SPECIFICATIONS

Glass-Coated, Bolted-Steel Potable Water Tank

AWWA Design

1.0 GENERAL

1.1 Scope of Work

1.1.1 Furnish and erect a glass-coated, bolted-steel water storage tank, including foundation, tank structure 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 factory applied glass- fused-to-steel bolt together tank construction for this facility has been predicated upon the design criteria, construction methods specified, and optimum coating for resistance to internal and external tank surface corrosion. Deviations from the specified design, construction or coating details, will not be permitted.

1.2.2 The bidder shall offer a new tank structure as supplied from a **U.S.A.** manufacturer specializing in the design, fabrication and erection of factory applied glass-fused-to-steel, bolt together tank systems. The manufacturer shall own and operate its production plant, fabricate and glass coat the tank at one U.S.A. location.

1.2.3 The tank shown on the contract drawings and specified herein is a Model _2528_ Aquastore Tank System as manufactured by CST Storage Company of DeKalb, Illinois.

1.2.4 Alternate glass-fused-to-steel tank products, as provided by other manufacturers, will be considered for prior approval by the Engineer. Manufacturers lacking the experience requirement will not be considered. The Owner's decision or judgment on these matters will be final, conclusive and binding.

1.2.5 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.

1.2.5.1 Tank or Dome substitutions which cause engineering and contract changes - the tank installation as shown on the plans and specified herein, is based on the equipment furnished by one manufacturer. A tank which is offered as a substitute to the specific requirements of these Specifications and which differs in detail and arrangement from that shown may require changes in design and construction. All costs which result from such changes in design and construction are to be borne entirely and unconditionally by the Contractor; said costs to include, but not be limited to structural, piping, mechanical and electrical changes and all engineering costs incurred as a result of the substitution, in the revision of Plans and Specifications, review of design changes by others, preparation of change orders, and any other costs directly resulting from said substitution.

1.2.6 Tank suppliers wishing to pre-qualify shall submit the following to the Engineer/Owner for consideration 14 days prior to bid date.

1.2.6.1 Typical structure and foundation drawing(s).

1.2.6.2 List of tank materials, appurtenances and tank coating specs.

1.2.6.3 List of five (5) tanks presently in **U.S.A.** potable water service, of size and character specified herein, operating satisfactorily for a minimum of five (5) years, including the name and telephone number of Owner and Engineer. The tanks listed shall have been manufactured in the present production facility; not by a predecessor company in a different facility.

1.2.6.4 Certification from tank manufacturer that the tank meets all of tank design standards listed in Section 2.0.

1.2.7 Only bids from **U.S.A.** manufactured tank suppliers who have successfully pre-qualified will be considered.

1.2.8 The Engineer reserves the right to evaluate all bids based on long term, 30 year minimum operation, coating and maintenance costs. Values to be used in this evaluation will be at the discretion of the Engineer, as detailed in this specification and bid tabulation form. The Engineer will add such costs, dependent upon the type of tank offered, to the bidder's bid price to determine the effective low bid for purposes of making the award.

1.3 Submittal Drawings and Specifications

1.3.1 Construction shall be governed by the Owner's drawings and specifications showing general dimensions and construction details, after written approval by the Engineer of detailed erection drawings prepared by the tank bidder. 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, _6_ 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 structure and foundation. All such submissions shall be stamped by a Registered Professional Engineer licensed in the state of project location, as well as, by a Registered Professional Engineer employed on the tank manufacturer's engineering staff.

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 for the work detailed thereon. The approval by the Engineer of the tank supplier's drawings shall be an approval relating only to their general conformity with the bidding drawings and specifications and shall not guarantee detail dimensions and quantities, which remains the bidder's responsibility.

1.3.4 The tank manufacturer's and installing contractor's standard published warranty shall be included with submittal information.

2.0 DESIGN CRITERIA

2.1 Tank Size

2.1.1 The factory coated glass-fused-to-steel, bolt together tank shall have a nominal diameter of __25__ feet, with a nominal sidewall height (to roof eave) of _28_ feet.

2.2 Tank Capacity

2.2.1 Tank capacity shall be __105,000__ gallons (nominal, U.S. gallons).

2.3 Floor Elevation

2.3.1 Finished floor elevation shall be set at Elevation _____.

2.4 Tank Design Standards

2.4.1 The materials, design, fabrication and erection of the bolt together tank shall conform to the AWWA Standard for "Factory Coated Bolted Steel Tanks For Water Storage" - ANSI/AWWA D103, latest revision.

2.4.2 The tank coating system shall conform solely to Section 10.4 of ANSI/AWWA D103. **NOTE:** Baked-on epoxy painted, stainless steel or galvanized bolt-together tanks are not considered equal.

2.4.3 The vitreous coating on the tank, bolt head encapsulation material, and joint sealant shall have been approved for listing under ANSI/NSF Standard 61 for Indirect Additives.

5.5.2 The tank manufacturer shall be ISO-9001 certified to assure product quality.

2.4.5 The tank manufacturer shall undergo an annual **FM** (Factory Mutual) inspection of their glass-coated, bolted-steel tank factory and provide written proof thereof to assure product quality.

2.5 Design Loads (Complete the blanks)

2.5.1 Specific Gravity _1.05__(Min. design shall be 1.0)

2.5.2 Wind Velocity __100___mph (AWWA D103 Std. 100 mph)

2.5.3 Shape Factor __.6_ (0.6 Std.)

2.5.4 Allowable Soil _3,000_psf (Per Eng.'s Bearing Capacity Soils Report)

2.5.5 Roof Snow Load _25_psf

2.5.6 Seismic per AWWA D103-97 Zone _2A_ Pseudo Dynamic.

3.0 MATERIALS SPECIFICATIONS

3.1 Plates and Sheets **Note**: all steel shall be smelted and produced in the U.S.A.

3.1.1 Plates and sheets used in the construction of the tank shell, tank floor (optional) or tank roof (optional), shall comply with the minimum standards of AWWA D103, Section 2.4.

3.1.2 Design requirements for mild strength steel shall be ASTM A570 Grade 30 with a maximum allowable tensile stress of 15,000 psi.

3.1.3 Design requirements for high strength steel shall be ASTM A607 Grade 50 with a maximum allowable tensile stress of 26,000 psi.

3.1.4 The annealing effect created from the glass coated firing process shall be considered in determining ultimate steel strength. In no event shall a yield strength greater than 50,000 psi be utilized for calculations detailed in AWWA D103, Sections 3.4 and 3.5.

3.1.5 Multiple vertical bolt line sheets and plates of ASTM A607 Grade 50 only shall be manufactured such that holes are staggered in the vertical bolt lines and that no two adjoining holes are in-line horizontally, except at the center of the sheet or plate.

1. Bolt seam design shall generally be in accordance with the requirements of AWWA D103 section 3.5.2; bolt spacing may be adjusted in the vertical bolt lines to increase the net section and improve joint efficiency to a maximum of 85%.
2. Double steel sheeting shall not be permitted to achieve structural requirements.

3.2 Rolled Structural Shapes

3.2.1 Material shall conform to minimum standards of ASTM A36 or AISI 1010.

3.3 Horizontal Wind Stiffeners

3.3.1 Design requirements for intermediate horizontal wind stiffeners shall be of the "web truss" design with extended tail to create multiple layers of stiffener, permitting wind load to transfer around tank.

3.3.2 Web truss stiffeners shall be of steel with hot dipped galvanized coating.

3.3.3 Rolled steel angle stiffeners are not permitted for intermediate stiffeners.

3.4 Bolt Fasteners

3.4.1 Bolts used in tank lap joints shall be 1/2" - 13 UNC- 2A rolled thread, and shall meet the minimum requirements of AWWA D103, Section 2.2.

3.4.2 Bolt Material

3.4.2.1 SAE Grade 2

3.4.2.1.1 Tensile Strength - 74,000 psi Min.

3.4.2.1.2 Proof Load - 55,000 psi Min.

3.4.2.1.3 Allowable shear stress - 18,164 psi (AWWA D103).

3.4.2.2 SAE grade 8/ASTM A325 heat treated to:

3.4.2.2.1 Tensile Strength - 150,000 psi Min.

3.4.2.2.2 Proof Load - 120,000 psi Min.

3.4.2.2.3 Allowable shear stress - 36,818 psi (AWWA D103).

3.4.3 Bolt Finish - Zinc, mechanically deposited.

3.4.3.1 2.0 mils minimum - under bolt head, on shank and threads

3.4.4 Bolt Head Encapsulation

3.4.4.1 High impact polypropylene co-polymer encapsulation of entire bolt head up to the splines on the shank.

3.4.4.2 Natural resin with UV (ultraviolet) light inhibitor. Color to be black.

3.4.5 All tank shell bolts shall be installed such that the head portion is located inside the tank, and the washer and nut are on the exterior.

3.4.6 All lap joint bolts shall be properly selected such that threaded portions will not be exposed in the "shear plane" between tank sheets. Also, bolt lengths shall be sized as to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after torquing will not be permitted.

3.4.7 All lap joint bolts shall include a minimum of four (4) splines on the underside of the bolt head at the shank in order to resist rotation during torquing.

3.5 Sealants

3.5.1 The lap joint sealant shall be a one component, moisture cured, polyurethane compound. The sealant shall be suitable for contact with potable water and meet applicable FDA Title 21 regulations, as well as, ANSI/NSF Additives Standard 61.

3.5.2 The sealant shall be used to seal lap joints, bolt connections and sheet edges. The sealant shall cure to a rubber like consistency, have excellent adhesion to the glass coating, have low shrinkage, and be suitable for interior and exterior exposure.

3.5.3 Sealant curing rate at 73° F and 50% RH

3.5.3.1 Tack-free time: 6 to 8 hours.

3.5.3.2 Final cure time: 10 to 12 days.

3.5.4 The sealant shall be Harvestore Products, Inc. System Sealer No. 98.

3.5.5 Neoprene gaskets and tape type sealer shall not be used.

4.0 GLASS COATING SPECIFICATION

4.1 Surface Preparation

4.1.1 Following the decoiling and shearing process, sheets shall be steel grit-blasted on both sides to the equivalent of SSPC-10. Sand blasting and chemical pickling of steel sheets is not acceptable.

4.1.2 The surface anchor pattern shall be not less than 1.0 mil.

4.1.3 These sheets shall be evenly oiled on both sides to protect them from corrosion during fabrication.

4.2 Cleaning

4.2.1 Sheet edges of sidewall and floor plates shall be **mechanically rounded** and then **flame coated with stainless steel** prior to glass coating. Glass coating of the sheet edges shall be similar to the flat panel surfaces. The process shall be equal to ***EDGECOAT***™ by Engineered Storage Products Company.

4.2.2 After edgecoating and prior to application of the coating system, all sheets shall be thoroughly cleaned by a caustic wash and hot rinse process followed immediately by hot air drying.

4.2.3 Inspection of the sheets shall be made for traces of foreign matter or rust. Any such sheets shall be re-cleaned or grit-blasted to an acceptable level of quality.

4.3 Coating

4.3.1 All sheets shall be primed with catalytic nickel oxide glass ground-coat on both sides, and then air dried per section 10.4.2.1 of AWWA D103.

5.5.2 An intermediate coat to both sides of the sheets, of cobalt blue glass frit, shall be made.

5.5.3 A top coat of titanium enhanced glass *(white color)* shall be applied to the interior surface.

5.5.4 The sheets shall then be fired at a minimum temperature of 1500 degrees F in strict accordance with the manufacturer's quality process control procedures, including firing time, furnace humidity, temperature control, etc.

4.3.5 The finished exterior color shall be the manufacturer’s standard cobalt blue.

4.4 Inspection

4.4.1 All coated sheets shall be inspected for mil thickness (Mikrotest or equal).

4.4.2 All coated sheets shall be checked for color uniformity by an electronic colorimeter.

4.4.3 An electrical “holiday” detection test shall be performed on the inside surface after fabrication of the sheet. Sheets with excessive “holidays” shall be rejected so as to minimize field touch up (See Sec. 5.3.4).

4.5 Packaging

4.5.1 All approved sheets shall be protected from damage prior to packing for shipment.

4.5.2 Heavy paper or plastic foam sheets shall be placed between each panel to eliminate sheet-to-sheet abrasion during shipment.

4.5.3 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 eliminates contact or movement of finished panels during shipment.

4.5.4 Shipment from the factory to the job site will be by truck, hauling the tank components exclusively. No common carrier, drop, or transfer shipments.

5.0 ERECTION

5.1 Foundation

5.1.1 The tank foundation is a part of this contract.

5.1.2 The tank foundation shall be designed by the manufacturer to safely sustain the structure and its live loads.

5.1.3 Tank footing design shall be based on __3,000__psf soil bearing capacity or greater as determined by geotechnical analysis performed by a licensed soils engineer. The cost of this investigation and analysis is not to be included in the bid price. Copies of the soils report are to be provided to the bidder prior to bid date by the Owner or Engineer.

5.1.4 Footing designs for soil bearing strengths less than that specified, and those designs deviating from tank manufacturers standard shall be the responsibility of the Owner and his Engineer based on tank live and dead loading data provided by the tank manufacturer.

5.2 Tank Floor Options: (Select 5.2.1 or 5.2.2)

5.2.1 Concrete Floor **(YES)**

5.2.1.1 The standard floor design is of reinforced concrete with an embedded glass coated steel starter sheet per AWWA D103-97 section 11.4.1.6 and the manufacturer's design, and is an integral element of the tank assembly; therefore the tank foundation and floor slab with embedded starter sheet shall be constructed by the tank supplier using manufacturer trained personnel regularly engaged in this type of tank construction.

5.2.1.2 Leveling of the starter ring shall be required and the maximum differential elevation within the ring shall not exceed one-eighth (1/8) inch, nor exceed one-sixteenth (1/16) inch within any ten (10) feet of length.

5.2.1.3 A leveling plate assembly (per Harvestore Products, Inc. - U.S. Patent No. 4,483,607), consisting of two 18" anchor rods (3/4" dia.) and a slotted plate (3 1/2" X 11" X 3/8" thk) shall be used to secure the starter ring, prior to encasement in concrete. Installation of the starter ring on concrete blocks or bricks, using shims for adjustment, is not permitted. The foundation with anchor bolts/leveling plates shall be a separate pour from the concrete floor.

5.2.1.4 Two water stop seals made of a butyl rubber elastomer special for this application shall be placed on the inside surface of the starter ring below the concrete floor line. These materials shall be installed as specified by the tank manufacturer.

5.2.2 Glass Coated Bolted Steel Floor (not applicable)

5.2.2.1 The floor design is glass-coated, bolted steel. Bolted steel panels shall be either placed over a three (3) inch compacted sand base contained by a steel or concrete ring wall, or a non-extruding and resilient bituminous type filler meeting the requirements of ASTM D1751 if set on a concrete slab.

5.2.2.2 Polyethylene copolymer caps and sealant shall be used to cover the bolts, nuts and washers exposed on the inside of the floor.

5.2.2.3 Leveling of the starter ring shall be required and the maximum differential elevation within the ring shall not exceed one-eighth (1/8") inch, nor exceed one-sixteenth (1/16") inch within any ten (10ft) feet of length.

5.3 Sidewall Structure

5.3.1 Field erection of the glass-coated, bolted-steel tank shall be in strict accordance with the procedures outlined in the manufacturer's erection manual, and performed by an authorized dealer of the tank manufacturer, regularly engaged in erection of these tanks.

5.3.2 Specialized erection jacks and building equipment developed and manufactured by the tank manufacturer shall be used to erect the tanks.

5.3.3 Particular care shall be taken in handling and bolting of the tank panels and members to avoid abrasion of the coating system. Prior to liquid test, all surface areas shall be visually inspected by the Engineer.

5.3.4 An electrical holiday test shall be performed during erection using a nine (9) volt leak detection device. All electrical leak points found on the inside surface shall be repaired in accordance with manufacturer's published touch up procedure using urethane sealer.

5.3.5 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 his responsibility for liquid tightness.

5.3.6 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.

5.4 Roof Options (Select 5.4.1 or 5.4.2)

5.4.1 **(YES)**Tanks with diameters of 14 to 31 ft. shall include a radially sectioned roof fabricated from glass-coated, bolted steel panels, as produced by the tank manufacturer, and shall be assembled in a similar manner as the sidewall panels utilizing the same sealant and bolting techniques, so as to assure a water/air tight assembly. The roof shall be clear span and self-supporting. Both live and dead loads shall be carried by the tank walls. The exterior coating finish shall be cobalt blue glass. The manufacturer shall furnish a roof opening which shall

be placed near the outside tank ladder and which shall be provided with a hinged cover and a hasp for locking. The opening shall have a clear dimension of at least twenty-four (24") inches in one direction and eighteen (18") inches in the other direction. The opening shall have a gasketed weather-tight cover.

5.4.2 **(N/A)** Roofs for tanks greater than 31 ft. diameter shall be constructed of non-corrugated triangular aluminum panels which are sealed and firmly clamped in an interlocking manner to a fully triangulated aluminum space truss system of wide flange extrusions, thus forming a spherical dome structure.

5.4.2.1 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.

5.4.2.2 The dome and tank shall be designed to act as an integral unit. The tank shall be designed to support an aluminum dome roof including all specified live loads.

5.4.2.3 Materials:

5.4.2.3.1 Triangulated space truss: 6061-T6 aluminum struts and gussets.

5.4.2.3.2 Triangular closure panels: .050"t 3003-H16 aluminum sheet.

5.4.2.3.3 Tension ring: 6061-T6 aluminum.

5.4.2.3.4 Fasteners: 7075-T73 anodized aluminum or series 300 stainless steel.

5.4.2.3.5 Sealant and gaskets: silicone rubber.

5.4.2.3.6 Dormers, doors, vents and hatches: 6061-T6, 5086-H34 or 3003-H16 aluminum.

5.4.2.4 Supplier shall be ESPC (Engineered Storage Products Company) of DeKalb, IL.

5.4.3 Roof Vent

5.4.3.1 A properly sized vent assembly in accordance with AWWA D103 shall be furnished and installed above the maximum water level of sufficient capacity so that at maximum possible rate of water fill or withdrawal, the resulting interior pressure or vacuum will not exceed 0.5" water column.

5.4.3.2 The overflow pipe shall not be considered to be a tank vent.

5.4.3.3 The vent shall be constructed of aluminum.

5.4.3.4 The vent shall be so designed in construction as to prevent the entrance of birds and/or animals by including an expanded aluminum screen (1/2 inch) opening. An insect screen of 23 to 25 mesh polyester monofilament shall be provided and designed to open should the screen become plugged by ice formation.

5.5 Appurtenances (per AWWA D103, Section 5)

5.5.1 Pipe Connections

5.5 Appurtenances (per AWWA D103, Section 5)

5.5.1 Pipe Connections

5.5.1.1 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, shall comply with AWWA D103 latest edition. ESPC Sealer No. 98 shall be applied on any cut panel edges or bolt connections.

5.5.1.2 Overflow piping shall be 8 inch diameter Class 350 DIP, extending to 24.00ft above FFE elevation.

5.5.1.3 Inlet piping shall be 8 inch diameter Class 350 DIP, extending to 24.00 ft above FFE elevation.

5.5.1.4 Outlet piping shall be 8 inch diameter Class 350 DIP, located 0ft FFE elevation with removable silt stop.

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5.5.1.5 Drain piping shall be 8 inch Class 350 DIP, located 0 ft elevation FFE.

5.5.2 Outside Tank Ladder

5.5.2.1 An outside tank ladder shall be furnished and installed as shown on the contract drawings.

5.5.2.2 Ladders shall be fabricated of aluminum and utilize grooved, skid-resistant rungs.

5.5.2.3 Safety cage and step-off platforms shall be fabricated of galvanized steel.

5.5.2.4 A hinged, lockable gate shall be installed at the base of the ladder safety cage to deter unauthorized access to the to of the tank. The owner shall provide and install the lock.

5.5.3 Sidewall Access Manway

5.5.3.1 One sidewall access manway shall be provided as shown on the contract drawings in accordance with AWWA D-103.

5.5.3.2 Such manway shall be a minimum of 24 inches in diameter and shall include a properly designed reinforcing frame and cover plate. A davit to hold the cover plate, when opened, is required for tanks in excess of 38’ tall.

5.5.4 Identification Plate 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.

5.5.5 Cathodic Protection

5.5.5.1 The responsibility for determining the need for, the design of and specifications for cathodic protection of the tank shall be the responsibility of the Engineer or Owner.

5.5.5.2 Attachment of rectifier boxes, anodes, or wiring to tank structure shall be approved by tank manufacturer.

5.5.5.3 When cathodic protection is specified, electrical continuity between all tank sidewall or floor panels shall be the responsibility of the tank manufacturer.

6.0 FIELD TESTING

6.1 Hydrostatic

6.1.1 Following completion of erection and cleaning of the tank, the structure shall be tested for liquid tightness by filling tank to its overflow elevation.

6.1.2 Any leaks disclosed by this test shall be corrected by the erector in accordance with the manufacturer's recommendations.

6.1.3 Water required for testing shall be furnished by the owner at the time of tank erection completion, and at no charge to the tank erector. Disposal of test water shall be the responsibility of the owner.

6.1.4 Labor and equipment necessary for tank testing is to be included in the price of the tank.

7.0 DISINFECTION

7.1 Standards

7.1.1 The tank structure shall be disinfected at the time of testing by chlorination in accordance with AWWA Specification C652 "Disinfection of Water Storage Facilities" as modified by the tank manufacturer.

7.1.2 Disinfection shall not take place until tank sealant is fully cured (10 to 12 days at 73° F/50% relative humidity).

7.1.3 Acceptable forms of chlorine for disinfection shall be:

7.1.3.1 Liquid chlorine as specified in AWWA C652.

7.1.3.2 Sodium hypochlorite as specified in AWWA C652.

7.1.3.3 Calcium hypochlorite (HTH) is not acceptable.

7.1.4 Acceptable methods of chlorination per AWWA C652:

7.1.4.1 Section 4.1.1.

7.1.4.2 Section 4.1.2 - chemical feed pump only (4.l.2.l).

7.1.4.3 Section 4.3.

7.1.5 Section 4.2 is acceptable.