DRY BULK STORAGE TANK SPECIFICATION
PREMIER POWDER COATED BOLTED STEEL TANK

1. GENERAL

1.1 Scope of Work

1.1.1 Furnish and erect bolted RTP (rolled, tapered panel) steel tank for dry bulk storage. Scope to include tank, factory powder coat process and tank appurtenances as shown on the contract drawings and described herein.

1.1.2 All required labor, materials and equipment shall be included.

1.2 Qualifications of Tank Supplier

1.2.1 The Engineer's selection of a factory applied, epoxy powder-coat bolt together storage tank is predicated on a thorough examination of design criteria, construction methods, and optimum coating for internal and external protection. Deviations from the specified design, construction or coating details will not be permitted.

1.2.2 The bidder shall offer a new tank as supplied from a manufacturer specializing in the design, fabrication and erection of factory applied epoxy coated, bolt together tank systems. The manufacturer shall fabricate and coat the tank in the same facility which it owns and operates.

1.2.3 The tank shown on the contract drawings and specified herein will be a Fusion 5000 FBE™ powder-coated, RTP bolted tank design as manufactured by Tank Connection or BOSS Tank.

1.2.4 Epoxy powder coated tank products, as provided by other manufacturers, will be considered for prior approval by the Engineer.

1.2.5 Erection of the tank is to be by the tank manufacturer or a certified factory approved subcontractor.

1.2.6 Strict adherence to the standards of design, fabrication, erection, product, quality, and long-term performance, established in this Specification will be required by the Owner and Engineer.

1.2.7 Tank suppliers wishing to pre-qualify shall submit the following to the Engineer/Owner for consideration:

1.2.7.1 Typical tank drawing(s).

1.2.7.2 List of tank materials, appurtenances and tank coating technical specifications.

1.2.7.3 Resume of job installation superintendent.

1.2.7.4 The installation crew shall have the experience and knowledge necessary to furnish the highest quality field construction possible. Synchronized jacking process to be the preferred tank construction process utilized.

1.2.7.5 Only bids from tank suppliers who have successfully pre-qualified will be considered.

1.3 Submittal Drawings and Specifications

1.3.1 The project shall be governed by the Owner's drawings and specifications showing general dimensions and construction details. There shall be no deviation from the drawings and specifications, except upon written order from the Engineer.

1.3.2 The bidder is required to furnish, for the approval of the Engineer and at no increase in contract price, _____ sets of complete specifications and construction drawings for all work not shown in complete detail on the bidding drawings. A complete set of structural calculations shall be provided for the tank and foundation.

1.3.3 When approved, two sets of such prints and submittal information will be returned to the bidder marked "APPROVED FOR CONSTRUCTION" and these drawings will then govern the work detailed thereon.

2. DESIGN CRITERIA

2.1 Tank Size

2.1.1 The epoxy powder-coated bolt together tank shall have a nominal diameter of _____ft. with a nominal eave height of _____ ft.

2.2 Tank Capacity

2.2.1 Tank working capacity shall be _____ cubic feet based on _____ angle of repose.

2.3 Design Parameters

2.3.1 Jobsite location - City, State, Zip Code
Material stored
Loose density of product - pounds per cubic foot
Maximum compacted product density - pounds per cubic foot
Product angle of repose - degrees
Required working capacity of each tank - cubic feet or tonnage
Tank size - diameter x height
Configuration - specify skirt support design, drive-through skirt or tank elevated on structural steel
Hopper slope - specify degrees
Hopper outlet size
Clearance from foundation to hopper discharge
Design loads - specify mass flow, funnel flow or expanded flow
Operating pressure and vacuum - ounces per square inch
Dust collector and/or equipment loads
Roof live load - PSF
Seismic zone - per IBC 2006, requires zip code
Standard wind design - per IBC 2006

2.4 Tank Design Standards

2.4.1 The RTP (rolled, tapered panel) bolted tank design shall have lap joint connections on both vertical and horizontal shell seams. American Petroleum Institute (API 12B) flanged panel tank design will not be acceptable.

2.4.2 Standard wind design is 90 MPH wind velocity per IBC 2006.

2.4.3 Seismic Design is to be based on the 2006 edition of the International Building Code. When designing a tank in a seismic zone, the load producing the higher stresses comparing wind and seismic will control the dynamic portion of design. Per IBC 2006, a 1/3 allowable stress increase for structural shape stiffeners is not allowed.

2.4.4 Combined live and dead roof load shall be uniformly distributed with all nozzle, manhole, and filter location designed for a minimum of 200 lbs each. Live and dead loads to be combined minimum of 20 psf. Roof to have 1:12 slope for water drainage.

2.4.5 Shell and Hopper Design

> 2.4.5.1 Shell and hopper product pressures are calculated using the technical paper *Effect of Solid Flow Properties and Hopper Configuration on Silo Loads*, by Jenike, A.W. Jenike and Johanson, Inc. The analysis uses the Janssen formula for defining pressures and load imposed by funnel or mass flow. Radial tension in the shell, from the above mentioned product loads, are from the Design of Steel Bins for Storage Of Bulk Solids, Gaylord and Gaylord, Section 8-2. Loadings in the hopper, from the above mentioned product loads, are from the *Design of Steel Bins For Storage of Bulk Solids*, Gaylord and Gaylord, Sections 5-12, 8-6.

2.4.5.2 Allowable stresses for carbon steel are per the AISC Manual of Steel Construction. Allowable Stress Design, 9th Edition and ASTM for carbon steel materials. Weld joint efficiencies, where applicable, shall be per ASME Section VIII, Division I, Table UW-12.

2.4.5.3 Shell design is based on the critical buckling formula for a long cylinder from the book *Structural Analysis Of Shells*, by Baker, Kovalevsky, & Rish. The shell material's critical buckling stress is not allowed to exceed its yield strength.

2.4.5.4 Shell resistance to radial tension from dry product pressure is based on the principles of API 620, Section 3.10 with allowable seam loads based on the principles of AISC.

2.4.5.5 Hopper resistance to tension from dry product pressure is based on the principles of API 620 Section 3.10 with allowable seam loads based on the principles of AISC. The hopper to sidewall connection design is based on the principles of API 620 Section 3.12.

2.4.5.6 Deck sheet design under internal pressure is based on the principles of API 620 Section 3.10 with allowable seam loads based on the principles of AISC. The deck to sidewall connection under internal pressure is based on the principles of API 650.

2.4.5.7 Shell design under vacuum is based on the critical buckling formula from the book *Structural Analysis of Shells*, by Baker, Kovalevsky & Rish.

2.4.5.8 Sidewall panels shall be RTP (rolled, tapered panel) design, utilizing lap joint panel connections. Formed flanged panels will not be allowed.

2.4.5.9 Tank shall be designed for (center fill) (off-center fill) (center discharge) (off-center discharge) of product.

2.4.5.10 Tank design pressure shall be 4.5 oz per square inch positive and .5 oz per square inch negative (design tank for atmospheric pressure).

2.4.5.11 Tank design to be based on a level full capacity using the maximum compacted density of the product.

2.4.5.12 Owner solicits recommendations that may improve the price, delivery, or performance of tanks. As an alternate, vendor is invited to quote changes in physical dimensions, modifications to the design, fabrication, or stock of Vendor's standard equipment that would reduce the initial cost of the equipment as specified without changing the design premise. Any alternate quotations submitted must be clearly labeled as "Alternate Quotation".

3. MATERIALS SPECIFICATIONS

3.1 Plates and Sheets

3.1.1 Design requirements for steel shall be ASTM A1011 Grade 36, 40, 50, 60 and 70 material.

3.2 Rolled Structural Shapes

3.2.1 Material shall conform to minimum standards of ASTM A1011 Grade A36, A992 or A53 Grade B material.

3.3 Bolt Fasteners

3.3.1 Bolts used in tank lap joints shall be Â½ - 13 UNC-2A rolled thread, and shall meet the minimum requirements of AISC.

3.3.2 Bolt Material

3.3.2.1 SAE Grade 8, tensile strength - 150,000 psi minimum (Note: SAE Grade 2 and Grade 5 bolts shall not be used in panel seam structural connections.)

3.3.2.2 Anchor bolts conform to ASTM A36 or A307.

3.3.3 Bolt Finish - JS500 electro-plated.

3.4 Gasket

3.4.1 The lap joint bolted connections shall utilize EPDM (synthetic rubber) strip gasket for sealing. For high temperature applications (in excess of 230 °F), Viton gasket shall be specified.

4. FACTORY POWDER COAT PROCESS

4.1 Cleaning

4.1.1 Following the fabrication process, sheets and tank components shall be thoroughly washed and rinsed.

4.1.1.1 Washing shall be with a 3-4% solution of DuBois MC-726 and 140°F water.

4.1.1.2 The PH level shall be monitored and maintained at 10 to 12.

4.1.1.3 Rinsing shall be in a two stage booth with ambient temperature fresh water used in second stage.

4.1.1.4 All water shall be removed from sheets and tank components with forced air at ambient temperature.

4.2 Surface Preparation

4.2.1 Sheets and tank components shall be blasted using steel shot S-230.

4.2.2 Sheets and tank components shall be blasted on both sides providing a surface profile of SSPC-SP10. Anchor profile shall be 1.0 mil minimum.

4.3 Powder Coating

4.3.1 After cleaning and blasting, the sheets and tank components shall receive an epoxy powder coating on both sides. The powder coating shall be applied with an electrostatic process. The thermoset powder coat system shall be as specified:

Interior Coating: Fusion 5000 FBE™ @ 5 mils
Ext. Primer: EXT Fusion 5000 FBE™ @ 3mils
Ext. Topcoat: EXT Fusion 5000 SDP™ @ 2 mils

4.3.2 Coating thickness shall be maintained by the use of PLC controlled automatic spray guns that are set for the application.

4.3.3 Visual inspection for coverage shall be made after powder application and before the first oven cure. Areas with light coverage shall be re-sprayed with a manual spray gun.

4.4 Powder Curing

4.4.1 Sheets and tank components shall then be heated in an oven to achieve a metal temperature of 375° and held for 15 minutes.

4.4.2 After oven curing, the sheets and tank components shall cool down to a metal temperature of 125° or less.

4.4.3 Both visual inspection and dry film test shall be randomly performed before the application of the top coat.

4.5 SDP Top Coat (super durable polyester)

4.5.1 SDP top coat shall be applied with a 2 mil minimum thickness on all exterior surfaces.

4.5.2 The SDP top coat shall provide excellent gloss retention and UV resistance. Color is to be selected from chart consisting of seven standard colors.

4.5.3 Visual and wet mil thickness testing shall be randomly performed before the second oven curing.

4.6 Final Curing

4.6.1 Sheets and tank components shall then pass through the final cure oven where the oven temperature ranges from 300° to 475° based upon the metal thickness.

4.7 Inspection

4.7.1 During final cool down, sheets shall be randomly inspected for cure, adhesion, coating thickness and holidays.

4.7.2 Cure shall be confirmed using MEK rub.

4.7.3 Adhesion shall be confirmed using 100 squares test.

4.7.4 Coating thickness shall be confirmed using dry film thickness gage.

4.8 Packaging

4.8.1 After cool down and inspection, the sheets and tank components shall be unloaded and packaged for shipment.

4.8.2 Sidewall sheets shall be stacked on wooden skids with paper placed between each sheet to prevent any scuffing. Skids shall be loaded to 5,600 pound maximum weight. Each skid shall be wrapped in heavy mil, black poly reinforced paper and then steel banded.

4.8.3 Roof sheets and hopper or bottom sheets as well as other tank components shall be packaged to prevent damage and then wrapped and banded.

5.0 TANK STRUCTURE

5.1 Sidewall Structure

5.1.1 Field erection of the epoxy powder-coated, bolted steel tank shall be in strict accordance with the procedures outlined by the manufacturer, using factory trained erectors.

5.1.2 Vertical shell support stiffeners shall conform to minimum standards of ASTM A1011 A36 or A992.

5.1.3 Particular care shall be taken in handling and bolting of the tank panels and members to avoid abrasion of the coating system.

5.2 Roof

5.2.1 Epoxy powder-coated steel deck.

> 5.2.1.1 Tank shall include a sectioned roof fabricated from epoxy powder-coated, bolted steel panels, as produced by the tank manufacturer, and shall be assembled in a similar manner as the sidewall panels. The roof shall be clear-span and self-supporting. Both live and dead loads shall be carried by the tank walls.

5.3 Hopper

5.3.1 Epoxy powder-coated steel hopper.

5.3.1.1 Tank shall include a sectioned hopper fabricated from epoxy powder-coated, bolted steel panels, as produced by the tank manufacturer, and shall be assembled in a similar manner as the sidewall panels. Hopper shall be self-supporting with full compression bar attachment to tank sidewall.

5.3.1.2 Hopper support stools shall conform to minimum standards of ASTM A1011 A36.

5.4 Appurtenances

5.4.1 Standard Tank Accessories

3'x 6'8" walk-in door in skirt
20" center roof dome with cover plate
Foundation anchor bolts
Hardware and gasket for assembly of tank
Outside tank ladder (OSHA) with safety cage and step-off rest platforms - HDG finish
Deck manway access
Deck perimeter guardrail with toe board (OSHA) - HDG finish
Hopper manway access with bolt-on cover
Stub and flanged nozzles in deck, sidewall and hopper
Manufacturer's nameplate

5.4.2 Optional Tank Accessories

Product material testing to ensure reliable flow

Double door access in skirt - 6' (wide) x 6'8" (height)

12' (wide) x 14' (height) truck drive-through openings in skirt

Hillside flange in deck for mounting filter (size & weight required)

Level indicator nozzles/couplings/openings - specify quantity and size

Complete fill pipe assembly (aluminum, stainless, carbon steel)

TC target box located in tank center dome

Deck manway access (20" snap lock) (20" combination manway ventilator) (20" combination manway PRV) (24" combination manway PRV)

Special hopper transition outlet - specify size

Spiral stairway access to top of tank (OSHA)

Maintenance platforms - specify size and location

Crossovers for access between tanks (OSHA) - specify span between tanks

6.0 INSTALLATION

6.1 Installation Process

6.1.1 Field erection of the bolted steel tank will be in strict accordance with manufacturer's procedures using factory trained and certified erectors.

6.1.2 Particular care will be taken to protect the baked-on powder coated panels from damage (i.e., scratches, abrasion) during field installation.

6.1.3 Tank to be constructed utilizing synchronized (hydraulic screw) jacking process, which keeps construction crews at grade level for safety and point access quality control.

6.1.4 Any coating damage will be repaired per manufacturer's recommendations.

6.2 Field Testing

6.2.1 Exterior water spray test to be conducted per manufacturer's procedure.

7.0 TANK MANUFACTURER'S WARRANTY

7.1.1 The tank manufacturer shall include a warranty on tank materials, coating system and field installation service. As a minimum, the warranty shall provide assurance against defects in material, coatings and workmanship for a period of one year.

7.1.2 Tank manufacturer shall provide a non-leak warranty on field installation service.