



## SPECIFICATION FOR GLASS-FUSED-TO-STEEL BOLTED STORAGE TANKS

### PART 1 – GENERAL

#### 1.1 DESCRIPTION

- A. CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required to design, fabricate, deliver, erect, and test tank constructed of factory prefabricated glass-coated, bolt-together steel panels. Each tank structure shall include a foundation and other accessory components as shown on the Contract Drawings and described herein.
- B. All required tank materials and principal appurtenances shall be supplied by the tank manufacturer.
- C. Installation shall be executed by a qualified and experienced erection crew, trained and certified by the tank manufacturer.
- D. Tank structures and appurtenances shall be new and not previously used.

#### 1.2 QUALITY ASSURANCE

- A. The Supplier shall offer a factory applied glass coated bolt together shop pre-fabricated sectional steel tank.
- B. The Supplier will offer a new tank structure as a manufacturer specializing in the design, fabrication and erection of factory applied glass coated, bolted tank systems. Structural design shall meet or exceed the latest AWWA Standard for Bolted Steel Tanks (AWWA D103) unless otherwise specified herein.
- C. Design and Fabrication Criteria:
  - 1. Except as otherwise shown or specified, all materials, joints, workmanship and all other aspects of the tank and fabrication shall meet or exceed ANSI/AWWA D103, hereinafter AWWA D103. The tank structural design shall conform to AWWA specifications.
  - 2. Tanks with roofs shall be designed for roof live loads and roof dead loads.
  - 3. The ground snow load shall be \_\_\_\_ pounds per square foot.

- a. Snow Load Importance Factor: \_\_\_\_ (Is)
  - b. Thermal Factor: \_\_\_\_ (Ct)
  - c. Snow Exposure Factor: \_\_\_\_ (Ce)
4. Tank shall be designed for a basic wind speed of \_\_\_\_ miles per hour.
5. Tank shall be designed for the following seismic conditions:
- a. Map Spectral Response:
    - i.  $S_s =$  \_\_\_\_\_
    - ii.  $S_1 =$  \_\_\_\_\_
  - b. Seismic Use Group = \_\_\_\_
  - c. Site Class = \_\_\_\_
6. Tank foundation shall be designed with an allowance soil bear capacity of \_\_\_\_\_ psf.
7. Specific Gravity of stored media: \_\_\_\_\_.

**1.3 SUBMITTALS**

**A. Action Submittals:**

- 1. Submit for approval the following:
  - a. Copies of detailed tank drawings. Drawings shall include all dimensions, sizes, plate thicknesses, anchorage, nozzle details, and details of all required accessories.
  - b. Fabrication shall not be started until submitted drawings are approved.

**B. Informational Submittals: Submit the following:**

- 1. Manufacturer’s Design Calculations.

Structural calculations shall be submitted for tank structures and foundations. The calculations shall be reviewed and the submittals sealed by a Professional Engineer licensed and registered in the state of \_\_\_\_\_.

- C. Warranty:
1. If within a period of one (1) year from date of completion (or 14 months after delivery), the tank structure or any part thereof shall prove to be defective in material or workmanship upon examination by the manufacturer, the manufacturer will supply a replacement part, will repair, or allow a credit for same.
- D. The tank manufacturer shall provide a standard Maintenance Manual upon approval of the drawings and completion of the tank installation.

## **PART 2 – PRODUCTS**

### **2.1 GENERAL**

- A. Tanks shall be manufactured by the following manufacturer:
1. United Industries Group, Inc.
  2. Pre-approved equal

### **2.2 TANK**

- A. Tank Size:
1. Nominal Diameter: \_\_\_\_\_ feet.
  2. Max. Nominal Tank Sidewall Height: \_\_\_\_\_ feet.
  3. Design Freeboard: \_\_\_\_\_ inches.
  4. Min. Nominal Tank Capacity: \_\_\_\_\_ gallons.
  5. Number of Tanks: \_\_\_\_\_.
- B. Plates and Sheets:
1. Plates and sheets used in the construction of the tank shell, tank floor (if required) and tank roof (if required) shall meet or exceed structural requirements of the standards of AWWA D103, latest edition.
  2. Design requirements for Mild Carbon Cold Rolled steel up to 1/8" shall be minimum ASTM A36 or equal S235 with the following min. mechanical properties:
    - Minimum tensile strength: 300MPa = 43.5 KSI
    - Minimum yield strength: 240MPa = 34.8 KSI

Design requirements for High Strength Hot Rolled steel over 1/8" shall be minimum ASTM A572 Grade 60, 65 or equal S380 CCE\* specifically prepared and approved by a steel mill for the enameling process with the following min. mechanical properties:

- Minimum tensile strength: 600MPa = 87 KSI
- Minimum yield strength: 420MPa = 60.9 KSI

*Note\*: CCE stands for Continuous Casted & Enamel Capable (Special Quality) This special steel is required in order to overcome "Fish Scale Effect" and enamel coating bubble defects caused by high carbon and high hydrogen content in inferior carbon steel grades.*

3. Inferior steel grades shall not be used.
4. Steel plates shall be mechanically rolled in factory to the required tank radius utilizing rolling machines.
5. All steel plate edges including all tank openings and bolt holes shall be mechanically beveled, squared and/or rounded prior to application of enamel glass coating system.
6. When Rolled Structural Shapes are used, the design and engineering shall conform to minimum standards of AWWA D-103.

C. Horizontal Wind Girders/Stiffeners:

1. Horizontal wind girder shall be utilized on all open top tanks and in high wind speed zones. The number and size of wind girders shall be determined by the design calculations. Multiple wind girders shall be utilized as determined by the calculations permitting wind loads to distribute uniformly around the tank.
2. Wind girder shall be fabricated of steel with hot dipped galvanized coating

D. Bolt Fasteners:

1. All lap joint bolts shall be without fins. "Fin neck" bolts with splines on the underside of the bolt head at the shank shall not be permitted due to their damaging effect on the glass coating.
2. The bolt finish shall be Zinc, mechanically deposited or JS500 plating system.
3. The entire bolt head shall be encapsulated up to the splines on the shank with high impact polypropylene co-polymer (if required).
4. Tank sidewall bolts shall be installed such that the head portion is located inside of the tank, and the washer and nut are located on the exterior.

5. All lap joint bolts shall be properly selected such that threaded portions will not be exposed in the "shear plane" between the sheets. Also, bolt lengths shall be sized as to achieve a neat and uniform appearance.
6. Excessive threads extending beyond the nut will not be permitted.
7. All lap joint bolts shall include a preventative measure at the underside of the bolt head such as neoprene rubber or EPDM in order to resist rotation during tightening.
8. Where appropriate and when recommended by the manufacturer, such as corrosive chemical or de-mineralized water applications, stainless steel bolts should be used.

E. Sealants:

1. The lap joint sealant shall be a one component, moisture cured, polyurethane based elastic sealant. For potable water storage tanks the sealant shall be suitable for contact with potable water and shall be approved by the manufacturer and certified for this use (NSF61 or BS 6920), as an indirect additive: such as Manus Bond 75AM or Sikaflex.

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 glass coating, low shrinkage, and be suitable for interior and exterior use. Neoprene gaskets and tape type sealer shall not be used.

F. Powder Glass Coating:

1. The glass coating system shall meet or exceed the requirements of AWWA D103 Latest revision.
2. Surface Preparation and Cleaning:
  - a. After fabrication and prior to application of the coating system, all sheets/plates shall be thoroughly brushed and cleaned on both sides of all oils and lubricants. The importance of using special steel specifically prepared for the enameling process, containing micro-voids specifically developed for trapping hydrogen during the cooling process after firing, eliminates the necessity of a toxic Nickel Oxide primer.
  - b. Special Quality steel shall be used in combination with powder enamel coating, not liquid, to additionally eliminate shop sandblasting or chemical pickling in order to achieve a roughened surface profile.
3. Coating Application:
  - a. No shaping, bending, punching, flanging, or grinding is done on the steel after brushing and before coating. Field coating is not carried out. All

openings are shop located and cut in factory prior to glass coating application.

- b. Only powder glass coating shall be applied on all exposed edges. Application of stainless steel on any edge is not permitted due to chemical reaction that will promote corrosion on contact with two dissimilar metals.
- c. No catalytic Nickel Oxide coating shall be applied as Nickel is a toxic chemical which is prohibited by environmental and health agencies for the use on material that may come into contact with any stored media, particularly potable water.
- d. An electrostatic enamel process consisting of a 2-coat Powder Enamel Coating System, 2-coats and 2-burns of powder enamel, fired at temperature of 1580° F in strict accordance with the ISO 9001 quality control procedures, including firing time, furnace humidity and temperature control requirements shall be used.
- e. Interior and Exterior surfaces shall be glass lined with the same quality enamel material and shall be of the same thickness and color.
- f. The dry film thickness of the interior and exterior coating should be minimum 7.0 mils and should not exceed 14.0 mils. In no case dry film thickness (DFT) shall ever exceed 20mils (500 microns). All plates with DFT over 20mils shall be rejected.

*Note: If the enamel is very thick, over 14.0 mils, it has a higher probability to crack by time due to the different coefficient of thermal expansion of steel and glass. The target for a high quality Glass-Fused plate is a thin glass layer that is fused into the steel uniformly with no pinholes.*

4. Inspection:

Visible inspection as well as Holiday Detection Test shall be performed on both sides of the glass coated plates. If any pinholes are found they shall be repaired i.e. coated second time and Holiday Detection Test shall be performed again on the entire panel. If upon completion of Holiday repairs any pinholes are found at least on one side, the entire plate shall be rejected and substituted with the one that has passed the Holiday Testing.

- a. All coated sheets shall be inspected for mil thickness (Mikrotest or equal).
- b. An electrical leak detection test shall be performed on the inside surface of each panel after fabrication. Every sheet shall be 100% tested for holidays and any sheet with a discontinuity shall be rejected.

G. Floors:

1. Tank floor shall be reinforced concrete with an embedded glass coated first ring installed per the manufacturer's design.
2. Tank footing design shall be based on the maximum allowable soil bearing capacity as determined by geotechnical analysis performed by a licensed geotechnical engineer. The cost of this investigation and analysis shall not be included in the bid price. Copies of the soil report shall be provided to the bidder prior to bid date by the Owner or Project Engineer.

H. Roofs:

1. General:

- a. Tank roofs shall be furnished by the tank manufacturer.
- b. Roofs shall be clear span and self-supporting. Center post supports are not permitted.
- c. Roof live loads and dead loads shall be carried by tank sidewalls, without additional support.

2. Aluminum Dome Roof:

- a. Aluminum dome roofs shall be constructed of non-corrugated, triangular aluminum panels, which are sealed and firmly clamped in an interlocking manner within a fully triangulated aluminum space truss system.
- b. The dome shall be clear span and designed to be self-supporting from the periphery structure with primary horizontal thrust contained by an integral tension ring. The dome dead weight shall not exceed 3 pounds per square foot of surface area.
- c. The dome and tank will be designed to act as an integral unit. The tank will be designed to support an aluminum dome roof including all specified live loads.
- d. Roof Vent - A properly sized atmospheric vent assembly in accordance with AWWA D103-09 shall be furnished and installed on the roof. The overflow pipe shall not be considered as a tank vent. The vent will be so designed in construction as to prevent the entrance of birds and/or animals by including an expanded aluminum screen.

3. Glass Lined Carbon Steel Roof:

- a. A Glass Coated Carbon Steel Roof can be provided for tanks up-to 59' in diameter.
- b. The roof will be self-supporting glass lined CS with external rafters.

- c. The roof shall be assembled in a similar manner as tank sidewall panels utilizing the same sealant and bolting techniques to assure a weather/air or optionally gas tight assembly up to 30mbar (0.45PSI) design/test pressure.
- d. The manufacturer will furnish a roof opening, placed near the outside tank ladder and which will be provided with a hinged cover and a hasp for locking.

## 2.3 TANK ACCESSORIES

- A. Level Indicator:
  - 1. Manufacturer shall supply and install visual liquid level indicator on the side of the tank.
- B. Pipe Connections:
  - 1. Where pipe connections are shown to pass through tank panels, they shall be factory located and cut at factory prior to the application of the glass coating system.
  - 2. The manufacturer shall utilize an interior and/or exterior flange assembly and the tank shell reinforcing as required by the project engineer and owner's requirements.
  - 3. A single component urethane sealer shall be applied on any cut panel penetrations or bolt connections.
- C. Access Door/Manway:
  - 1. Tank shall be provided with min. one (1) 24-inch diameter manway in first (bottom) ring as shown on Contract Drawings or as per AWWA D103.
- D. Identification Plate:
  - 1. A manufacturer's nameplate shall list the tank serial number, tank diameter and height, maximum design capacity, intended storage use, and date of installation. The nameplate shall be affixed to the tank exterior sidewall at a location approximately 5' from grade elevation in a position of unobstructed view.
- E. Cathodic Protection System:
  - 1. The manufacturer shall design and supply a passive, cathodic protection system if required.
- F. External Overflow Weir and Pipe:



1. Overflow pipe shall be determined by the manufacturer or specified by the Engineer and shall be composed of galvanized CS sch 40 pipe or equal PVC pipe or CS epoxy coated sch 40 pipe.
- G. Roof Access Hatch:
1. Provide min. One (1) 24-inch x 24-inch access hatch.
- H. Ladders:
1. An exterior vertical caged tank ladder shall be furnished and installed as shown on the contract drawings.
  2. Ladders shall be fabricated of carbon steel. Finish shall be hot dipped galvanized or epoxy coating. EPDM protective pads should be used when ladders, stairways or other attachments are required, to protect the tank walls from damage.
  3. Safety cage and step-off platform shall be constructed of galvanized steel. A locking cage gate shall be attached to the bottom of the safety cage.

## **2.4 TANK PACKAGING**

- A. All sheets that pass Factory Inspection and Quality Control checks shall be protected from damage prior to packing for shipment.
- B. Suitable non-abrasive packaging sheets shall be placed between each panel to eliminate sheet-to-sheet abrasion during shipment.
- C. Individual stacks of panels will be wrapped in heavy mil black plastic and steel banded to special wood pallets built to the roll-radius of the tank panels. This procedure minimizes contact or movement of finished panels during shipment.

## **PART 3 – EXECUTION**

### **3.1 ERECTION**

- A. Except as otherwise shown or specified, Tank shall be erected in accordance with the requirements of AWWA Standard D103 latest edition and manufacturer's recommendations and instructions.
- B. Supervisory personnel of the erection crew shall identify themselves to responsible personnel of the Engineer or Inspector upon initially entering the job site.
- C. Tank Foundation:
  1. The tank foundation shall be designed by a certified PE to safely sustain the structure and its live loads.

2. Place a water-stop seal on the inside surface of the starter ring below concrete floor line. Sika-Swell Sealant bead approximately 6" below top of concrete on the internal and/or external surface of the starter ring could be utilized as a water stop. Install materials in accordance with tank manufacturer's instructions as shown on the foundation plans.
3. Tank footing design shall be based on the soil bearing capacity given by the engineer.

D. Tank Structure:

1. Field erection of the glass-coated, bolted-steel structures and components shall be in strict accordance with the procedures established by manufacturer and performed by the manufacturer or an authorized dealer of the tank manufacturer regularly engaged in erection of these tanks.
2. Specialized erection jacks, and other building equipment developed and supplied by the tank manufacturer may be used to erect the tanks as well as scaffolding, ladders, crane, scissor lift and/or others depending on application and location of tank.
3. Particular care shall be taken in handling and bolting of the glass coated steel tank panels, appurtenances and members to avoid abrasion of the coating system. Prior to liquid test, all surface areas shall be visually inspected. Chips or scrapes in the glass coating shall be repaired per the tank manufacturer's recommended procedure.
4. The placement of the sealant on each panel may be inspected prior to placement of adjacent panels. However, the inspection shall not relieve any responsibility for liquid tightness.
5. No backfill is to be placed against the tank sidewall without prior written approval of the tank manufacturer. Any backfill allowed shall be placed strictly in accordance with the instructions of the tank manufacturer.

### 3.2 FIELD TESTING

- A. Following completion of erection and cleaning of the tank, the structure shall be tested for liquid tightness by filling to its overflow elevation.
- B. The erector in accordance with the manufacture's recommendations shall correct any leaks disclosed by this test.
- C. The owner shall furnish water required for testing at the time of tank erection completion, and at no charge to the manufacturer or the appointed tank erector. Disposal of test water shall be the responsibility of the owner.

- D. Upon request labor, water and equipment necessary for hydrostatic tank testing shall be included in the contract price of the tank as optional.

### **3.3 - DISINFECTION**

- A. If required, the tank structure shall be disinfected at the time of testing by chlorination in accordance with AWWA Standard C652 "Disinfection of Water Storage Facilities" or as modified by the manufacturer or the appointed erector.
- B. Disinfection shall not take place until tank sealant is fully cured.
- C. Acceptable forms of chlorine for disinfection shall be:
  - 1. Liquid chlorine as specified in AWWA C652. (Section 4.2.1).
  - 2. Sodium hypochlorite as specified in AWWA C652. (Section 4.2.2).
  - 3. Calcium hypochlorite (HTH) is not acceptable.
- D. Acceptable methods of chlorination per AWWA C652:
  - 1. Section 4.3.1.
  - 2. Section 4.3.1.2 – chemical feed pump only (4.3.1.2).
  - 3. Section 4.3.3.
  - 4. Section 4.3.1.3 is not acceptable

**END OF SECTION**