

# Series 4000 Counterflow Cooling Towers



# COOLING TOWER TECHNOLOGY EXPERTS SINCE 1951

**POWER | PETROCHEMICAL | REFINING** 

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# Series 4000 Counterflow Cross Section





Star Cooling Towers supplies a wide range of cooling tower products and services to utilities, process, and industrial customers.

They have come to rely on Star Cooling towers' reputation for quality, value, and super customer service. They know Star Cooling Towers consistently lives up to its own high standards on every job.

### SERVICES

EXPERIENCED ENGINEERING AND DESIGN

PRE-ENGINEERED AND CUSTOM DESIGNS

INNOVATIVE DESIGNS USING LATEST COOLING TOWER TECHNOLOGIES

FULL-TIME CONSTRUCTION STAFF

OUTSTANDING SAFETY PERFORMANCE

### **ENGINEERED BY EXPERTS**



Our experienced engineering and design group can offer you the best value option for your particular cooling tower application, whether it is one of our pre-engineered cooling towers or a custom-designed solution. Many fill options to fit your application.

### UPGRADE TO A PREMIUM PULTRUDED FIBERGLASS TOWER

The Series 4000 is constructed from premium quality fiberglass. Owners and operators accustomed to wooden-structure cooling towers from decades past can upgrade to this modern high-performance fiberglass version. Upgrading to fiberglass means avoiding the environmental issues that come with wood preservatives, including arsenic and other toxic chemicals. Better yet, fiberglass is impervious to water intrusion that leads to the eventual rot and decay of wood cooling towers and is resistant to chemical attack.



## CELL EXTENSIONS OR NEW APPLICATIONS

The Series 4000 is ideal for cell extensions or expansion projects, as well as new cooling tower applications. The Series 4000 uses the latest available heat transfer and drift eliminator technologies, and the same high-quality materials STAR has been known for since its founding in 1951.

### NON-CORROSIVE CONSTRUCTION COMPONENTS

- FRP structural components
- Rigid FRP fan deck and fan stacks
- FRP blade louvers standard
- Type 304 stainless steel hardware standard



## FINITE ELEMENTANALYSIS FOR WOOD & FRP STRUCTURAL DESIGNS



### **REVIT + AUTOCAD 3D DESIGN AND VISUALIZATION SOFTWARE**

You can count on Star Cooling Towers' experience in cooling tower engineering, design, manufacturing, repair, and construction.

Our team will work with you through the design, budgeting, planning, and installation of your project to make sure you get the best job for the best value.

- Project planning and budget preparation
- Thermal performance testing
- Cooling tower optimization and upgrades
- Temporary cooling towers



Design wind loading is in accordance with ASCE 7 for the wind velocity and exposure for the new cooling tower location. Pultruded polyester resin structural fiberglass shapes for columns, braces, joists, and ties are in accordance with CTI Standard-137 "Fiberglass Pultruded Structural Products" and CTI Guideline ESG-152 Structural Design of FRP Components".

Structural joints consist of joint connectors properly fitted and thru-bolted to the structural members. Structural columns will extend to the basin floor or piers and shall be fully grouted if necessary to assure proper bearing surface. All diagonal braces will be anchored to the basin floor. All perimeter columns which do not have a diagonal brace extending outside the tower footprint will also be anchored.

Columns shall be standard 3 ½" square tube unless required larger as determined by design loading. Horizontal support beams shall be 3 ½" channel or 5 ½" channel as necessary per the span and loading requirements. Diagonal wind bracing shall be a minimum 3 ½ " square tube unless required larger.



### Hardware

All bolts, nuts, washers, and fasteners will be 304 series stainless steel. Structural connectors will be 304 series stainless steel.

### Casing

The tower is cased with a nominal 12 oz. fiberglass reinforced plastic (FRP) panels, extending from the top of the air inlet upwards to the fan deck level. All joints and connector locations are sealed to prevent water leakage. Prefabricated finish corner roll strips are used on all corners. The casing is secured with stainless steel screws with neoprene-backed stainless steel washers.

### Louvers

Louvers on the air inlets are comprised of 12 oz./SF FRP (fire retardant FRP) casing material for the louver panels, 4" fiberglass channel bottom louver supports, and polypropylene upper diagonal support arms. All hardware will be stainless steel (grade to match tower structure).

### **Cell Partitions**

Double-wall partitions between cells are provided in the transverse direction when two or more cells form the full cooling tower. Fiberglass cladding will be secured to one side of the column bent line using SST screws with neoprene-backed stainless steel washers. Panels will be hung horizontally starting at the bottom of the fan deck and extending down to 1'-0 below the basin curb elevation. Notching around structural members shall be neat and clean leaving gaps less than ½".



### Wind Walls

Wind walls are provided in the longitudinal direction. Fiberglass panels are secured to one side of the column lines nearest to the geometrical center of the cell structure. When a structural bent line is not at the geometrical center (cells with an odd number of transverse bays) the wall will offset to the two nearest bent lines in an alternating pattern every two bays. Sheathing will extend from 1'-0" below the basin curb elevation upwards to within 1'-0 of the bottom of the fill. Wind walls are intended to reduce crosswind air velocities sufficient to minimize nuisance blowout of water on the leeward side of the tower; they are not airtight or without gaps

### FANDECK (FRP)

The deck is constructed of 24" wide overlapping pultruded FRP profiles fastened to the deck framing members. The deck is designed for a 60 PSF loading as specified by the CTI. The deck shall have a non-skid top surface.

### Film Fill - Cellular PVC

The heat exchanger system consists of formed plastic sheets installed in modules. The standard film type fill is manufactured from patented thermoformed corrugated sheets of rigid polyvinyl chloride (PVC), impervious to decay, fungus, biological attack, and the specified water quality limits. The sheets will be solvent welded or mechanically crimped together to form a standard module of 6'-0" long by 1'-0" or 1'-6" wide by either 1'-0" or 2'-0" deep. The fill maintains its shape under all climatic conditions for continuous operation or extended shutdown periods. The fill is designed to withstand continuous operating temperatures up to 140°F. The fill is supported on FRP I-Beam mid-bay joists spaced on 2' (nominal) centers and FRP Channels at the column lines



Each cell is provided with a header pipe with a 125# ANSI drilled flanged connection located one foot outside of the casing. Headers 14" and larger will be fabricated from spiral wound FRP pipe while sizes 12" and under may utilize PVC (sch. 40) pipe with a Vanstone type flange. FRP flanges will be 'two-holed' for alignment with external piping.

PVC distribution lateral pipes are attached to the header with neoprene flexible grommet seals. These lateral pipes uniformly cover the plan area of the tower. The lateral and nozzle spacing have been hydraulically optimized for proper performance.

Threaded polypropylene nozzles are attached to the lateral pipes with a PVC nozzle adapter that is attached directly to the lateral pipe. These nozzles are designed to maintain even flow over the entire fill area. Flow adjustment is achieved by varying the spray nozzle's orifice diameter. The nozzle orifices are removable and interchangeable and are color-coded by the varying orifice diameters.



The drift eliminators are comprised of three-pass sinusoidal waved sheets of polyvinyl chloride (PVC) assembled in solvent welded or mechanically attached packs. The packs are 5 ½" thick x 1'-0" wide x 6'-0" long. The DE packs are supported on an independent level of support framing located approximately 2' above the distribution header piping and covering the entire tower plan area. The purpose of the drift eliminators is to reduce the circulating water losses, due to drift, to the percentage of the circulating water flow required



### MECHANICAL EQUIPMENT

#### Each mechanical drive package shall consist of a right angle speed reducer connected to an electric motor via a floating driveshaft. An axial flow fan is mounted on the output shaft of the speed reducer. The fan and motor are mounted on a galvanized steel support frame attached to the tower structure. The motor and gear are shimmed for proper alignment and the driveshaft shall be properly aligned per the manufacturer's recommendations. The following describes each of these major components in more detail:

#### FAN ASSEMBLIES

The fans are selected for smooth, vibration-free operation. Each fan shall employ manually adjustable, fiberglass blades attached to a galvanized steel hub. Each blade shall be statically balanced at the factory against a master. The blades shall be secured to the hub with hot-dip galvanized hardware. **GEAR REDUCERS** 

The right angle, single and double reduction, and spiral-bevel gear reducers shall be designed in accordance with AGMA standards and CTI Bulletin STD-111. The speed reducers are sized with a minimum service factor (S.F.) of 2.0 based on the motor nameplate horsepower. The bearings shall be

lubricated by a positive splash slinger system. **DRIVESHAFTS** 

#### Each drive shall include a composite fiber, singlepiece driveshaft connected by flexible, self-aligning couplings to the motor and to the gear reducer. Each driveshaft and coupling set shall be sized for a minimum service factor of 2.0 based on the motor nameplate rating. The coupling hubs shall be keyed to the shafts, and the shaft assembly shall be dynamically balanced. Coupling hubs and hardware shall be 316 stainless steel.

#### MOTORS

Each fan motor is suitable for use with a VFD, 1800 RPM, 3/60/460, 1.15 SF, IEEE841E

#### **VIBRATION SWITCHES**

Each drive shall be provided with a vibration switch equipped with a single-pole, double throw snap switch as manufactured by F.W. Murphy, Inc., or equal, unless otherwise specified. The switch will be mounted on the mechanical support frame outside the fan stack air stream near the motor.

#### LUBE OIL PIPING

The gearbox lube oil piping consists of 304 stainless steel piping for the oil drain, fill and vent lines running from the reducers to outside of the fan stacks. The gearbox oil level for standing and operating conditions shall be marked on the sight glass located outside of the fan stack near the fill and drain plugs.



#### FANSTACKS

The fan stacks shall be of the velocity recovery design and shall be constructed of heavily ribbed fiberglass panels bolted together with 316 stainless steel hardware. An access panel shall be provided for the removal of mechanical equipment on stacks 10 feet high and taller. A full radius inlet bell is provided for smooth airflow into the fan. The stack shall be designed for a wind load of 40 PSF.



#### ACCESS TO THE FAN DECK

The fan deck is accessed by an FRP stairway and FRP\_ escape ladder with an FRP cage. An FRP handrail system shall be provided around the full perimeter of the fan deck. Internal access shall be through a 30- inch x 30-inch access hatch leading down into the plenum. An FRP ladder shall be provided for access down to the drift eliminator and fill levels with a removable platform provided at the DE level.





### **DESIGN, CONSTRUCTION, REPAIR, & UPGRADES SINCE 1951**

# The Integrity of Service and Technology



#### **Outstanding Customer Service**

The Star Performance Plus program is designed to offer you complete support for the proper maintenance, operation, and optimization of your new cooling tower.

The result is consistent thermal performance, reduced unplanned maintenance, and emergency downtime, and overall maintenance cost reduction.

- Cooling tower start-up & training services
- Performance testing
- Annual inspection services
- Maintenance planning & budgeting
- Scheduled maintenance services
- Emergency response plans & implementation

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Our large selection of quality OEM (Original Equipment Manufacturer) replacement parts are compatible with most models and manufacturers of cooling towers, and they offer a high-quality, reliable, low-cost alternative to expensive original equipment parts.

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