CCSolutions
Composite Cooling Solutions, L.P.

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

# FIELD ERECTED COOLING TOWER

# CONCRETE STRUCTURE WITH PVC FILL

## PART 1 - GENERAL

### 1.1 DESCRIPTION:

Induced draft, counterflow type cooling tower, field erected within a reinforced concrete structure and related accessories. Equipment designed for long life, to meet noise and thermal efficiency criteria.

### 1.2 QUALITY ASSURANCE:

A. Design Criteria:

1. Design to withstand 40 PSF wind load.
2. Free water drift loss shall not be greater than 0.005% of the circulating water flow rate.
3. Sound levels at 50 feet from the units shall not exceed _____ dBA.

B. Performance Criteria:

1. Manufacturer shall certify in writing that the performance of cooling tower will meet contract requirements of design air wet bulb temperature, entering and leaving water temperatures, water flow rate, fan horsepower and specified pump head. Certification shall be made at time of submittal.
2. Manufacturer shall submit curves showing predicted performance as required in CTI Test Code ATC-105 to be used at the time of field performance test.
3. Field performance test shall be conducted as described in Section 3.2 of this specification.
4. In the event the cooling tower fails to perform as specified, Contractor shall make the necessary corrections or replace appropriate internals of the cooling tower. This procedure shall be repeated, at no additional cost to the Purchaser, until further testing by the original testing agency confirms that the cooling tower performs as specified.

### 1.3 DOCUMENTS REQUIRED AT TIME OF BID:

A. Curves showing predicted performance (CWT vs. WBT) as required by CTI Test Code ATC-105.

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

B. Sound level data and details of sound attenuators if required to meet specified noise criteria.
C. Drawings detailing interface points, imposed loads of equipment, critical structural requirements and major internal component support and/or mounting details.

## 1.4 SUBMITTAL DATA REQUIRED:

A. Certificates by Manufacturer:

1. Cooling Tower performance.
2. Special Design Requirements.

B. Detailed shop drawings for approval identifying and locating all required embeds, sleeves, penetrations and block outs.

C. Detailed component literature.

## 1.5 APPLICABLE PUBLICATIONS:

The publications listed below form a part of this specification to the extent referenced. They are included in the text by the basic designation only.

A. *Military Specifications (Mil. Spec.)*:
MIL-P-21035 .... Paint, High Zinc Dust Content, Galvanizing Repair

B. *American Society for Testing Materials (ASTM)*:
A52 ..... Steel Sheet, zinc coated (galvanized) by the Hot-Dip Process
D1784/D1785 ..... PVC Resin Compounds/Schedule 40 & Schedule 80 Pipe
B117-73 ..... Salt Spray (Fog) Testing
E84-81 ..... Surface Burning Characteristics of Building Materials
D2996 ..... Standard Specifications for Filament Wound RTRP

C. *American National Standard Institute (ANSI)*:
A12.1 ..... Safety Requirements for Floor/Wall Openings, Railing and Toeboards

D. *Cooling Technology Institute (CTI)*:
ATC-105 ..... Acceptance Test Code for Water-Cooling Towers
STD-111 ..... Gear Speed Reducers for Industrial Water-Cooling Towers
STD-136 ..... PVC Materials

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

## PART 2 - PRODUCTS

### 2.1 GENERAL:

A. Furnish where indicated by the Architectural and Engineering drawings, one complete cooling tower with _____cells, counterflow induced draft design.

### 2.2 CAPACITY:

A. The cooling tower shall have the capacity to cool _____GPM of water per cell from _____ºF HWT to _____ºF CWT when operating at a design inlet wet bulb temperature of _____ºF.

### 2.3 BY GENERAL CONTRACTOR:

A. Reinforced concrete foundation, beams, monolithic concrete wall structure, roof deck and fan stack shall be provided by the General Contractor.

### 2.4 FOUNDATION:

A. Foundation and related work shall be per Architectural or Engineering working drawings.

### 2.5 BASIN:

A. The basin floor slab shall be a continuous pour of high density air-entrained concrete throughout the tower structure. The mix shall be of a test strength minimum of 4,000 psi (28 days) compressive. The structure shall contain the reinforcing steel as detailed on the architectural or engineering drawings, and shall be constructed to conform to the specifications of the American Concrete Institute. Standard curing measures shall be carried out to protect the concrete while "green".

B. All exposed concrete shall be rub-finished to provide a smooth and uniform surface free of form marks and defects. *Honeycomb concrete will not be permitted.*

C. A continuous stripping of molded polyvinyl plastic water-stop (6 inch dumbbell or equal) shall be located on the centerline position of the basin wall section/basin floor slab intersection, and at all other cold pour joints.

D. The basin wall sections shall be made in a second continuous pour, and shall contain the necessary reinforcing steel as called for on the architectural or engineering drawings and shall be so arranged as to interlock with the water-

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

stop seal in the floor slab to form a completely waterproof basin.

**2.6 WALL STRUCTURE**:

A. The tower wall sections shall be constructed of monolithic concrete as specified on structural drawings.

B. All exposed concrete shall be rub-finished to provide a smooth and uniform surface free of form marks and defects. *Honeycomb concrete will not be permitted.*

C. Any cold pour joints in vertical walls shall have a continuous stripping of molded polyvinyl plastic water-stop (six inch dumbbell) or equal.

**2.7 COOLING TOWER:**

A. Furnish all material, equipment and appurtenances, required for a complete counterflow induced draft cooling tower. This cooling tower shall include fill, drift eliminators, water distribution system, fan assemblies, speed reducers, fan drive motors, and all other materials and parts required to make this cooling tower complete. The Contractor will furnish reinforced concrete waterproof basin, internal structural members, all related walls, and any required coping and related flashing.

B. It is the intention of this specification to cover the basic construction requirements for a permanent type cooling tower having aesthetics and life expectancy in keeping with the total project concept, one with full thermal efficiency throughout its life with minimum operating costs and minimum maintenance expense.

C. The Cooling Tower Manufacturer shall be responsible for furnishing structure sizes and weight loading information required for proper design and shall be responsible for all necessary co-ordinations.

D. Upon completion, the Tower Manufacturer shall issue a written guarantee duly signed, covering the following components, and if any of these components fail during the specified time, they shall be replaced F.O.B. shipping point.

1. PVC Fill, Water Distribution System and Drift Eliminator System shall be guaranteed against un-serviceability for a period of five (5) years.
2. Remaining components shall carry the manufacturer's standard warranty of one (1) year of service or eighteen months from date of shipment, whichever occurs first.

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

E. The cooling tower shall be constructed where indicated on the structural drawings. Internals of ____ complete cooling tower cell(s) shall be provided as indicated on contract drawings. The Cooling Tower Manufacturer shall consider space limitations with regard to water cooling capacity and performance, fan air handling, and motor brake horsepower requirements.

F. The following shall be furnished by the Cooling Tower Manufacturer and installed under factory supervision:

1. **Fill Support Lintels** - Heavy duty, continuous, multi-span FRP lintels shall span the concrete fill support beams and support the tower fill material. The minimum Shear Load Service Factor of the FRP lintels shall be 3.0 minimum and the Bending/Flexural Service Factor shall be 2.5 minimum as per CTI Guidelines for Structural Design of FRP Components.

2. **Fill Media -** The fill media shall be fabricated from rigid, corrugated PVC sheets that are designed specifically for cooling tower salt water service and is UV protected. The media modules shall be resistant to rot, fungi, bacteria and inorganic / organic and alkalis commonly found in cooling towers. The PVC sheet shall be prime, rigid PVC conforming to ASTM D1784: 12454B with the following minimum properties.

| PROPERTY | TEST METHOD | UNIT | TYPICAL VALUE |
|---|---|---|---|
| Specific Gravity | D792 | gm./cu . cm | 1.45 max. |
| Tensile Strength | D638/D882 | PSI | 6,000 min. |
| Flexural Modulus | D790 | PSI | 425,000 min. |
| Flexural Strength | D790 | PSI | 11,000 min. |
| Elastic Modulus | D638/D882 | PSI | 360,000 min. |
| Izod Impact | D256 | ft. lbs./ in. | 1.0 min. |
| Impact Resistance | D4226 | in. lbs./mil | 0.8 min. |
| Heat Deflection | D648 | 264 PSI | 162 min. |
| Flame Spread Rating | E-84 | | Less than 15 |
| Flammability | D635 | | Self extinguishing < 5 sec |
| Crush Strength 10 mil sheet thickness | | $lbs/ft^2$ | 1000 |
| Crush Strength 15 mil sheet thickness | | $lbs/ft^2$ | 3000 |

.

The fill media shall be bonded or mechanically fastened into rigid packs that are self-supporting for use in cooling tower applications and meet CTI STD-136 for PVC materials. The fill pack shall be bottom supported on FRP fill beams and capable of a

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

minimum concentrated bearing capacity of 500 lbs/ft2 to handle temporary maintenance traffic on the fill surface. Alternate layers of fill shall be stacked at 90-degree angles.

The fill design shall be high performance cross fluted or off-set fluted, vertical flow film fill with a minimum flute size of 21-mm. The fill packs are to be designed for a maximum operating temperature of 125 degree F or 50 degree C without damage.

The thickness of the PVC sheet material after forming shall be 10 mils minimum to provide long term structural life of the fill packs and to resist erosion from water spray. The minimum variation in thickness shall be no more than 2 mils nominal sheet thickness.

The surface of the fill media shall have an engineered microstructure to improve turbulence and heat transfer.

Water Quality Information for Fill Design
The tower owner or project engineer should provide to the tower vendors detailed make up water analysis with planned final concentrations and allowable upset conditions. This information will assist the tower manufacturer in selecting the best fill design to provide maximum fill life and minimize fill plugging.

3. **Drift Eliminators** - Cellular 3-pass PVC type, fabricated from rigid, and corrugated, 15 mil minimum thickness PVC sheets that are UV protected type. The drift eliminators will nest together as installed to form a continuous even surface to evenly pass air but restrict bypass of water droplets. The drift eliminators shall flame spread rating of 15 or less per (ASTM E84). The drift eliminators shall have been lab tested and certified drift test are available upon request.

   The drift eliminators shall be installed on the hot water distribution piping to provide a stable support system and low profile. The maximum support span shall not exceed 30 inches to prevent drift eliminator deflection.
   The maximum free water carry-over (drift) shall not exceed 0.005% of total tower flow.

   A stainless steel or FRP framed inspection access hatch shall be provided for viewing the distribution the distribution system

   A 24" wide FRP grating maintenance walkway from the access opening to the center of each cell and an FRP maintenance access ladder from walkway to gearbox.

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

4. **Speed Reducers** - Speed reducer shall be rated in accordance with practices of the American Gear Manufacturer's Association (AGMA), using a cooling tower service factor of greater than 2. Rating shall also be in accordance with CTI STD-111. Gear reducers shall be of the spiral bevel, single reduction type. The gear reducer shall be bolted to a HDG base plate which in turn is bolted and grouted to the concrete structure.

5. **Controls** - An electronic vibration switch with weatherproof housing shall be supplied to protect mechanical equipment against excessive damage due to a malfunction of rotating members. The vibration switch shall be mounted on the gear reducer. Vibration switch shall be provided with a time delay device (manually adjustable) that ignores start-up and transient vibration shocks. Mounting of the vibration switch shall be by Manufacturer. Associated electrical connections shall be by others.

   An oil level switch shall be provided by the cooling tower manufacturer to provide protection for sudden loss of oil or low oil level in the gear reducer.

   Electrical connection and wiring of the vibration switch and oil level switch, in series with the control circuit of the cooling tower fan motor shall be supplied and installed by others.

   Stainless steel drain and fill lines shall be provided with a stainless steel oil level sight glass shall be installed terminating outside the fan stack. The connection to the gear shall be butyl type hydraulic flexible piping.

6. **Fan Assembly** - The complete fan assembly (fan and mounting) shall be designed to give maximum fan efficiency and long life when handling saturated air at high velocities. Fan shall be of an adjustable multi-blade design with a minimum of ___ blades rotating at a tip speed of less than 12,000 FPM . The fan blades shall be FRP construction. Fan hub shall be of HDG steel plate construction. Provide non-corrosive metal spacer sleeve to prevent fan from dropping onto gear reducer in the event of shaft bushing failure.

7. **Drive Connection** - The motor shall be mounted outside the air stream. The drive shaft shall be all stainless steel or graphite composite torque tube type full-floating type, with non-lubricated flexible couplings at both ends. Hub shall be type 304 stainless steel minimum. Each drive shaft coupling shall be provided with a stainless steel guard, to prevent damage to surrounding equipment in case of shaft failure

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

8. **Fan Motors** - Motor shall be NEMA standard, TEFC enclosure, Class F insulation, corrosive duty and 1.15 SF at 40ºC ambient. Motor shall be ___HP, ____Volts 3 phase/60 Hertz, ___speed, ___winding, suitable for across line starting. Motor shall be mounted to a HDG base plate, bolted and grouted securely to the concrete fan deck.
   Only the fan drive motor(s) and base plate shall be supplied and installed by Cooling Tower Manufacturer. Complete electrical service for motors, motor control center and accessories as shown on contract drawings are specified elsewhere and are to be supplied and installed by others.

9. **Water Distribution System** – The distribution system will incorporate a low pressure design to minimize tower pump head and reduce pump energy costs of operation. The distribution system for each cell shall consist of a centrally located header, complete with side laterals, fittings and nozzles. Nozzle operating pressure shall be 60 inches of water maximum. The nozzles to be large orifice type with threaded connection to the lateral pipes for easy removal without tools for maintenance.

   All lateral piping shall be PVC and header material shall be PVC or FRP depending on pipe sizes. Each header and lateral pipe shall be secured to the tower wall with FRP angles and SS U-bolts as supports, leveled and securely mounted to the concrete wall with stainless steel expansion bolts. The piping shall be supported from above by SS steel rod hangers anchored to the concrete roof members and FRP horizontal support beams.

   The tower internal distribution piping, including spray nozzles, piping and fittings shall be supplied and installed by Tower Manufacturer complete to flange face located at a point either 6 inches below the top of the fill support beam or 12 inches from the external side wall for side-entry towers. Completed system shall be capable of evenly distributing the water over the fill area at various flow conditions and maintain a maximum nozzle head pressure of 60 inches of water pressure at all times.
   All remaining piping, including distribution supply piping, make-up, overflow, drain and suction lines shall be supplied and installed complete by the Mechanical Contractor in coordination with Tower Manufacturer.

   All penetrations through basin structure and pipe sleeves if required shall be installed in a manner to ensure a waterproof joint by others.

10. **Fan Deck** - Fan deck shall be constructed of poured-in-place monolithic concrete by the General Contractor, forming a rigid base for mounting the fan, speed reducer, drive shaft and motor.

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

11. **Exhaust Fan Stacks** - Exhaust fan stack shall be constructed of poured-in-place monolithic concrete by the General Contractor. For fan stacks less than six feet high, easily removable aluminum fan screen shall be provided for safety as a standard, by the Cooling Tower Manufacturer. Grout ring for proper fan tip clearance shall be by General Contractor after installation and alignment of fan drive equipment by Tower Manufacturer.

12. **Tower Access** - A hot dip galvanized steel access door and ladder shall be furnished in each cell by the Cooling Tower Manufacturer for internal access to fill from the fan deck level as shown on drawings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

A. Verify that all the equipment and materials comply with approved shop drawings, manufacturer's submittals and contract documents.

B. Provide support beams, platforms, hangers, embedded items and anchor bolts required for the proper installation of equipment as shown on the drawings and recommended by the Tower Manufacturer.

C. Contractor shall receive, store and protect all shipments of Tower Manufacturer prior to installation. Shipment shall be coordinated with contractor site personnel.

### 3.2 FIELD TESTING:

The Contractor shall follow manufacturer's instructions for inspection, adjustments and cleaning necessary prior to initial startup. A thermal performance test shall be conducted when adequate heat load is available and shall be at the option and expense of the Owner. Performance test shall be in strict accordance with Cooling Tower Institute Acceptance Test Code ATC-105 and performed by an independent third party testing agency approved by the Owner/Consultant.

If the cooling tower is unable to deliver 100% thermal performance, the following penalties will be assessed the Cooling Tower Manufacturer, based on results of the above- referenced CTI Test.

4150 International Plaza, Suite 500
Fort Worth, Texas 76109
Phone 817.246.8700
Fax 817.246.8717

www.compositecooling.com

**Penalty = (100% - Q) x 2P (US Dollars)**

Q = tower capability as defined by CTI Code ATC-105 and as determined by acceptance tests.
P = price of cooling tower internal equipment for each cell tested.

### 3.3 ACCEPTABLE MANUFACTURERS:

Composite Cooling Solutions, LP.

Bidders are cautioned that no deviations or exceptions to this specification will be permitted**.**

Tower manufacturers desiring to bid as specified shall submit a written pre-qualifying statement to the Engineer for approval, at least 21 days prior to bid date. The statement shall include a brief history of the manufacturer and the manufacturer's experience in the design and production of FRP composite structural components, and internal materials similar to those specified for this project.

**END OF SECTION**