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VANGUARD® Packed Column Air Stripping Tower Specifications

VANGUARD® air stripping towers are forced draft air stripping towers with single unit capacities from 60 to 4,000 gallons per minute. Delta air strippers are designed to remove volatile organic chemicals and certain other substances from water. These towers are a unique design that Delta Cooling Towers has been manufacturing since 1981 and have been very well received in both commercial and industrial applications.

The towers operate on a countercurrent forced draft design. A blower, ducted into the sump plenum provides air at a slight positive pressure and forces it to flow upward against the water trickling downward through the packing. As the air passes over the water, spread over the packing surface as a thin film, the molecules of contamination cross the air to water interface and enter the air stream. The air then exits the column either to atmosphere or to some means of vapor phase offgas treatment.

Delta VANGUARD® air stripping towers are available in most accepted materials of construction; aluminum, stainless steel, or FRP. Random packed medias are offered as well as our own Delta-Pak® structured packing.

Delta VANGUARD® Air Strippers possess known, predetermined stripping performance and operational characteristics based upon field and pilot test data obtained from certified test laboratories. The quality and performance of these systems is evidenced by our more than 500 installations worldwide.

SECTION 11_ _ _
PACKED COULUMN AIR STRIPPING TOWER
(FIBERGLASS)

1 GENERAL INFORMATION

1.01 Scope of Work Included

Design, fabrication, and delivery of One (1) Fiberglass packed column air stripping tower in accordance with the below design criteria and all applicable codes and standards. Scope of supply shall at a minimum include the specified air stripping towers; all associated internals, packing media and influent piping, the air blowers and intake ductwork, filters and louvers, and installation supervision and startup services.

1.02 Related Work Not Included in Scope

- a. Concrete work is by others and is specified in Section _____.
- b. Control Systems and Field Wiring is by others and is specified in Section _____.

1.03 Materials and Workmanship

All equipment and materials shall be furnished in new condition suitable for the conditions of service to which they will be subjected. Items must meet the applicable specifications and standards for grade and quality. Referenced standards are as follows:

- a. American Society for Testing and Materials (ASTM).
- b. ASME RTP-1 Reinforced Thermoset Plastic Corrosion Resistant Equipment
- c. American National Standards Institute (ANSI) B16.5 Flange Dimensions.
- d. Occupational Safety and Health Act (OSHA) Standards for Safety.
- e. ASTM D2563 Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts.
- f. ASTM D 3299 Standard Specification for Filament – Wound Glass - Fiber - Reinforced Thermoset Resin Corrosion - Resistant tanks.

1.04 Submittals

Six (6) copies of the Engineering Review Submittal shall be submitted to the engineer, and approved, prior to release of any items for manufacturing, fabrication, or delivery. Submittals, at a minimum, shall contain the following items:

- a. Detailed shop drawings and equipment layout drawings.

Delta Cooling Towers, Inc
VANGUARD® Packed Column Air Stripping Tower Specifications

- b. Process design calculations.
- c. Written Process Guarantee
- d. Blower and air handling equipment drawings including blower curves.
- e. Anchor bolt details and support pad-loading calculations. To include loading due to weight, ladder and platform attachment, and wind or seismic loading.
- f. Tower shell structural calculations.
- g. Data sheets and cut sheets detailing any auxiliary equipment to be supplied.
- h. Preliminary site shipment Packing list detailing all items to be shipped to the jobsite.
- i. Data sheets on any instruments or gauges to be supplied.

1.05 Operation and Maintenance Manuals

Six (6) copies of the Operational and Maintenance Manual shall be supplied to the engineer prior to delivery of the equipment to the jobsite. The manual shall contain record copies of all drawings, installation instructions, start-up instructions, safety instructions, and all information required for the proper operation and upkeep of all items supplied.

1.06 Experience Qualifications

The supplier of this equipment must be regularly engaged in the manufacture and delivery of Packed Column Air Stripping Towers and shall have such equipment of similar size and performance in successful and continuous operation. At a minimum the air stripping tower manufacturer shall have 15 years of experience in the manufacture and supply of air stripping tower systems of similar size and capacity.

1.07 Alternate Layouts or Equipment Manufacturers

If the contractor should choose to pursue the use of an alternate manufacturer to that which is stipulated in this specification, all changes to the current design both within this section and on the overall project shall be the sole responsibility of the contractor. This responsibility is inclusive of all costs associated with this change in suppliers from both an engineering and construction standpoint. **Approval of this alternate and its associated changes must be obtained from the engineer prior to the bid.**

Delta Cooling Towers, Inc
VANGUARD® Packed Column Air Stripping Tower Specifications

2 PRODUCTS

2.01 Packed Tower Air Stripper

The air stripping column shall be Model No. ΔS6-125RF as manufactured by DELTA COOLING TOWERS, INC, 186 US Highway 206, Roxbury Twp., New Jersey 07836, phone (973)586-2201. **No alternate manufacturers will be accepted without submittal to the engineer fourteen (14) days prior to the bid, and approval by the engineer via specification addendum.**

2.02 Performance Requirements

The air stripping system shall be designed to meet the following performance requirements:

Contaminant	Design Influent Concentrations	Maximum Effluent Concentration	Minimum Removal Efficiency
CO2	mg/l	mg/l	95.0%

2.03 Operating Parameters

Parameter	Value
Quantity of Units	1
Model Number	S6-125RF
Tower Diameter	6'-0"
Maximum Overall Tower Height	24'-0"
Design Flow Rate per unit	750gpm
Minimum Flow Rate per unit	500gpm
Water Temperature	55°F
Packing Type	Random
Packing Bed Depth	12'-6"
Minimum Air to Water Ratio	25:1
Maximum Liquid Loading Rate	26.5gpm/sqft
Blower Flow Rate (Per Unit)	2,510cfm
Blower Horsepower	5.0hp

Note: It is the responsibility of the column manufacturer to select and size all components of the column to meet the removal criteria. The component sizes shall meet or exceed those given herein.

2.04 System Preliminary Nozzle Schedule

Quantity	Description	Size
2	Inspection Manway	20"
1	Influent Nozzle	8"
1	Effluent Nozzle	10"
1	Air Outlet Connection	20" Ducted

Delta Cooling Towers, Inc
VANGUARD® Packed Column Air Stripping Tower Specifications

1	Air Inlet Connection	14" x 24"
2	Packed Bed Differential Connection	3/4"
1	Sump Drain	2"
2	Cleaning System inlet and outlet	2.5"

Note: It is the responsibility of the column manufacturer to select and size all connections on the column to meet the design requirements.

2.05 Tower Design Criteria

2.05.1 Tower Shell

- a. The air stripping tower column is to be constructed entirely of NSF Approved Fiberglass Resin System (Dion Ver 9102). All applicable ANSI/BOCA Codes shall be used for for wind and seismic loading.
- b. The tower shell shall have a minimum thickness as determined by ASTM D3299 but shall not be less than 3/16" thick.
- c. The design calculations must allow for the addition of 10 feet of packed bed depth for future needs.
- d. No Shell Body flanges will be allowed below the distribution section of the tower. This creates a major leakage point that can compromise the operation of the tower.
- e. The tower shall be shipped in one piece with all internals installed (including media) and all body sections connected by the final installation gaskets and hardware.
- f. A 90 to 110 mil internal corrosion barrier shall be provided, and shall be composed of a 10mil Nexus Veil liner uniformly wetted with resin to a resin rich thickness of 10mils and an inner laminate that consists of randomly chopped glass wetted with resin to a resin rich thickness of 80 to 100mils.
- g. Hand Lay-up Construction Method (heads, joints, fittings): Alternating layers of 1.5 oz/ft² chopped strand e-glass and 24oz/yd² woven roving. Woven roving shall be Type E glass, nominal 24 ounces per square yard, 4 x 5 weave, with silane type finish. Glass content for hand lay-up layers shall be 30%-45%.
- h. Filament Wound Construction Method (shell): Continuous roving used for filament winding shall be Type E glass with a silane type finish, with a nominal yield of at least 110 strand yards per pound. Glass content for filament wound layers shall be 55%-70%.
- i. Final Laminate Quality: Meet requirements of the visual acceptance criteria in ASTM D2563 Level II including, but not limited to, the following:
 - Appearance.
 - Defects.
 - Cut edges.

Delta Cooling Towers, Inc
VANGUARD® Packed Column Air Stripping Tower Specifications

- Construction joints.
- j. The tower shall be supplied with a base ring around the tower base or with multiple anchor lugs. The base ring or lugs shall have a minimum thickness of $\frac{3}{4}$ " and will have a sufficient number of anchor bolt holes to safely transmit the maximum overturning moment loads imposed by the design wind or earthquake loads specified above from the shell to the foundation.
- k. The flat bottom of the tower shall have a knuckle radius of 1.5 inches. The reinforcement of the knuckle-radius area shall extend up the vertical wall a minimum of 12 inches.
- l. The tower shall be provided with all necessary connections, inspection ports, lifting lugs, ladders, platforms, and pipe support brackets. All connections 2" and larger shall be flanged.
- m. All flanged nozzles on the tanks shall be rated at 150 psig minimum. The flange outer diameters and drilling shall be per ANSI 16.5.
- n. The back face of the flanges shall be spot-faced, flat and parallel to the flange face of sufficient diameter to accept a SAE metal washer under the bolt head or nut.
- o. All tank nozzles 4" and smaller shall be gusseted with either conical type or plate type gussets.
- p. Nozzles shall have a 6-inch projection as measured from the face of the flange to the inside wall of the tank.
- q. Shell nozzles shall be mounted radially, perpendicular to the side shell. Top nozzles shall be mounted parallel to the vertical axis of the tank with boltholes straddling this principle axis. Nozzles shall be finished flush with the inside surface of the tank. Provide gaskets for blind flanges.
- r. The tower shell and influent pipe shall be flanged at or near the top of the packing bed to allow for the extension of the packing bed by a minimum of 10'-0" in the future.
- s. The roof of the air discharge section of the tower shall be coned or pitched to prevent the accumulation of snow and/or rainwater.
- t. The towers shall feature a top flanged air outlet for connection to ductwork to the scrubbers.

2.05.2 Influent Pipe

Delta Cooling Towers, Inc
VANGUARD® Packed Column Air Stripping Tower Specifications

- a. The air stripping tower shall be supplied with a Schedule 10 Stainless Steel influent pipe. The pipe shall terminate with a 150# Raised Face flange at approximately 5'-0" above grade.
- b. The pipe shall be attached to the tower shell via pipe support brackets and u-bolts.
- c. The influent pipe shall be flanged at or near the top of the packing bed to simplify tower extension should future performance requirements warrant.

2.05.3 Manways

- a. A minimum of four (4) manways shall be provided for inspection and access to tower internals.
- b. Manways shall be positioned in the sump, at the bottom of the packing bed, at the top of the packed bed, and in the distribution section.
- c. The manway at the bottom of the packed bed shall be provided with an expanded metal screen to prevent the escape of packing media during inspection.
- d. All manways shall be provided with bolted covers which shall be gasketed and water/air tight.
- e. Manway covers shall be of clear plexiglass, designed for the internal pressures of the system. An FRP coverplate shall be supplied with 316SS hardware.

2.05.4 Internal Components

- a. The design packing depth shall be provided utilizing DeltaPAK Structured Packing Media. (NO ALTERNATES ALLOWED)
- b. The packing media must be NSF CERTIFIED.
- c. Packing Media to have minimum surface area of 100sqft per cuft.
- d. Packing Media to have minimum void space of 98%.
- e. Packing Media to be Type 1 PVC.
- f. The packing media shall be factory installed prior to shipping to the jobsite.
- g. Due to the large variation in performance characteristics and efficiencies from alternate packing medias, no alternate medias shall be considered.
- h. The packing shall be supported by an FRP grating structure. This structure shall be supported by an internal continuous ring welded to the tower shell. Independent support beams shall also be used when required to minimize deflection.

Delta Cooling Towers, Inc
VANGUARD® Packed Column Air Stripping Tower Specifications

- i. Air inlet connections from the blower to the tower shall be flanged externally and shall be shrouded internally to prevent entry of water from the packing above.
- j. A mist eliminator shall be located above the distribution system. This mist eliminator shall be the Delta AB design, constructed of Type 1 PVC material. Minimum mist eliminator pad depth is 12”.

2.05.5 Distribution System

- a. The distributor shall be of header lateral full cone nozzle design.
- b. The nozzle shall be located to provide full coverage of the packing surface while avoiding spraying too much on the walls.
- c. Water shall be transferred from the outside of the vessel to the inside via a distribution pipe of PVC Schedule 80 Materials.
- d. Nozzles should operate at 10psig or less and be of a full cone pattern.
- e. Nozzles shall be PVC Materials.

2.05.6 External Coating

- a. U-V inhibited, NPG-ISO polyester gel coat, 18 to 22 mils per manufactures instructions.
- b. Final pigment color of gel coat to be per client requirements.

2.05.7 Miscellaneous

- a. Bolting and Hardware: All hardware used to assemble the tower, its internals, and all associated ductwork and piping shall be 316 stainless steel.
- b. Anchor Bolts: Design of the anchor bolt system for attachment of the tower to the concrete foundation is the responsibility of the tower manufacturer. The design of the tower foundation is the responsibility of others. Supply and installation of the anchor bolts is the responsibility of the contractor.
- c. Gasketing: The tower body flange, manway connections, and ductwork connections shall be sealed with a 1” wide closed cell neoprene sponge gasket. All piping connections shall be sealed with a 1/8” thick full-faced red rubber gasket.

2.06 Air Handling Equipment

2.06.1 Air Blower

Delta Cooling Towers, Inc
VANGUARD® Packed Column Air Stripping Tower Specifications

- a. Centrifugal blowers of FRP construction shall be utilized to supply the forced draft air required for operation of the towers. Blower and motor shall be sized by the manufacturer to meet the performance criteria listed in section 2.03a & 2.03b. The blowers shall be manufactured by Chicago Blower, New York Blower or approved equal.
- b. The blower motor shall comply with the following specifications:
 - i. 460 Volt / 3-phase / 60 hz
 - ii. TEFC
 - iii. 1.15 Service Factor
 - iv. VFD Duty Rated
 - v. B-10 Bearing Life greater than 100,000hours.
- c. The blower shall have the following accessories:
 - i. Flanged Inlet and Outlet
 - ii. Motor Weather Cover
 - iii. Belt and Shaft Guard
 - iv. Unitary Mounting Base
 - v. Vibration Isolators
 - vi. Drain Connection
- d. The sound levels generated by the blower during normal operation shall not exceed 85 dBA – weighted, slow response, under free field condition, at a horizontal distance of 10 feet from the surface of sound generation
- e. The blower shall be dynamically balanced at the factory prior to shipping.

2.06.2 Ductwork

- a. All required ductwork to connect the blower discharge to the Air Stripping Tower and to connect the blower inlet to the filter assembly shall be provided by the tower manufacturer.
- b. The ductwork shall be constructed of similar materials as the tower and will be a minimum thickness of 1/8".
- c. The ductwork must be of molded FRP construction. Rivet or lock seam ductwork is not acceptable.
- d. The ductwork must be flanged at each field joint to allow for simplicity of installation.

2.06.3 Accessories

- a. Flex Boots: The inlet and discharge of the blower shall have flex boot assemblies installed to isolate vibration and ease installation. The flex boot dimensions shall be identical to the blower inlet and discharge flanges. The flex boot flanges shall be

Delta Cooling Towers, Inc
VANGUARD® Packed Column Air Stripping Tower Specifications

aluminum and the boot material shall be fiber-reinforced neoprene with all seams sewn. Rubber materials and slip fit boots shall not be acceptable.

- b. Discharge Pressure Switch: A pressure switch shall be installed on the blower discharge ductwork to verify blower operation. The pressure switch shall be Dwyer Series 1950 or approved equal.
- c. Filter Housing: Blower inlet air filters and housing shall be supplied. The filters shall be Farr 30/30 extended area, 4" deep, and shall be installed in a Farr glide pack holding frame.
- d. Intake Louver: The filter housing shall be supplied with a properly sized intake louver to prevent the entry of rain and snow into the filters. The intake louver shall be an American Warming and Ventilating model AW-21 fixed blade.
- e. Packing Differential Pressure Indicator: Pressure gauge mounted to a bracket that displays the pressure loss across the packed bed. Gauge should be a 4" dial type scaled to the range selected by the tower manufacturer.

2.07 Manway Access Ladders and Platforms

An OSHA compliant caged ladder and platform assembly shall be provided by the tower manufacturer as shown on the contract drawings for access and inspection of the tower internals. The ladder and platform shall be supported directly from the tower shell via support clips molded to the tower shell.

- a. Ladder: The ladder shall be composed of $\frac{3}{4}$ " diameter rungs. The ladder shall have a minimum space of 16" between the vertical runners. The vertical distance between rungs shall be uniform and shall not exceed 12". The minimum distance between the rungs and the tower shell is 7".
- b. Cage: The ladder assembly shall include a continuous safety cage from no more than 7'-6" above grade and running to 3 feet 6 inches above the upper platform. The cage shall be permanently welded to the ladder and be connected to the platform handrail via bolted clips. At the cage base, a locking door shall be installed to prevent unwanted entry.
- c. Platform: An inspection platform shall be provided at an elevation several inches below the upper manway. The platform shall be supplied with the necessary handrails, toe plates, and safety gates. The walking surface shall either be non-slip grating or diamond plate. Per OSHA standards, platform shall be a minimum of 3 feet wide and the step across distance from the ladder to the platform shall be between 3 and 12 inches.
- d. The ladder and platform assembly shall be fabricated from structural grade aluminum.

3 Installation & Service

3.01 Inspection

- a. Inspection of all products fabricated to this Specification is required prior to shipment unless specifically waived in writing by ENGINEER. This shall include Visual inspection to the requirements of ASTM D2563 Level II.
- b. A clearance for shipment shall not relieve the Fabricator's responsibility as to performance guarantees, quality of materials and workmanship and dimensional conformity with the Drawings.
- c. ENGINEER will be permitted access to the plant area at all times during fabrication and shall be notified one week prior to the estimated date of fabrication.
- d. Repairs authorized by ENGINEER shall be re-inspected before final acceptance unless specifically waived.
- e. Noncompliance with this Specification or evidence of poor workmanship shall be cause for rejection.

3.02 Delivery & Installation

- a. The tower shall be properly protected for shipment. Shipping Covers shall be installed on all connections and properly sized saddles shall be utilized.
- b. Prior to the pouring of the foundation, the tower manufacturer will supply an anchor bolt template for use by the General Contractor in setting the anchor bolts. This template must be a direct transfer of the hole locations from the actual tower base ring. (Epoxy in place Anchors are an acceptable alternative.)
- c. Installation, handling, and storage shall be in strict accordance with the manufacturer's recommendations and instructions as supplied in the O&M manuals and shop drawings. Care shall be taken at all times to not damage the tanks and the accessories.
- d. The General Contractor shall provide all field labor and equipment for installation of the tower.

3.03 Field Service

- a. The tower manufacturer shall supply a trained service technician for the following services upon notification by the Contractor:
 - i. (2) Man Days for Installation Inspection and Certification
 - ii. (2) Man Days for Equipment Start-up and Testing
 - iii. (1) Man Day for Operator Training

3.04 Disinfection

Disinfection of the newly installed air stripping tower, and supply/disposal of all disinfection chemical is the sole responsibility of the general contractor.

3.05 Spare Parts

The following spare parts shall be supplied for each tower:

- a. One set of Gaskets
- b. One complete set of Intake Filters
- c. One Full Set of Blower Bearings

3.06 Continuing On-Site Support

The manufacturer must maintain a local representative with service technician capabilities and the ability to supply the owner with trained onsite support within 24hours notice. This support group must maintain a local technician within 100miles of the jobsite.

4 Optional Equipment