FIRE PROTECTION

Specification For Thermoset Epoxy Powder Coated Bolted Steel Liquid Storage Tank

As Supplied by FORGE Global Industries, LLC

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PART 1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish and erect a thermoset epoxy powder coated bolted steel water storage tank and tank appurtenances as shown on the contact drawings and described herein.
B. All required labor, materials, and equipment shall be included.

1.02 QUALIFICATIONS OF TANK SUPPLIER

A. The selection of factory applied thermoset epoxy powder coated bolt together tank construction for this facility has been predicated upon specific criteria, construction methods, and superior coating for resistance to internal and external tank corrosion. Deviations from specified design, construction or coating details will not be permitted.
B. The bidder shall offer a new tank structure as supplied from a manufacturer specializing in the design, fabrication and erection of factory applied thermoset epoxy powder coated, bolt together systems. The manufacturer shall own and operate its steel fabrication and coating facilities.
C. FORGE Global Industries, LLC is a specialist in the design, fabrication, and erection of factory-coated bolted steel tanks.
D. Strict adherence to the standards of design; fabrication, erection, product quality, and long-term performance established in the Specification will be required by the Owner and Engineer.
E. Tank suppliers wishing to pre-qualify shall submit the following to the Engineer/Owner for consideration.

1.03 TYPICAL STRUCTURE DRAWING(S)

A. List of tank materials, appurtenances, and tank coating technical specifications.
B. The Installation contractor shall have a minimum of 5 years' experience and knowledge necessary to furnish and erect the highest quality tank possible. Under no circumstance shall an inexperienced contractor be awarded the project.

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1.04 DRAWINGS AND SPECIFICATIONS

A. Construction and erection of the tank shall be governed by the tank manufacturer prepared drawings and specifications as approved by the owner's engineer. There shall be no deviation from the original approved drawings and specifications. Any modifications to the original design must be submitted in writing to the tank manufacturer's engineer for review and approval and approved in writing by the client's engineer.
B. Final approved drawings and calculations shall be P.E. stamped by a licensed professional engineer or structural engineer licensed in the state of _____.

PART 2.00 - DESIGN CRITERIA

2.01 TANK SIZE

A. The factory thermoset epoxy powder coated bolt together tank shall have a nominal diameter of _____ feet with a nominal sidewall height (to roof eave) of _____ feet.

2.02 TANK CAPACITY AND ELEVATION

A. Tank capacity shall be _____ gallons (useable, U.S. gallons).
B. Freeboard space in the top of the tank shall be a minimum of _____ inches.
C. Roof snow load _____ psf.

2.03 TANK DESIGN STANDARDS

A. The material, design, fabrication, and erection of bolt together fire water tanks shall conform to the latest edition NFPA-22 Standards for Water Tanks for Private Fire Protection and the latest edition of AWWA Standard for "Factory-Coated Bolted Steel Tank for Water Storage" – AWWA D103.
B. The tank coating system shall conform solely to the requirements of the latest edition of AWWA D103.
C. The bolted tank design shall have lap joint connections on both vertical and horizontal shell seams.

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PART 3.00 - MATERIAL SPECIFICATIONS

3.01 PLATES AND SHEETS

A. Plates and sheets used in the construction of the tank shell, tank floor, and tank roof (when supplied), shall comply with the minimum standards of the latest edition of AWWA D103.
B. Design requirements for mild strength steel shall be ASTM 1011-36 or ASTM A570, Grade 50.
C. Design requirements for high strength steel shall be A656, Grade 60 or higher.

3.02 ROLLED STRUCTURAL SHAPES

A. Material shall conform to the minimum standards of ASTM A36, ASTM A572 or A992 as specified.

3.03 HORIZONTAL WIND STIFFENERS (IF DESIGN REQUIRES)

A. Intermediate horizontal wind stiffeners shall be of either horizontal plate or “web truss” design (with extended tail to create multiple layers of stiffener), permitting the wind loads to distribute around the tank.
B. If “web truss” stiffeners are specified, they shall be of steel with hot dipped galvanized coating.
C. Rolled steel angle stiffeners are not permitted for intermediate stiffeners.

3.04 BOLT FASTENERS

A. Bolts used in the tank lap joints shall be 1/2" – 13 UNC-2A rolled thread, and hall meet the minimum requirements of the latest edition of AWWA D103.
    1. Bolt Material:

SAE Grade 2 (1” bolt length)

i. Tensile strength – 74,000 psi Min.
ii. Proof load – 55,000 psi Min.

SAE Grade 5 / A325

i. Tensile strength – 120,000 psi Min.
ii. Proof load – 85,000 psi Min.

SAE Grade 8/ASTM A490 (> 1” bolt length) heat treated to

i. Tensile strength – 150,000 psi Min.

ii. Proof load – 120,000 psi Min.

2. Bolt Finish:

Zinc, mechanically deposited.

3. Bolt Head Encapsulation:

High impact polypropylene copolymer encapsulation of the entire bolt head up to the splines on the shank.
The bolt head encapsulation shall be certified to meet the NSF 61 Standard for indirect additives.
All bolts on the vertical tank wall shall be installed such that the head portion is located on the inside of the tank, and the washers/nuts are on the exterior of the tank.
Bolt lengths shall be sized to achieve 2 exposed threads after torquing. a neat and uniform appearance. Excessive threads extending beyond the nut after torquing will not be permitted.

3.05 SEALANTS AND GASKETS

A. The Sikaflex 201 or 1A sealant shall be used to seal lap joints and bolt connections and edge fillets for sheet notches and starter sheets. The sealant shall cure to a rubber-like consistency, have excellent adhesion to the thermoset epoxy powder coating, low shrinkage, and be suitable for interior and exterior use.
   1. Sikaflex 201 or 1A sealant curing rate at 73° F and 50% RH.
      a. Tack-free time: 6 to 8 hours.
      b. Final cure time: 10 to 12 days.
B. The bottom plate and bottom angle seams shall be coated with paint on sealer CIM 1000
C. For locations requiring gaskets (both linear and sheet) EPDM rubber material is to be used.
D. All bolted connections in bolted tanks may incorporate an EPDM prefabricated gasket minimum width 1 ¾". A single piece double-punched gasket shall be used at vertical seams which require two vertical rows of punching. Field caulking will be allowed when joining a discontinuous gasket section and at certain joint connections. Neoprene backed steel washers shall be provided at all bolts in contact with the stored liquid. For lap joint flat panel style bolted tanks, a one component, moisture cured, polyurethane compound sealant shall be used. The sealant shall be suitable for contact with potable water and shall be certified to meet ANSI/NSF Additives Standard 61 for indirect additives. The sealant shall be used to seal lap joints and bolt connections and edge fillets for sheet notches and starter sheets. The sealant shall cure to a rubber-like consistency, have excellent adhesion to the epoxy coating, low shrinkage, and be suitable for interior and exterior use.

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PART 4.00 - THERMOSET EPOXY POWDER COATING SPECIFICATION

4.01 CLEANING AND SURFACE PREPARATION

A. After fabrication and prior to application of the coating system, all sheets are to be thoroughly degreased, cleaned in a three (3) stage wash followed immediately by drying through a gas convection oven to prevent flash rusting.
B. Sheet and Parts shall be steel grit-blasted on all sides to the equivalent of SSPC-SP10 (near white metal). Sand blasting and chemical pickling of steel sheets is not acceptable.
C. The surface anchor pattern shall not be less than 1.0 mil.
D. Three stage wash: Cal Clean Wash, Rinse, and Zirconium.

4.02 COATING

A. No shaping, bending, punching, flanging, or grinding may be done on the steel after blasting and before coating. Field coating is to be limited to minor touch ups only.
~~B.~~ Coating shall be in accordance with the latest edition of AWWA D103.
C. Interior coating shall be ForgeShield Epoxy applied 7 mils average dry film thickness (DFT).
D. Exterior coating system shall be as follows:
   1. Primer – One coat ForgeShield Epoxy applied to 5 mils average DFT.
   2. Topcoat – One coat Super Polyester TGIC applied to 3 mils average DFT.
   3. The same thermoset epoxy powder coating as applied to the sheet surfaces shall be applied to the exposed edges and bolt holes.

4.03 FACTORY INSPECTION

A. Coated sheets shall be inspected for mil thickness (Mikrotest or equal).
B. An electrical leak detection test shall be performed on the inside surface after fabrication of the sheet. Sheets with excessive electrical leakers shall be rejected to minimize field touch up.

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PART 5.00 – ERECTION

5.01 FOUNDATION

A. The tank foundation shall be designed to safely sustain the structure and its live loads.
B. Tolerances on concrete foundations (Ringwalls and slabs) shall be level within ±1/8 in. (±3 mm) in any 30-ft (9-m) circumference under the shell. The levelness on the circumference shall not vary by more than ±1/4 in. (±6 mm) from an established plane.
C. The proper design and installation of foundations for tanks are extremely important to ensure uniform and minimum unequal / differential settlement.

5.02 TANK FLOOR

A. Steel Floor
    1. The floor is to be a thermoset epoxy coated bolted steel floor. Bolted steel panels shall be placed over a compacted gravel/sand base contained by a steel or concrete ringwall, or concrete slab, with a non-extruding and resilient bituminous type filler meeting the requirements of ASTM D1751 placed between the tank floor and gravel/sand base to function as a cushion.
B. Concrete Floor
    1. The floor design is of reinforced concrete with an embedded thermoset epoxy powder coated steel starter sheet per the manufacturer's design and IAW AWWA D103, Section 13.4, Type 6.
        a. Leveling of the starter ring shall be required and the maximum differential elevation with the ring shall not exceed one-eighth (1/8) inch, nor exceed one-sixteenth (1/16) inch within any ten (10) feet of length.
        b. A leveling plate assembly shall be used to secure the starter ring, prior to encasement in concrete. Installation of starter rings on concrete blocks or bricks, using shims for adjustment, is not permitted.
        c. Place a butyl rubber elastomer waterstop seal on the inside surface of the starter ring below concrete floor line. Place one bentonite impregnated water seal below the butyl rubber seal. Install materials in accordance with the tank manufacturer's instructions.

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5.03 SIDEWALL STRUCTURE

A. Field erection of the thermoset epoxy powder coated bolted steel tank shall be in strict accordance with the procedures outlined by the manufacturer. The installation will be by the tank manufacturer using trained or certified personnel. Or an authorized erector of the tank manufacturer who regularly is engaged in erection of these bolted tanks.
B. Specialized erection jacks and building equipment developed and manufactured by the tank manufacturer shall be used to erect the tank(s).
C. Particular care shall be taken in handling and bolting the tank panels and members to avoid abrasion of the coating system. Prior to a liquid test, the Engineer shall visually inspect all surface areas.
D. The placement of sealant on each panel may be inspected prior to placement of adjacent panels. However, the Engineer's inspection shall not relieve the bidder from their responsibility of liquid tightness.
E. No backfill shall be placed against the tank sidewall without prior written approval and design review of the tank manufacturer. Any backfill shall be placed according to the strict instructions of the tank manufacturer.

5.04 TANK ROOF

A. Steel Roof
    1. Tank shall include a roof fabricated from thermoset epoxy powder coated, bolted steel panels, as produced by the tank manufacturer. The roof shall be assembled in a similar manner to the sidewall panels utilizing the same sealant and bolting techniques, to assure a weather/airtight assembly. The roof shall be clear-span and self-supporting or center supported. Both live and dead loads shall be carried by the tank walls and any center supports. The manufacturer shall furnish a roof opening which shall be placed near the outside tank ladder. The opening shall have a clear dimension of at least twenty-four (24) inches in one direction and fifteen (15) inches in the other direction. The opening shall have a curb at least four (4) inches in height, and the cover shall have a downward overlap of at least two (2) inches, or a gasketed weather-tight cover in lieu of the four (4) inch curb and two (2) inch overlap.
B. Roof Vent
    1. A properly sized vent assembly in accordance with the latest edition of AWWA D103, or latest edition, shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum design rate of water fill or withdrawal, the resulting interior

pressure or vacuum will not exceed 0.5" water column. If the tank is located in an area where heavy frost is common during the winter months a frost-free vent would be required.

5.05 APPURTENANCES

A. Pipe Connections
   1. Where pipe connections are shown to pass through tank panels, they shall be field located, saw cut, (acetylene torch cutting or welding is not permitted), and utilize an interior and exterior flange assembly and the tank shell reinforcing shall comply with the latest edition of AWWA D103. A single component urethane sealer shall be applied on any cut panel edges or bolt connections.
   2. Overflow piping shall be _____ inches in diameter, non-coated sch. 80 pvc, non-coated seamless aluminum tubing, or epoxy coated sch. 10 carbon steel and shall be one pipe size larger than the inlet. A 90-degree internal weir elbow with external downcomer pipe and flap valve shall be provided for the overflow. The overflow pipe shall not be considered a tank vent.
   3. Inlet connection shall be _____ inches in diameter, with external 150# rfso flange nozzle conforming to the location specified on the plan sheet.
   4. Suction (outlet) connection shall be _____ inches in diameter, with external 150# flat faced flange nozzle & internal 90-degree elbow with vortex breaker.

A. Outside Tank Ladder
   1. An outside ladder shall be furnished and installed as shown on contact drawings.
   2. Ladders shall be fabricated of steel and utilize skid-resistant rungs. Finish shall be epoxy coated safety yellow or hot dipped galvanized.
   3. Ladders shall be equipped with a fall protection system when height exceeds twenty (20) feet. No safety cage or step-off platform is required per OSHA.

B. Access Doors
   1. A minimum of two (2) openings shall be provided in the first ring of the steel suction tank shall be provided as shown on the contract drawings in accordance with the latest edition of NFPA-22. These may be either flush clean out or round manway style.
   2. The manhole opening shall be a minimum of twenty-four (24) inches in diameter. The access door (shell manhole) and the tank shell reinforcing shall comply with the latest edition of AWWA D103.

C. Roof Hatch
   1. The manufacturer shall furnish one roof opening, placed near the exterior ladder. The roof opening shall be provided with a hinged cover and hasp for locking and shall have a clear dimension of at least twenty-four (24) inches square. The opening shall have a curb, at least

four (4) inches in height and the cover shall have a downward overlap of at least two (2) inches.

D. Roof Guardrails
   1. Provide roof guardrail system in accordance with latest editions of NFPA-22 and AWWA D103. All guardrail dimensions and features must be compliant with federal and state safety laws.
E. Liquid Level Indicator
   1. A liquid level indicator with stainless steel float, number board, and high visibility target shall be provided and installed as detailed on the plan sheet.
F. Sensors
   1. High and low water level sensors are to be provided to monitor the high and low water levels in the tank as shown on the plan sheet. Provide Potter WLS or equal.
   2. A temperature switch is to be provided to monitor the temperature in the tank. Provide Potter TTS or equal.
G. Identification Plate
   1. A manufacturer's nameplate shall list the tank serial number, tank diameter and height, and maximum design capacity. The nameplate shall be affixed to the tank exterior sidewall at a location approximately five (5) feet from grade elevation in a position of unobstructed view.

5.06 FREEZE PROTECTION

A. Insulation system
   1. Insulation will consist of foil-faced polyisocyanurate foam with a thickness of two (2) inches providing an R-value of twelve (12) or greater.
B. Heater(s)
   1. Provide immersion heater(s) or equal to help maintain forty-two (42) degrees or better year around to go in conjunction with the insulation.

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PART 6.00 - FIELD TESTING

6.01 TESTING

A. Following completion of erection and cleaning of the tank, the structure shall be tested for liquid tightness by filling the tank to its overflow elevation. The tank shall be filled at the rate suggested in FORGE's Hydrotesting Manual provided with final drawings.
B. The erector, in accordance with the manufacturer's recommendation, shall correct any leaks disclosed by this test.
C. The owner shall furnish the water required for testing at the time of tank completion, and at no charge to the contractor. Disposal of the test shall be the responsibility of the owner.

PART 7.00 TANK MANUFACTURER'S WARRANTY

7.01 GENERAL

A. The tank manufacturer shall warrant the liquid storage tank shall be free from any defect in material or workmanship, under normal and proper use, maintenance and operation, during the period expiring on the earlier of 12 months after liquid is first introduced into the tank or 15 months after the shipment from the factory.