**> A.

Minimum Circuit Ampacity: <**Insert number**> A.

Maximum Overcurrent Protection Device: <**Insert number**> A.

Electrical Characteristics: [**208**] [**240**] [**480**] <**Insert value**> V ac, three phase, 60 Hz.

Retain "Capacity/Cell," "Entering-Fluid Temperature," "Fluid Flow Rate" and "Fluid Pressure Drop" subparagraphs below for projects with hot-water-coil basin heaters.

Capacity/Cell: <**Insert MBtu/h**>.

Entering-Fluid Temperature: <**Insert deg F**>.

Fluid Flow Rate: <**Insert gpm**>.

Fluid Pressure Drop: <**Insert psig**>.

Retain "Capacity/Cell," "Steam Flow," and "System Pressure" subparagraphs below for projects with steam-coil or -injection basin heaters.

Capacity/Cell: <**Insert MBtu/h**>.

Steam Flow: <**Insert lb/h**>.

Steam Pressure: <**Insert psig**>.

1. EXECUTION
   * + 1. EXAMINATION
          1. Examine roughing-in for concrete bases, anchor-bolt sizes and locations, piping systems, and electrical systems to verify actual locations and sizes before evaporative refrigerant condenser installation.
          2. Proceed with installation only after unsatisfactory conditions have been corrected.
       2. INSTALLATION
          1. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

Install evaporative refrigerant condensers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

* + - * 1. Maintain manufacturer's recommended clearances for service and maintenance.
        2. Loose Equipment: Install electrical components, devices, and accessories that are not factory mounted.
      1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Install piping adjacent to evaporative refrigerant condensers to allow service and maintenance.
        2. Install flexible pipe connectors at final connection of evaporative refrigerant condensers mounted on vibration isolators.
        3. Run overflow, drain, and bleed lines to sanitary sewage system.
        4. Domestic Water Piping: Comply with requirements in Section 221116 "Domestic Water Piping." Connect to water-level control with shutoff valve and union or flange at each connection.
        5. Refrigerant Piping: Comply with requirements in Section 232300 "Refrigerant Piping." Connect to evaporative refrigerant condenser coil with isolation valves at each connection.

Retain "Hot-Water Piping" or "Steam and Condensate Piping" paragraph below. Retain first paragraph if hot-water basin heater is installed; retain second paragraph if steam basin heater is installed; delete both if electric basin heaters or no heaters are installed.

* + - * 1. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Connect to supply and return basin-heater tappings with shutoff valve, strainer, control valve, and union or flange on supply connection and union or flange and balancing valve on return connection.
        2. Steam and Condensate Piping: Comply with requirements in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties." Connect steam supply to basin heater with shutoff valve, strainer, control valve, and union or flange and condensate piping with union or flange, shutoff valve, strainer, and an appropriate steam trap.

Retain "Ducts" paragraph below if evaporative refrigerant condenser is installed indoors.

* + - * 1. Ducts: Comply with requirements in Section 233113 "Metal Ducts." Connect ducts to evaporative refrigerant condenser inlet and outlet, full size of outlet, with flexible duct connection.
      1. ELECTRICAL CONNECTIONS
         1. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
         2. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
         3. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

Retain one of first two subparagraphs below. First subparagraph cross-references to Section 260553 "Identification for Electrical Systems" and should be retained for consistent electrical identification. Second subparagraph is an abbreviated version of the product specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

Locate nameplate where easily visible.

* + - 1. CONTROL CONNECTIONS
         1. Install control and electrical power wiring to field-mounted control devices.
         2. Connect control wiring between control devices.
         3. Connect control wiring according to Section 260523 "Control Voltage Electrical Power Cables."
      2. FIELD QUALITY CONTROL

Retain one of first three paragraphs below.

Retain "Testing Agency" paragraph below to require Contractor to hire an independent testing agency.

* + - * 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" paragraph below to require a Company Field Advisor to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Field Advisor per OGS Spec Section 014216 to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" paragraph below to require Contractor to perform tests and inspections and retain the optional text to require Contractor to arrange for the assistance of a factory authorized service agent.

* + - * 1. Perform the following tests and inspections[**with the assistance of a Company Field Advisor per OGS Spec Section 014216**]:

Leak Test: After installation, fill water coils with water, and test coils and connections for leaks. Repair leaks and retest until no leaks exist.

Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

* + - * 1. Evaporative refrigerant condenser will be considered defective if it does not pass tests and inspections.
        2. Prepare test and inspection reports.
      1. STARTUP SERVICE
         1. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
         2. Obtain performance tables from manufacturer.
         3. [**Engage a Company Field Advisor per OGS Spec Section 014216 to perform**] [**Perform**] startup service.

Complete installation and startup checks according to manufacturer's written instructions.

Clean entire unit, including basins.

Verify that accessories are properly installed.

Check makeup water float.

Verify clearances for airflow and for evaporative refrigerant condenser servicing.

Check for vibration isolation and structural support.

Lubricate bearings on fans and shafts.

Verify fan wheel rotation for correct direction and for vibration or binding. Correct vibration and binding problems.

Adjust belts to proper alignment and tension.

Retain first subparagraph below for evaporative refrigerant condensers with variable-speed fans.

Operate variable-speed fans through entire operating range, and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.

Retain first subparagraph below for evaporative refrigerant condensers with vibration switches.

Check vibration switch setting. Verify operation.

Verify water level in basin. Fill to proper startup level. Check makeup water-level control and valve.

Start external-circuit circulating pumps.

Verify operation of evaporative refrigerant condenser basin, makeup line, automatic freeze protect dump, and controlling device. Replace defective and malfunctioning units.

Verify operation of basin heater and control thermostat. Replace defective and malfunctioning units.

Verify that evaporative refrigerant condenser discharge is not recirculating into air intakes. Recommend corrective action.

Check HVAC water treatment system for proper operation, and measure chemical treatment levels. Verify operation of evaporative refrigerant condenser basin automatic blowdown and of controlling device.

* + - * 1. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing of evaporative refrigerant condensers.
        2. Startup Report: Report findings during startup. Identify startup steps, corrective measures taken, and final results.
      1. ADJUSTING
         1. Adjust water-level control for proper operating level.
         2. Occupancy Adjustments: When requested within [**12**] <**Insert number**> months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [**two**] <**Insert number**> visits to Project during other-than-normal occupancy hours for this purpose.
      2. DEMONSTRATION
         1. [**Engage a Company Field Advisor per OGS Spec Section 014216 to train**] [**Train**] Facility’s maintenance personnel to adjust, operate, and maintain evaporative refrigerant condensers.

END OF SECTION 236333