

SECTION 13100

GLASS FUSED TO STEEL TANK

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish and erect three (3) Glass-Fused-to-Steel, bolted tanks, foundations, tank structure, stairways, platforms, walkways, and pipe supports attached to the tank, including all tank appurtenances as shown on the contract drawings and described herein. Tank manufacturer shall provide all aluminum components that are to be connected or attached to the tanks. Tanks shall be designed and constructed to install a dome in the future.
 - a. Prior to making any piping connections the Contractor shall fill each tank with water and surcharge the soil for a minimum of 14-days.
- B. All required labor, materials and equipment shall be included.

1.2 SUBMITTALS

- A. Construction shall be governed by the County'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.
- B. 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 by the tank manufacturer for the tank structure, foundation, stairways, platforms, and aluminum structures. 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.
- 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 for the work detailed thereon. The approval by the Engineer of the tank manufacturer'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.
- D. The tank manufacturers and installing contractor's standard published warranty shall be included with submittal information. Submit detailed design drawings sealed by a professional engineer registered in the state where the tank is located.
- E. Submit design calculations sealed by a professional engineer registered in the state where the tank is located.
- F. Submit mix designs for floor slab and footing concrete mixes.

1.3 QUALIFICATIONS OF TANK MANUFACTURER

- A. 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. No deviations from the specified design, construction, or coating details, will be accepted.
- B. The tanks shown on the contract drawings and specified herein are Model 8725 Aquastore Tank Systems as manufactured by CST Storage of DeKalb, Illinois. Approved equal may be considered.
- C. Tank Manufacturer must strictly adhere to the standards of design; fabrication; erection; product quality; and long term performance, established in this Specification.
- D. Tank substitutions which cause engineering 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.
- E. The bidder shall offer a new tank structure as supplied from a U.S. manufacturer specializing in the design, fabrication and erection of factory applied glass-fused-to-steel, bolt together tank systems. The manufacturer shall employ a staff of full time engineers, and shall own and operate its production plant, fabricate and glass coat the tank at one U.S. location.
- F. 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 be considered non-responsive. The Owner's decision or judgement on these matters will be final, conclusive and binding.
- G. Tank manufacturers proposing alternate glass fused to steel products shall pre-qualify with the Engineer/Owner in order to be registered as an acceptable alternate. Alternate tank manufacturers wishing to pre-qualify shall submit the following to the Engineer/Owner for consideration not less than 21 days prior to bid date: list of fifteen (15) glass-fused-to-steel water or wastewater located in the state of Florida operating for a minimum of ten years; list of tank materials and tank coating specs; list of five (5) tanks with a minimum of one million gallons capacity in service at least five years; typical structure and foundation drawings; certification from the tank manufacturer that the tank meets all of the design standards listed in section 2.
- H. Only bids from US manufactured tanks who have successfully pre-qualified will be considered.
- I. The Engineer shall reserve the right to evaluate all alternative tank 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. Alternate tank manufacturer shall provide life cycle cost formula to the Engineer for review. All information shall be submitted to the Owner/Engineer no less than 21 days prior to bid date, not after bids are received.

1.4

TANK DESIGN CRITERIA

- A. Tank Design Standards
 - a. The materials, 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 (potable water applications) or AISC for wastewater tank applications.
 - b. Florida Building Code 2014.
 - c. The tank coating system shall conform solely to Section 10.4 of ANSI/AWWA D103. NOTE: Baked-on epoxy painted or galvanized bolt-together tanks are not considered equal.
 - d. The glass 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.
 - e. The tank manufacturer shall be ISO-9001 certified to assure product quality.
 - f. The tank manufacturer shall certify during the shop drawing approval phase that they undergo an annual FM (Factory Mutual) inspection of their US manufacturing facility and provide proof thereof to assure product quality.
 - g. Tank shall be designed to incorporate domes at some point in the future and shall be designed to be buried up to 3-ft.
- B. Tank Size: The factory-coated glass-fused-to-steel, bolt together tank shall have a nominal diameter of 86.72 feet, with a nominal sidewall height of 25.25 feet.
- C. Tank Capacity: Tank effective capacity shall be 1,071,000 gallons (nominal, U.S. gallons) with 12" freeboard.
- D. Floor Elevation: Finished floor elevations shall be as shown on the Drawings.
- E. Tank Design Loads:
 - a. Specific Gravity 1.0 (Min. design shall be 1.0)
 - b. Wind Velocity 150 mph (ASCE 7-10, Risk Category IV)
 - c. Wind Default: AWWA D102-09
 - d. Allowable Soil Bearing Capacity 1825 psf
 - e. Roof Snow Load n/a psf
 - f. Seismic Design: AWWA D103-09
 - g. Seismic Site Class D
 - h. Seismic Importance Factor (I_e): 1.5
- F. Stairway/Platform/Walkway Design Criteria
 - a. Florida Building Code 2014
 - b. Dead Load (Grating): 5 psf
 - c. Live Loads:
 - Walkway: 60 psf
 - Stairs: 100 psf

- d. Wind Load:
 - Basic Wind Speed: 150 mph
 - Exposure: C
 - Risk category: II
- e. Refer to the Structural Aluminum notes as part of the Contract Plans

PART 2 PRODUCTS

2.1 PLATES AND SHEETS

- A. All steel shall be smelted and produced in the U.S.A.
- B. Plates and sheets used in the construction of the tank shell shall comply with the minimum standards of AWWA D103, Section 2.4.
- C. Design requirements for mild strength steel shall be ASTM A570 Grade 30 with a maximum allowable tensile stress of 14,566 psi.
- D. Design requirements for high strength steel shall be ASTM A607 Grade 50 with a maximum allowable tensile stress of 26,000 psi.
- E. 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.
- F. When multiple vertical bolt line sheets and plates of ASTM A1011 Grade 50 are used, they 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; and the effective net section area shall not be taken as greater than 85% of the gross area.
- G. Sheet edge protection: after initial sheet preparation, all full height vertical wall sheets shall be beveled. A metal coating of stainless steel shall then be thermally bonded on these edges at a thickness of 1.5 to 5 mils (0.0015 to 0.005 inches). The coating shall have a tensile strength of >1500 psi (10 MPa) (per ASTM C633-79). Concrete materials shall meet the requirements of ACI 301. Cement shall be Portland Type I or II. Up to 25% of cement may be replaced by fly ash.

2.2 ROLLED STRUCTURAL SHAPES

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

2.3 HORIZONTAL WIND STIFFENERS

- A. Design requirements for intermediate horizontal wind stiffeners shall be of the "web truss" design with extended tail to create multiple layers of stiffeners, permitting wind load to be distributed around the tank.
- B. Web truss stiffeners shall be of steel with hot dipped galvanized coating.
- C. Rolled steel angle stiffeners are not permitted for use as intermediate stiffeners.

2.4 BOLT FASTENERS

- A. 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.
- B. Bolt Material
 - 1. SAE J429 Grade 2 (1" bolt length)
 - a. Tensile Strength - 74,000 psi Min.
 - b. Proof Load - 55,000 psi Min.
 - c. Allowable shear stress - 18,163 psi Min.
 - 2. SAE J249 Grade 5 (1-1/4" bolt length)
 - a. Tensile Strength - 120,000 psi Min.
 - b. Proof Load - 85,000 psi Min.
 - c. Allowable shear stress - 29,454 psi Min.
 - 3. SAE J249 Grade 8 (> 1-1/4" bolt length)
 - a. Tensile Strength - 150,000 psi Min.
 - b. Proof Load - 120,000 psi Min.
 - c. Allowable shear stress - 36,818 psi Min.
- C. Bolt Finish - Zinc, mechanically deposited. 2.0 mils minimum - under bolt head, on shank and threads.
- D. Bolt Head Encapsulation - High impact polypropylene co-polymer encapsulation of entire bolt head up to the splines on the shank. Natural resin with UV (ultraviolet) light inhibitor. Color to be black.
- E. 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.
- F. 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.
- G. 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.
- H. Polyethylene co-polymer "bolt caps" and sealant shall be used to cover the bolts, nuts, and washers exposed on the outside of the tank sidewall.

2.5 SEALANTS

- A. 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.
- B. The sealant shall be used to seal lap joints and bolt connections. The sealer shall not be used as a coating except for minimal exposed panel edges for the embedded starter ring, notches of sidewall panels, and edges exposed for nozzle connections. The sidewall panel edges shall be protected by the fused glass coating (spray or brush on coatings are not

acceptable). 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.

- C. Sealant curing rate at 73° F and 50% RH
 - 1. Tack-free time: 6 to 8 hours.
 - 2. Final cure time: 10 to 12 days.
- D. Neoprene gaskets and tape type sealer shall not be used.

2.6 GLASS PROCESS

- A. Surface Preparation: The tank sheets shall be steel grit-blasted on both sides to the equivalent of SSPC-10 (near white blast cleaning). Sand blasting and chemical pickling of steel sheets is not acceptable. The surface anchor pattern shall be not less than 1.0 mil. These sheets shall be evenly oiled on both sides to protect them from corrosion during fabrication.
- B. Cleaning: After fabrication 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. Inspection of the sheets shall be made for traces of foreign matter, soil particles, grease, or rust. Any such sheets shall be re-cleaned or grit-blasted to an acceptable level of quality.
- C. Coating:
 - 1. A base coat of glass frit containing nickel oxide shall be applied to both sides of the sheet.
 - 2. A second coat of milled cobalt blue glass shall be applied to both sides of the sheet.
 - 3. A third coat of glass shall be applied to all interior sidewall and floor sheet surfaces which must be a titanium dioxide reinforced mixture, white color. The specified coating shall be Aquastore Vitrium. An acceptable alternate three coat system must be submitted for approval at least three weeks prior to the bid.
 - 4. The same glass coating as applied to the exterior sheet surfaces shall be applied to the exposed edges.
 - 5. The sheets shall then be fired at a minimum temperature of 1500 degrees F in strict accordance with the manufacturer's ISO 9001 quality control procedures, including firing time, furnace humidity, temperature control, etc.
 - 6. The interior coating process for sidewall sheets and floor must be a 3 coat process. The interior color shall be white. The exterior color shall be cobalt blue.
 - 7. Dry film interior coating thickness shall be 10.0 -18.0 mils (0.010 to 0.018 inches) minimum.
 - 8. Dry film exterior coating thickness shall be 7.0 - 15.0 mils (0.007 to 0.015 inches) minimum.
 - 9. The finished exterior color shall be the manufacturer's standard cobalt blue.
- D. Factory Inspection: The manufacturer's quality system shall be ISO 9001 certified and refer to ISO (International Organization for Standardization) for the following testing and procedures.
 - 1. Chemical Resistance of Glass Coating: Frits shall be individually tested in accordance

with pertinent sections of ISO 28706-1:2008.

2. Measurement of Glass Thickness: Glass thickness shall be measured using an electronic dry film thickness gage (magnetic induction type). The thickness gage shall have a valid calibration record.
 - a. The thickness of the glass shall be between 10.0 and 18.0 mils (0.010 and 0.018 inches).
3. Measurement of Color: The exterior color of the sheets shall be measured using a colorimeter. The colorimeter shall have a valid calibration record. The color must fall within the tolerances specified by the tank manufacturer, CST Storage, else the panel shall be rejected.
4. Factory Holiday Test: A dry volt test using a minimum of 1100 volts is required. Frequency of the test shall be every sheet. Any sheet registering a discontinuity on the interior surface or floor shall be rejected.
5. Fishscale test: The glass coating shall be tested in-house for fishscale by placing the full size production sheets in an oven at 400° F for one hour. The sheets shall then be examined for signs of fishscale. Any sheet exhibiting fishscale shall be rejected and all sheets from the gage lot will be similarly tested.
6. Impact Adherence Test: The adherence of the glass coating to the steel shall be tested in accordance with ISO standards. Any sheet that has poor adherence shall be rejected.

2.7 PACKAGING

- A. All approved sheets shall be protected from damage prior to packing for shipment.
- B. Heavy paper or plastic foam 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 maintain the roll-radius of the tank panels and minimize contact or movement of finished panels during shipment.
- D. Shipment from the factory to the job site will be by truck, hauling the tank components exclusively. No common carrier, drop, or transfer shipments.

2.8 STRUCTURAL ALUMINUM

- A. Structural aluminum shall be 6061-T6, unless otherwise noted.
- B. Aluminum work shall be in accordance with the Aluminum Association's Specifications for Aluminum Structures, Latest Edition.
- C. Fasteners; unless otherwise noted, all fasteners shall be 316 stainless steel meeting the requirements of ASTM A193.
- D. All welding shall conform with AWS D1.2, latest structural welding code - aluminum.

- E. All fillet welds shall have a minimum size of ¼" with 5356 filler alloy unless otherwise noted.
- F. Provide non-slip aluminum stair treads with a minimum live load capacity of 100 psf.
- G. Provide shop drawings in accordance with Section 01340 for aluminum framing prior to fabrication and installation.
- H. Where the contact of dissimilar materials may cause electrolysis or where aluminum will come in contact with concrete, mortar, grout, or plaster, the contact surface of the aluminum shall be coated with one heavy coat of bituminous paint.
- I. All exterior aluminum components included but not limited to, stairways, platforms, ladders, connectors, and handrails shall be provided by the tank manufacturer.

PART 3 EXECUTION

3.1 FOUNDATION

- A. The tank foundation is a part of this contract and shall be installed by the tank manufacturer using the tank manufacturer's standard drawings and details. The foundation shall be designed per the soil conditions in the geotechnical report to minimize settlement.
- B. The tank foundation shall be designed by the manufacturer to safely sustain the structure and its live loads.
- C. Tank stemwall design shall be based on the soil bearing capacity given in section 2.5.4 above 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.
- D. Foundation 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.
- E. Embedded starter ring shall be 19" minimum or as determined by the manufacturer.
- F. Slot mount concrete footing is not acceptable. The floor shall be reinforced concrete construction and shall be designed as a membrane slab in accord with AWWA D-110.

3.2 TANK FLOOR

- A. The standard floor design is of reinforced concrete with an embedded glass fused to steel starter sheet per the manufacturer's design, and is an integral element of the tank assembly; therefore, the tank floor slab with embedded starter sheet shall be constructed by the tank manufacturer using manufacturer trained personnel regularly engaged in this type of tank construction.
- B. 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.

- C. A leveling plate assembly (per Engineered Storage Products Company - 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" thick) 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.
- D. 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.

3.3 SIDEWALL STRUCTURE

- A. Field erection of the Glass Fused to Steel, 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. Dealer's field supervisor shall be certified by the manufacturer as having undergone factory training in proper tank erection techniques.
- B. Specialized erection jacks and building equipment developed and manufactured by the tank manufacturer shall be used to erect the tanks.
- C. 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.
- D. An electrical leak 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.
- E. 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.
- F. 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.

3.4 APPURTENANCES

- A. Stainless Steel Pipe Connections: 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. A single component urethane sealer shall be applied on any cut panel edges or bolt connections.
- B. Sidewall Access Manway: One sidewall access manway shall be provided for each tank in accordance with AWWA D-103. Such manway shall be a minimum of 30 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. Contractor shall coordinate with tank manufacturer to place the centerline of the manway 3-ft above finished grade.

- C. 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.
- F. Cathodic Protection: The manufacturer shall design and supply a passive, sacrificial anode cathodic protecting system, per the tank manufactures standards. The anodes shall be floor mounted. The cathodic protection system shall be designed for protection of uncoated steel surfaces in the product zone, including rebar within the uncoated concrete tank floor.

3.5 TESTING

- A. Hydrostatic Testing: Following completion of erection and cleaning of the tank, the structure shall be tested for liquid tightness by filling tank to its overflow elevation. Any leaks disclosed by this test shall be corrected by the erector in accordance with the manufacturer's recommendations. 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. Labor and equipment necessary for tank testing is to be included in the price of the tank.

3.6 WARRANTY

- A. Tank Manufacturer's Warranty: The tank manufacturer shall include a warranty for the tank materials and coating. As a minimum, this warranty shall provide assurance against defects in material or workmanship of the glass-coated surface for the minimum period specified. 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 one (5) years after liquid is first introduced into the tank or 62 months after the substantial portion of the tank sheets is delivered to the site where the tank is erected.
- B. Tank Erector's Warranty: The tank erector shall warrant the tank erection/installation to be free from defects in workmanship and materials during the period expiring on the earlier of one (1) year after liquid is first introduced into the tank or 14 months after notice of substantial completion of the tank erection. In addition, any defect to be corrected under the tank manufacturer's warranty shall be corrected by the Tank Erector at no cost to the Owner.

END OF SECTION