Specification for Spunstrand® Horizontal Airflow
Vertical Bed Carbon Scrubber
4 Vertical Beds
(Typical) 4X1 & 4X2

Products

2.01 GENERAL

A. Fiberglass Reinforced Plastic Horizontal airflow split Vertical bed Scrubber Vessel as manufactured by Spunstrand Inc.® or pre-approved equal, and shall be used to scrub foul and VOC laden air, up to ____ PPM continuous H^2S, and other VOC's and identified environmental conditions as described in related specification sections.

2.02 Performance: Activated carbon absorber systems shall be designed as follows:

Air Flow (cfm)	800-46,000 cfm
Facial Velocity (fpm)	50-75 fpm
Vessel Dimensions	12”Ø -168”Ø
Bed Type	Single or double
Media Depth	18”-36”

2.03 Materials

A. FRP Vessel

1. Type: Filament wound rated at design pressures indicated in the drawings. Minimum wall thickness shall be ___ including the liner.

2. Grade: Type 1, Grade 2 RTRP, Class E per ASTM D2310 and D2996.

3. Vessel shall be designed for not less than 20 inches water column pressure and 12 inches water column vacuum. The design, applicable construction, and inspections shall be in accordance with NBS PS 15-69.

4. A minimum structural safety factor of 5 shall be used in the design of the Vessel.

5. The resin used shall be Hetron 992FR selected to meet the exposures and temperatures of the air to be exhausted. Fillers other than antimony trioxide added for flame retardance when required, shall **not** be allowed, and should not exceed 5% by weight. A thixotropic agent for viscosity control may be used as recommended by the resin manufacturer. No thixotropic agent is to be used in the corrosion liner or on surfaces to be in contact with the corrosive environment. Flame spread rating shall be 25 or less per ASTM E-84. Catalyst shall be DDM9 or High Point 90 as recommended by Ashland Chemicals.

6. Corrosion liner: Inner surface shall contain one (1) ply of a 10 mil thick minimum C-glass surfacing veil saturated with vinylester resin. The surface veil shall be overlapped a minimum of 1". Surface veil layers shall be followed by one (1) layer of 1-1/2 oz./sq. ft. chopped strand mat. Corrosion liner is to gel completely before proceeding with structural laminates. In no case shall the interruption exceed 12 hours. Total liner thickness to be 50 mils. No thixotropic agent or fire retardant additive is to be used in the liner resin. Corrosion liner shall contain not less than 20 % nor more than 30% glass by weight. The liner shall pass inspection for ASME RTP-1 Table 6-1 visual acceptance criteria.

7. Structural layer shall be filament wound of Hetron 992FR premium grade vinylester resin and Type E 250 strand yield continuous glass roving. The band width is 2 1/4” using (7) strands per inch. Filament winding cycle thickness to be 0.06" maximum. Glass content

55 to 65 %. Winding angle shall be 55° to 70°± 3°. Chopped hoop winding and hand lay-up will not be allowed in the structural layers.

8. Exterior of all laminates shall contain sufficient resin to insure a relatively smooth surface free from exposed glass fibers or sharp projections. Scrubber vessels located outdoors shall contain an exterior colored surface coat. An ultraviolet stabilizer added to the final coat of resin that also incorporates paraffinated wax curing elements. Color to be selected by owner from Spunstrand color chart.

9. Vessel beds (4) shall be vertical and ___" minimum width. Beds shall be secured with minimum 1.5" thick vinylester grating, and either FRP I-beams or back to back FRP channel, permanently bonded to the inside of the vessels structural layer. After bonding the supports, the liner shall be built back up to 50 mil minimum over the structural bonds. The beds shall have top access manways for filling and replacing the scrubber media. TETKO Polypro mesh 5-2000/51 or equal shall be used to contain the media, and secured 360 degrees to the grating. The manways shall be ___"Ø 150 lb. flange and blind flange complete with EPDM gasket and SS hardware.

10. The scrubber inlet and outlets shall be flanged as shown on the drawings.

11. Domed ends shall be factory attached and constructed to the same liner and structural wall thickness. Chopper gun or hand-lay-up method are acceptable so long as there is no antimony added to the 50 mil liner.

12. Vessel shall be equipped with a 12"Ø FRP sump with a 3/4" drain and ball valve (Optional: when buried below ground level w/sump pump connected to pipe), to be connected to a P-trap supplied by others (utilized in wastewater applications).

13. Vessel will have inserted in each media bed a grounding rod which will have a external means to connect a conductor grounding.

2.04 ACCESSORIES

A. Media

1 Media beds in the vessel are to be SPUNCARB #___-___ for all 4 beds in a 4x1, or in a 4 X 2 the two inside first pass beds, and SPUNCARB #___-___ in the outside second pass beds.

2. Media specs refer to spec section for media.

B. Media installation.

1. SPUNCARB ___-___:
   a. Media to be installed by contractor on site.
   b. Supplied by scrubber manufacturer.

C. FRP duct manifold, fan and stack:

1. FRP duct and stack will be supplied by the carbon vessel supplier per specifications.

2. PVC flex connector with flanges will be supplied to connect fan to vessel.

3. Fan will also be supplied as part of a complete scrubber package, with the Vessel supplier being responsible for the successful supply and start-up of the system. A minimum of 2 days will be required by the vessel supplier at start-up to insure proper installation and operation. (Fan Specifications will be included based on application).

4. Epoxy coated steel base saddles will be provided by vessel manufacturer, and shall be checked and stamped by a Washington State Structural Engineer, to meet structural requirements of seismic zone III.

(Optional) A Media Life Sampling Probe, which allows the external viewing of the remaining life of the carbon media, shall be included in each carbon bed.

Quality Assurance

A. Prebid approval for filament wound FRP scrubbers and retlated interconnecting materials will be required for all manufacturers ot listed in the specification. Pre-bid approval will be based on receiving the following acceptable samples and data a minimum of seven (7) days prior to bid date:
   1. (2) sample cutouts demonstrating 60 to 110 mil clear liner with no antimony, and filament wound structural laminate. Samples to be a minimum of 8" Ø, and RTP-1 visual level II.
   2. Company filament winding history and at least two (2) FRP carbon scrubber job names with similar type construction, contacts and phone numbers for reference.
   3. At least one stamped set of calculations from a previous buried duct job.
   4. A copy of the fabricators complete quality manual.

B. All FRP Vessels shall be fabricated and installed by qualified, experienced mechanics, who have a minimum of 3 years' experience with the lay-up, fabrication and installation of this type of system.

C. Factory Inspection:
   1. Owner shall be given access to the FRP Vessel and all quality control records during fabrication and upon completion for the purpose of verifying compliance to the Contract Documents.

   2. The owner shall maintain the right to tour the FRP duct manufacturer's plant anytime that fabrication is in process prior to final shipment. The owner and engineer may exercise the option, without any advance notice, to tour the plant and inspect all stages of fabrication to ensure that quality control is being maintained.

   3. Inspection by owner does not relieve any responsibility of the fabricator to meet the requirements of this specification.

   4. Final Inspection - The engineer and owner may carry out a final inspection of the equipment prior to shipment. Fabricator shall give the owner a minimum of 5 days advance notice of scheduled ductwork. Prior to final inspection by owner, the vessel shall be cleaned of all foreign material, and shall be in a position that allows easy access and viewing.

D. Acceptance:
   1. Lack of compliance with any aspect of the specifications and drawings will be grounds for rejection of the equipment.

   2. Repair of rejected equipment - Repair procedures must be approved by the owner prior to implementation. No more than 5 percent of the surface area of each FRP vessel component may be repaired.

E. The fabricators inspector (Quality Control Manager) will provide the owner with a complete Quality Control report for the job. The report will be available within 15 days after the final parts are complete. The final report will include the QC sheets on all parts manufactured,

making it impractical to send prior to the final shipment of a job that will span several months. The fabricator will have available after each shipment, the completed QC sheets for review upon request at any time.

F. The fabricator shall submit a sample of a vessel cutout at least 8" in diameter, to demonstrate specification compliance, and the ability to produce and maintain ASME RTP-1 Table 6-1 visual acceptance criteria. At the fabricators expense, a plant and fabrication method inspection by an outside testing agency will be required prior to fabrication, or a letter from FSE confirming a satisfactory inspection in the last 6 months. A failed inspection, and any subsequent reinspection will also be at the fabricators expense.

Submittals

A. Provide the following information in addition to the standard submittal requirements with the Bid:

1. The fabricator shall submit for approval all reference standards, calculations, fabrication drawings, and all engineering details of the duct design prior to beginning fabrication.
    a. The submittal should include all information utilized by the fabricator which describes specifically how their FRP vessels are manufactured. This should be in the form of shop drawings, standards, specifications, other shop instructions and QC records. This should include, but not be limited to:
        1.) Resin Type
        2.) Types and amounts of filler.
        3.) Corrosion liner description
        4.) Reinforcement types for hand lay-up or chopped laminates.
        5.) For filament-wound laminates:
            a.) Helix angle
            b.) Glass content range
            c.) Strand yield
            d.) Strand by inch in the winding band.
            e.) Ply thickness
            f.) Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate.
        6.) For all Fabricated parts.
            a.) Construction type
            b.) Laminate thickness
            c.) Ply sequences
            d.) Glass content range
        7.) For all secondary overlays (both interior and exterior):
            a.) Laminate thickness
            b.) Ply sequences and widths
        8.) Construction details for all other special configurations and fabricated parts.

B. FRP vessel cupout a minimum of 8" in diameter and of the quality of workmanship and glass / resin being quoted. These will be retained for quality comparison on materials shipped to jobsite.

C. Recommended procedure for the protection and handling of materials prior to installation.

D. Quality control manual detailing shop QC inspection procedures and documentation, and samples of all shop QC forms utilized in the process.