

## SECTION 15711 - COOLING TOWERS

## PART 1 - GENERAL

## 1.1 DESCRIPTION OF WORK:

- A. Extent of factory-fabricated cooling tower work required by this section is indicated on drawings and schedules and by requirements of this section.
- B. Types of factory-fabricated cooling towers specified in this section include the following:
  - 1. Factory-Fabricated Cooling Towers:
    - a. Induced-draft, propeller fan, crossflow.
    - b. Forced-draft, propeller fan, crossflow.
    - c. Forced-draft, propeller fan, counterflow.
    - d. Forced-draft, centrifugal fan, counterflow.
  - 2. Ejector Cooling Towers
  - 3. Condenser Water Holding Tanks
- C. Refer to other Division-15 sections for condenser water piping; condenser water treatment; vibration control; remote cooling tower sump; temperature controls; not work of this section.
- D. Refer to Division-16 sections for the following work; not work of this section.
  - 1. Power supply wiring from power source to power connection on cooling tower. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
  - 2. Interlock wiring between cooling towers; and between cooling towers and field-installed control devices.
    - a. Interlock wiring specified as factory-installed is work of this section.
- E. Provide the following electrical work as work of this section, complying with requirements of Division-16 sections:
  - 1. Control wiring between field-installed controls, indicating devices, and cooling tower control panels.
    - a. Control wiring specified as work of Division-15 for Automatic Temperature Controls is work of that section.

## 1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of factory-fabricated cooling towers, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Provide manufacturer's certification of tower cooling capacity, based on factory-performance tests, and provide performance curve plotting Leaving-Water Temperature (LWT) against Wet-Bulb Temperature (WBT).
- C. Certify tower wind resistance to withstand pressure indicated, in any direction.

- D. Certify earthquake resistance against loading as indicated.
  - E. Codes and Standards:
    - 1. UL and NEMA Compliance: Provide electric motors and electrical components required as part of factory- fabricated cooling towers, which have been listed and labeled by UL and comply with NEMA Standards.
    - 2. NEC Compliance: Install cooling towers in accordance with NFPA 70 "National Electrical Code".
- 1.3 SUBMITTALS:
- A. Product Data: Submit manufacturer's technical product data, including rated capacities, pressure drop, fan performance data, weights (shipping, installed, and operating), installation and start-up instructions, and rating curves with selected points clearly indicated.
  - B. Shop Drawings: Submit assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of all components.
  - C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to cooling towers. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
  - D. Record Drawings: At project closeout, submit record drawings of installed systems products in accordance with requirements of Division 15.
  - E. Maintenance Data: Submit maintenance data and parts list for each cooling tower, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams, in maintenance manual; in accordance with requirements of Division 15.
  - F. Certifications: Submit required certifications and written tests results for required testing.
- 1.4 DELIVERY, STORAGE, AND HANDLING:
- A. Handle cooling towers and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged cooling towers or components; replace with new.
  - B. Store cooling towers and components in clean place. Protect from dirt, fumes, construction debris, and physical damage.
  - C. Comply with Manufacturer's rigging and installation instructions for unloading cooling towers, and moving them to final location.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
  - 1. Factory-Fabricated Cooling Towers:

- a. Baltimore Aircoil Co., Inc.
  - b. Halstead & Mitchell Co.; Div. of Halstead Industries.
  - c. Marley (The) Cooling Tower Co.
  - d. Recold.
  - e. Zurn Industries, Inc.; Cooling Tower Div.
2. Ejector Cooling Towers:
    - a. Baltimore Aircoil Co., Inc.
  3. Condenser Water Storage Tank:
    - a. American Steel and Iron Co.

## 2.2 FACTORY-FABRICATED COOLING TOWERS:

Design Note: Verify if local code authority requires cooling tower to have fire protection system inside cooling tower, for either plastic cell media or plastic tower casing.

- A. General: Fabricate cooling towers using manufacturer's standard design, materials, and construction in accordance with published product information, except as otherwise indicated.
- B. Design structural system for the following live loading in addition to tower dead-loads and operating-loads:
  1. Wind Loading: 30 psf on exposed vertical surfaces.
  2. Earthquake Resistance: Acceleration of 1.0 G horizontally through center of gravity.
- C. Fabricate structural system including assembly of collecting basin and steel casings by one of the following methods:
  1. Bolt connections with fasteners having equal or better corrosion-resistance than materials fastened; seal joints to make watertight enclosure.
  2. Weld connections and weld metal seams continuously to make watertight.
  3. Provide rigging supports on structure for final rigging.
- D. Casings: One of the following materials fabricated and installed by manufacturer to make tower watertight.
  1. Provide galvanized steel.
  2. Provide hot-dipped galvanized steel with polymer coating.
  3. Provide stainless steel.
- E. Collecting Basin and Sump: One of the following materials and types of units, designed and installed to support water and to ensure water tightness:
  1. Provide galvanized steel.

2. Provide hot-dipped galvanized steel with polymer coating.
  3. Provide stainless steel.
  4. Provide integral type collecting basin and sump with lift-out strainer with openings smaller than nozzle orifices, and with connections for drain, overflow and water make-up.
  5. Provide integral type collecting basin and sump with oversized bottom outlet drain, for use with remote sump.
- F. Wetted-Surface Fill: One of the following materials fabricated into wave-formed configurations installed by manufacturer to assure break-up of water into droplets.
1. Provide galvanized steel sheets.
  2. Provide hot-dipped galvanized steel sheets with polymer coating.
  3. Provide stainless steel sheets.
  4. Provide vertical sheets of polyvinyl chloride plastic having flame spread rating of 5 per ASTM E 84.
- G. Drift Eliminators: One of the following materials fabricated by manufacturer into three-pass configuration to limit drift-loss to indicated maximum percentage of circulating-water flow-rate:
1. Provide polyvinyl chloride plastic, having flame spread rating of 5 per ASTM E 84.
  2. Provide galvanized steel.
  3. Provide hot-dipped galvanized steel with polymer coating.
  4. Provide stainless steel.
- H. Louvers: One of the following materials designed and installed by manufacturer, and of sufficient thickness and rigidity to prevent visible sagging:
1. Provide galvanized steel.
  2. Provide hot-dipped galvanized steel with polymer coating.
  3. Provide stainless steel.
  4. Provide fiberglass reinforced plastic (FRP).
- I. Water Distribution System: Galvanized steel, open basin, gravity-flow type with plastic metering orifices; installed by manufacturer to ensure even distribution of water over wetted-surface-fill.
- J. Water Distribution System: One of the following materials designed and installed by manufacturer to ensure even distribution of water over wetted-surface-fill.
1. Galvanized steel pipe header and removable galvanized steel pipe branches.
  2. Schedule 40 PVC pipe header and removable schedule 40 PVC pipe branches.

3. Nozzles: Provide removable plastic, brass, or ceramic nozzles.
  4. Pressure Drop: Maximum pressure drop of 5 psi.
- K. Basin Covers: One of the following materials, removable and with handles, installed by manufacturer to prevent debris from entering basin and to inhibit algae growth by eliminating sunlight:
1. Provide galvanized steel sheet.
  2. Provide hot-dipped galvanized steel with polymer coating.
- L. Discharge Dampers: Provide airfoil capacity control dampers and linkage for cells as indicated, formed of galvanized steel sheets, designed and installed by manufacturer to control air flow and to provide linear control of tower capacity.
- M. Inlet Screens: One of the following materials, mounted in removable frames by manufacturer:
1. Provide galvanized steel mesh.
  2. Provide hot-dipped galvanized steel mesh with polymer coating.
  3. Provide stainless steel mesh.
- N. Discharge Hoods: One of the following materials, including access doors, fabricated and installed by manufacturer to prevent recirculation of discharge air:
1. Provide galvanized steel.
  2. Provide hot-dipped galvanized steel with polymer coating.
  3. Provide stainless steel.
- O. Sound Attenuators: One of the following materials, factory-fabricated and mounted by manufacturer at intake and discharge of tower, lined with water proof sound- absorbent non-combustible material held in place by manufacturer's standard method except as otherwise indicated:
1. Line attenuators with glass fiber.
    - a. Secure lining with galvanized steel retainers.
    - b. Secure lining with stainless steel retainers.
- P. Basin Heaters: Provide galvanized steel coils designed to be supplied with one of the following:
1. Hot-water at temperature of 180 deg. F (82 deg. C).
  2. Steam at minimum pressure of 5 psi.
- Q. Basin Heaters: Provide electric immersion heaters including thermostat and low-water cutout, in weatherproof enclosure, for field wiring.
- R. Provide basin heaters sized by manufacturer to maintain basin water at 40 deg. F (4.4 deg. C) at ambient temperature of 0 deg. F (-18 deg. C) and wind velocity of 15 mph.

- S. Handrails: Provide galvanized steel pipe rails of required height above tower. Include knee and toe rails of required diameter and heights.
- T. Ladders: Provide galvanized steel or aluminum ladder, to top of cooling tower working surface.
  - 1. Safety Cage: Include safety cage of galvanized steel or aluminum.
- U. Water Level Control: Provide plastic or bronze mechanical float with adjustable linkage.
- V. Water Level Control: Provide electric float switch.
- W. Water Level Control: Provide electric float switch and solenoid makeup valve.
- X. Flow Control Valves: Provide one of the following flow control valves for balancing flow to each distribution basin, and for shut-off during servicing:
  - 1. Provide butterfly valves.
  - 2. Provide globe valves.
- Y. Fans and Drives: Provide one of the following fans and drives, installed by manufacturer.
  - 1. Provide cast-aluminum propeller-fan of adjustable-pitch type.
  - 2. Provide cast-aluminum propeller-fan of fixed-pitch type.
  - 3. Provide galvanized steel propeller fan of fixed-pitch type.
    - a. Provide gear-drive including speed reducer.
    - b. Provide V-belt drives with sheave sized for rated air flow.
- Z. Fans and Drives: Provide forward curved centrifugal fans with galvanized steel blades and V-belt drive with sheave sized for rated air flow.
- AA. Fan Bearings: One of the following types installed by manufacturer.
  - 1. Provide self-aligning ball bearings; include external extended grease lines, and fittings.
  - 2. Provide bronze sleeve bearings with external oil lines, and fittings.
- BB. Motor Type: Provide open drip-proof, energy efficient type motor.
- CC. Motor Type: Provide totally enclosed, fan-cooled energy efficient type motor.
- DD. Motor Type: Provide totally enclosed, air over, energy efficient type motor.
- EE. Motor Speed: Provide single-speed motor rated at 1800 rpm.
- FF. Motor Speed: Provide two-speed motor rated at 1800/900 rpm.
- GG. Vibration Cutout Switch: Provide switch to de-energize fan motors if excessive vibration occurs due to fan imbalance.

- HH. Discharge Damper Controls: Provide electric damper operator, controller, end switches, transformer, and weatherproof enclosure.
- II. Assemble components by one of the following methods:
1. Use galvanized or stainless fasteners and accessories to assemble components.
  2. Weld metal seams and joints.
- JJ. Apply phosphatized pretreatment on zinc coated surfaces which have not been mill-phosphatized or polymer-coated. Apply gasoline-soluble rust preventative compound on ferrous parts which cannot be galvanized, including shafts and machined parts.
1. Finish components with zinc-coated metal surfaces by one of the following methods:
    - a. Coat abraded areas and welded areas with galvanizing repair paint. Finish-paint exposed surfaces with zinc chromated paint.
    - b. Provide 2-1/4 oz. (per sq. ft. of sheet) zinc coating on basin and sump, after fabrication, by hot-dip galvanizing process. Coat abraded areas and welded areas of work with galvanizing repair paint.
    - c. Apply to metal surfaces not galvanized, zinc-rich paint which has been tested and accepted by U.L. as being equivalent to hot-dipped galvanized steel.
- KK. For polymer-coated surfaces, electrostatically spray with thermosetting hybrid polymer fusebonded to hot-dipped galvanized substrate during thermally activated curing stage. Provide polymerized metal surfaces that are capable of:
1. When "X" scribed to base substrate, withstand 6,000 hrs. of 5% salt spray test according to ASTM B 117, with no blistering or chipping around intersection of scribes, nor any undercutting or creepage along scribes.
  2. When "X" scribed to base substrate, show no signs of chemical attack after 6,000 hrs. exposure in acidic (pH 4) and alkaline (pH 11) water solutions of 95 deg. F (35 deg. C).
  3. When directly impacted with 160 in. lbs. from 0.625 in. radius impact tool, in accordance with ASTM D 2794, show no fracture or delamination.
  4. When exposed to 6,000 hrs. of continuous ultraviolet exposure, equivalent to 120,000 hrs. of normal sunlight radiation, show no cracking.
  5. When subjected to 200 thermal shock cycles between -25 and 180 deg. F (-32 and 82 deg. C), show no signs of deterioration.
  6. When exposed continuously for 6,000 hrs. to high pressure (60 psig) water jet, show no signs of erosion.
- LL. Maximum Permissible Sound Pressure Level: Use 0.0002 microbar as reference. Measure at 50' in several directions, uniformly covering 360 deg. Do not exceed maximum permissible dB level, each of the following octave bands:
- 63 hz- dB1000 hz-dB  
 125 hz- dB2000 hz-dB  
 250 hz-dB4000 hz-dB  
 500 hz-dB8000 hz-dB

- MM. Vibration Control: Provide as scheduled, one of the following types of vibration isolators, with number and size of isolators selected by manufacturer.

Base Type A: No base, isolators attached directly to equipment.

Isolator Type 1: Pad, rubber or glass fiber.

Isolator Type 2: Rubber floor isolator.

Isolator Type 4: Restrained spring isolator.

### 2.3 EJECTOR COOLING TOWERS:

- A. General: Provide as indicated, factory-assembled and tested ejector cooling towers, of capacity as scheduled.
- B. Air Moving System: Design tower for forced draft without fans, motors, or other mechanical-electrical parts. Induce air into and through towers by water injection process.
- C. Water Distribution System: Inject water and distribute uniformly through hot-dip galvanized steel spray tree consisting of header with built-in strainer, branches with provision for clean-out, and brass spray nozzles. Provide accessibility for entire water distribution system from front of unit, for inspection and servicing.
- D. Pan Section: Construct pan section of hot-dip galvanized steel, finished with corrosion protection system. Fabricate depressed center sump in basin with connection for clean out and draining. Provide anti-vortexing device on suction connection, and large area hot-dip galvanized steel strainer screens, easily removable for cleaning.
- E. Casing Section: Construct casing section of hot-dip galvanized steel, finished with corrosion protection system. Provide person-size access doors; and brass, float operated make-up valve complete with large diameter plastic float.
- F. Inlet Air Stabilizers: Provide PVC inlet air stabilizers on intake side of unit, removable in easily handled sections to provide access to water distribution system.
- G. Eliminators: Construct eliminators of PVC, mount in discharge air stream.
- H. Discharge Louvers: Construct discharge louvers of hot-dip galvanized steel finished with corrosion protection system. Mount on discharge side of tower to direct air stream up and away from tower.
- I. Strainer System: Provide double filtration system consisting of:
1. Large area, lift out, tray type, hot-dip galvanized steel strainer screens with perforated openings mounted in water sump, finished with corrosion protection system.
  2. Large area, removable, hot-dip galvanized steel cylindrical strainer with perforations smaller than spray nozzle orifices mounted in spray header, finished with corrosion protection system. Provide blowdown connection at bottom of header/strainer assembly.
- J. Corrosion Protection System: Prepare hot-dip galvanized steel by cleaning, pretreating, rinsing, and drying. Electrostatically spray with thermosetting hybrid polymer fusebonded to hot-dipped galvanized substrate during thermally activated curing stage. Provide polymerized metal surfaces that are capable of:

1. When "X" scribed to base substrate, withstand 6,000 hrs. of 5% salt spray test according to ASTM B 117, with no blistering or chipping around intersection of scribes, nor any undercutting or creepage along scribes.
  2. When "X" scribed to base substrate, show no signs of chemical attack after 6,000 hrs. exposure in acidic (pH 4) and alkaline (pH 11) water solutions at 95 deg. F (35 deg. C).
  3. When directly impacted with 160 in. lbs. from 0.625 in. radius impact tool, in accordance with ASTM D 2794, show no fracture or delamination.
  4. When exposed to 6,000 hrs. of continuous ultraviolet exposure, equivalent to 120,000 hrs. of normal sunlight radiation, show no cracking.
  5. When subjected to 200 thermal shock cycles between -25 and 180 deg. F (-32 and 82 deg. C), show no signs of deterioration.
  6. When exposed continuously for 6,000 hrs. to high pressure (60 psig) water jet, show no signs of erosion.
- K. Assembly: Assemble unit parts with phenolic-epoxy coated, cadmium-plated, washerhead fasteners.
- L. Electric Immersion Heaters: Provide electric immersion heaters, factory-installed in cold water sump, of capacity and having electrical characteristics as scheduled. Provide control thermostat and low water cutout. Wiring to heaters; not work of this section.
- M. Steam Heaters: Provide galvanized steam coil, factory- installed in cold water sump, of capacity as scheduled. Controls, valves, and traps; not work of this section.
- N. Electric Water Level Control: Provide water level control consisting of magnetic type float switch in moisture proof housing, controlling solenoid valve with watertight housing located in make-up line to tower. Provide factory-set control that requires no field adjustment. Wiring to float switch and valve; not work of this section.
- O. Pressure Gauges: Provide pressure gauges, complete with brass gauge cocks, mounted on water inlet connection and spray header assembly. Provide gauges having 4-1/2" face and 0 to 100 psi range.

#### 2.4 CONDENSER WATER HOLDING TANKS:

##### A. General:

1. This contractor shall complete the installation of [ ] [ ] [ ] condenser water holding tank(s) which shall be provided under Division 5. Detailed drawings shall be prepared by the Structural Engineer in cooperation with the Mechanical Engineer.
2. After the tank(s) have/has been fabricated, installed in the building and tested by Division 5, the mechanical contractor shall become responsible for the completion of the tank(s), including welding pipe to tank(s), pipe fittings, piping, valves, controls, accessories and lining as detailed on the drawings and as specified.

- B. Lining: Tank(s) shall be lined by the fabricator, using applications of Wisconsin Protecting Coating Corp., "Plasite No. 7155," a total of ten (10) mils thick. Applications shall be in three coats in accordance with manufacturer's preparation and application instructions.

## PART 3 - EXECUTION

## 3.1 INSPECTION:

- A. Examine areas and conditions under which factory-fabricated cooling towers are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

## 3.2 INSTALLATION:

- A. General: Install cooling towers where indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices, to ensure that cooling towers comply with requirements and serve intended purposes.
- B. Level cooling towers to tolerance of 1/8" in 10'0", in both directions.
- C. Access: Provide access and service space around and over cooling towers as indicated, but in no case less than that recommended by manufacturer.
- D. Support: Install floor-mounted units on 4" high reinforced concrete pad, 6" larger on each side than cooling tower base. Cast anchor bolt inserts into pad.

OR

Support: Install roof-mounted units on structural steel mechanical equipment stand. Anchor cooling tower to stand with removable fasteners.

1. Construct mechanical equipment stand as indicated, and in accordance with NRCA Handbook and Accepted Roofing Knowledge, Detail "N".
  2. Mechanical equipment stand is specified in Division 5; not work of this section.
- E. Placement: Mount factory-fabricated cooling towers on vibration isolators if recommended by cooling tower and vibration isolation manufacturer. Install gaskets or sealants between cooling tower cells. Level units to tolerance of 1/8" in 10'-0", in both directions.
  - F. Mount ejector cooling tower on base using 5/8" minimum anchor bolts.
  - G. Condenser Water Piping: Provide flanged or union connections to cooling tower, with flexible pipe connections if tower is mounted on vibration isolators. Pitch lines so water will drain into sump. Connect inlets to cooling tower with shutoff valve, and balancing valve (if 2 or more inlets). Connect outlets with shutoff valves.
  - H. Make-up and Water Piping: Provide flanged or union connections to cooling tower, with flexible pipe connections if tower is mounted on vibration isolators. Pitch lines so water will drain into sump. Connect to automatic fill valve with 3-valve bypass, and backflow preventer.
  - I. Drain Piping: Connect drain, overflow, and bleed lines to cooling tower as indicated, full size of connection on cooling tower.
  - J. Mount pressure gauges, valves and controls furnished by manufacturer, in accordance with manufacturers instructions.
  - K. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

### 3.3 ADJUSTING AND CLEANING:

- A. Cleaning: Clean inside of cooling tower thoroughly before filling for start-up. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- B. Start-up: Comply with manufacturer's instructions for filling and start-up of operation, but not less than the following:
  1. Verify lubrication of rotating parts; lubricate as needed.
  2. Verify fan rotation direction.
  3. Verify that motor amperage is in accordance with manufacturer's data.
  4. Balance condenser water flow to each tower, and to each inlet for multiple inlet towers.
  5. Adjust water level control for proper operating level.
  6. Adjust bleed valve for indicated percentage of circulated water volume.
  7. Balance equalizer lines between multiple towers (if any).
  8. Adjust temperature controls and verify operation.
- C. Operation Test: Test each cooling tower to show that it will operate in accordance with indicated requirements.

### 3.4 CLOSEOUT PROCEDURES:

- A. Provide services of manufacturer's technical representative for one 8-hour day to instruct Owner's personnel in operation and maintenance of factory-fabricated cooling towers.
- B. Schedule training with Owner, provide at least 7-day notice to Contractor and Engineer of training date.

### 3.5 SPARE PARTS:

- A. General: Furnish to Owner, with receipt, the following spare parts:
  1. One spare set of matched fan belts for each belt driven fan.
  2. Six spare spray nozzles with grommets for each tower cell.
  3. One spare gasket for each gasketed access and inspection opening.
  4. One valve seat for mechanical water make-up valve.
  5. Two nozzle tie cables.
  6. One final strainer screen with o-ring gasket.

7. One float ball.

END OF SECTION 15711