DRY BULK STORAGE TANK SPECIFICATION
PREMIER POWDER COATED BOLTED STEEL TANK

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. 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.

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

1.2 QUALIFICATIONS OF TANK SUPPLIER

A. 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.

B. 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.

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

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

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

F. 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.

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

1. Typical tank drawing(s).
2. List of tank materials, appurtenances and tank coating technical specifications.
3. Resume of job installation superintendent.
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.
5. Only bids from tank suppliers who have successfully pre-qualified will be considered.

1.3 SUBMITTAL DRAWINGS AND SPECIFICATIONS

A. 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.

B. 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.

C. 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.

PART 2 - DESIGN CRITERIA

2.1 TANK SIZE

A. 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

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

2.3 DESIGN PARAMETERS

A. Jobsite location: City_____ State_____ Zip Code_____
B. Material stored: _____
C. Loose density of product: _____ pounds per cubic foot
D. Maximum compacted product density: _____ pounds per cubic foot
E. Product angle of repose: _____ degrees
F. Required working capacity of each tank: _____ cubic feet or tonnage
G. Tank size - diameter x height
H. Configuration – (Specify skirt support design)(Drive-through skirt)(Tank elevated on structural steel)
I. Hopper slope: _____ specify degrees
J. Hopper outlet size: _____
K. Clearance from foundation to hopper discharge: _____
(Mass flow)(Funnel flow)(Fluidized) design loads: _____
L. Operating pressure and vacuum: _____ /_____ ounces/square inch
M. Dust collector and /or equipment load _____ pounds
N. Roof live load: _____ PSF
O. Seismic loads per IBC 2006/ASCE 7-05 (optional: IBC 2012/ASCE 7-10)
   a. Ss = _____, S1 =_____, Site Class D (_____), I = 1.0 (_____)
P. Wind loads per IBC 2006/ASCE 7-05 (optional: IBC 2012/ASCE 7-10)
   a. _____mph, Exposure C (_____), I = 1.0 (_____)

2.4 TANK DESIGN STANDARDS

A. 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.

B. Based on the International Building Code, when designing a tank, the load producing the higher stresses comparing wind and seismic will control the dynamic portion of design. A 1/3 allowable stress increase for structural shape stiffeners is not allowed.

C. 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.

D. Shell and Hopper Design

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. 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.
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.
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.
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.
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.
7. Shell design under vacuum is based on the critical buckling formula from the book *Structural Analysis of Shells*, by Baker, Kovalevsky & Rish.
8. Sidewall panels shall be RTP (rolled, tapered panel) design, utilizing lap joint panel connections. Formed flanged panels will not be allowed.
9. Tank shall be designed for (center fill) (off-center fill) (center discharge) (off-center discharge) of product.

10. Tank design pressure shall be 4.5 oz per square inch positive and .5 oz per square inch negative (designed tank for atmospheric pressure).
11. Tank design to be based on the maximum compacted density of the product
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".

PART 3 - MATERIALS SPECIFICATIONS

3.1 PLATES & SHEETS

A. Design requirements for steel shall be ASTM; A36, A1011 Gr40, A572 Gr50 and Gr60 and A656 Gr70 material.

3.2 ROLLED STRUCTURAL SHAPES

A. Material shall conform to minimum standards of ASTM; A36, A992, A500 GrB or A53 GrB material.

3.3 BOLT FASTNERS

A. Bolts used in tank lap joints shall be ½ - 13 UNC-2A rolled thread, and shall meet the minimum requirements of AISC.

B. Bolt Material

1. SAE J429 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.)
2. Anchor bolts conform to ASTM F1554-Gr36 and Gr105.

C. Bolt Finish – JS1000 electro-plated.

3.3 GASKET

A. 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.

PART 4 - FACTORY POWDER COAT PROCESS

4.1 CLEANING

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

1. Washing shall be with a suitable detergent using such concentrations as recommended for de-greasing steel. Water temperatures will be elevated to improve the effect of the cleaning process.

2. The pH level shall be monitored and maintained according to the range recommended for use by the manufacturer for the cleaning process.
3. Cleaning shall be in a two stage booth. A fresh water rinse shall be used in the second stage of the wash system.
4. All water shall be removed from sheets and tank components with forced air.

4.2 SURFACE PREPERATION

A. Sheets and tank components shall be blasted on both sides providing an SSPC SP10 (near white blast) surface profile.

4.3 POWDER COATING

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

DRY STORAGE	FUSION SYSTEM	DFT*	Range (min/max)
Interior Coating	FUSION 5000 FBE™	5 mils nominal DFT	4-6 mils avg. DFT
Ext. Primer	EXT FUSION 5000 FBE™	3 mils nominal DFT	3-5 mils avg. DFT
Ext. Topcoat:	EXT Fusion SDP™	3 mils nominal DFT	3-5 mils avg. DFT

*DFT – Nominal dry film thickness

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

A. Sheets and tank components shall then be heated in an oven to cause the powder to gel adequately to cross-link with top coat.
B. Visual inspection and dry film test shall be randomly performed before application of top coat.
C. 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)

A. SDP top coat shall be applied at 3 mils minimum DFT, with a min/max range from 3 to 5 mils avg.
B. The SDP top coat shall provide excellent gloss retention and UV resistance. Color is to be selected from chart consisting of seven standard colors.

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

4.6 FINAL CURING

A. Sheets and tank components then pass through the final cure oven. Oven settings will be based on the proprietary data provided by the coatings supplier. Oven temperatures vary depending on metal thickness.

4.7 INSPECTION

A. During final cool down, sheets shall be randomly inspected for cure, adhesion, coating thickness and holidays.
B. Cure shall be confirmed using random MEK rub tests.
C. Adhesion shall be confirmed using 100 squares test (ASTM Class 5B).
D. Coating thickness shall be confirmed using dry film thickness gage.

4.8 PACKAGING

A. After cool down and inspection, the sheets and tank components shall be unloaded and packaged for shipment.
B. 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.
C. Roof sheets and hopper or bottom sheets as well as other tank components shall be packaged to prevent damage and then wrapped and banded.

PART 5 - TANK STRUCTURE

5.1 SIDEWALL STRUCTURE

A. 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.
B. Vertical shell support stiffeners shall conform to minimum standards of ASTM A36 or A992.
C. 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

A. Epoxy powder-coated steel deck.
    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

A. Epoxy powder-coated steel hopper.

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

5.4 APPURTENANCES

A. Standard Tank Accessories

1. 3'x 6'8" walk-in door in skirt
2. 20" center roof dome with cover plate
3. Foundation anchor bolts
4. Hardware and gasket for assembly of tank
5. Outside tank ladder (OSHA) w/safety cage & step-off rest platforms-HDG finish
6. Deck manway access
7. Deck perimeter guardrail with toe board (OSHA) - HDG finish
8. Hopper manway access with bolt-on cover
9. Stub and flanged nozzles in deck, sidewall and hopper
10. Manufacturer's nameplate

B. Optional Tank Accessories

1. Product material testing to ensure reliable flow
2. Double door access in skirt - 6' (wide) x 6'8" (height)
3. 12' (wide) x 14' (height) truck drive-through openings in skirt
4. Hillside flange in deck for mounting filter (size & weight required)
5. Level indicator nozzles/couplings/openings - specify quantity and size
6. Complete fill pipe assembly (carbon, stainless steel)
7. TC target box located in tank center dome
8. Deck manway access (20" snap lock) (20" combination manway ventilator) (20" combination manway PRV) (24" combination manway PRV)
9. Special hopper transition outlet - specify size
10. Spiral stairway access to top of tank (OSHA)
11. Maintenance platforms - specify size and location
12. Crossovers for access between tanks (OSHA) - specify span between tanks

PART 6 – INSTALLATION

6.1 INSTALLATION PROCESS

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

B. Particular care will be taken to protect the baked-on powder coated panels from damage (i.e., scratches, abrasion) during field installation.
C. Tank to be constructed utilizing synchronized (hydraulic screw) jacking process, which keeps construction crews at grade level for safety and point access quality control.
D. Any coating damage will be repaired per manufacturer's recommendations.

6.2 FIELD TESTING

A. Exterior water spray test to be conducted per manufacturer's procedure.
B. Smoke testing may be conducted in lieu of exterior water spray test, when applicable.

PART 7 - TANK MANUFACTURER'S WARRANTY

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