

# SECTION 13209 - FIBERGLASS REINFORCED PLASTIC TANKS

## City of San Diego, CWP Guidelines

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NTS: This Specification Section requires careful editing by the Specifier to delete all items/subjects not required by the project involved. The Specifier is required to add the requirements of any missing items.

The Specifier shall have an independent fiberglass consulting engineer verify and edit all information of this Section in accordance with the requirements of Section 06610. Any items covered by the FRP consulting engineer in Section 06610 shall be omitted in this Section, since Section 06610 has been listed as one of the "Related Sections" in this Specification Section.

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### PART 1 -- GENERAL

#### 1.1 WORK OF THIS SECTION

- A. **General:** The WORK of this Section includes providing all labor, equipment, materials, tools, supplies, fittings, and appurtenances required for the fabrication, support, installation, anchorage, hook-up, lining, protective coating, and testing of fiberglass-reinforced plastic above ground tank(s) and all appurtenant work, for a complete and workable installation as indicated.
- B. The items indicated under this Section shall be furnished by manufacturers having experience in the manufacture of similar products and having a record of successful installations.
- C. All plastic and fiberglass items shall be manufactured of material suitable for [potable water] [wastewater] [ ] and shall be certified for such use on the shop drawings. Tanks shall be designed and checked for all loads to be incurred during shipment, service, including, but not limited to, wind, temperature stress, and earthquake loads.

#### 1.2 RELATED SECTIONS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
  - 1. Section 06610 Glass Fiber and Resin Fabrications, General
  - 2. Divisions [2 and 15] Piping as applicable.

#### 1.3 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300 and Section 06610:

1. **Shop Drawings:** Shop drawings shall include detailed and certified design calculations by a registered engineer as indicated, bill of materials listing all components, resins, catalysts, promoters, ultraviolet light absorbers, agents, reinforcing materials, etc., with manufacturer's name, trade and identification marks. The laminate sequence used for all tanks must either be attached to or included on drawings used by the fabricator's shop personnel.
2. **Data Requirements:** The drawings and data submitted shall include the following:
  - a. Dimensions including anchor bolt layouts.
  - b. Nozzle schedule including size, mark, thickness, and rating.
  - c. Details of all clips and lugs for ladders, stairs, platforms, hold down lugs, pipe brackets, and anchor bolts, as integral parts of the tank. Pipe supports shall be spaced maximum 5-feet on centers.
  - d. Details of structural support members.
  - e. Equipment capacity (gallons).
  - f. Maximum design specific gravity.
  - g. Equipment weight empty and filled with [water] [wastewater] [     ].
  - h. Laminate sequence of construction and all materials of construction listed.
  - i. Specifications for all supplied bolting, gaskets and accessory items.

#### 1.4 SERVICES OF MANUFACTURER

- A. **Inspection, Startup, and Field Adjustment:** An authorized service representative of the manufacturer shall visit the site for not less than [5] days to perform the indicated field inspection services during installation, testing, and startup. These services, with the approval of the CONSTRUCTION MANAGER, may be scheduled in two trips to the job site.

## PART 2 -- PRODUCTS

### 2.1 TANK DESIGN

- A. **Standards:** Construction of tanks shall be in accordance with ASTM standards listed.
- B. **Design:** [Fiberglass tanks shall be constructed using the filament winding or contact molded method. For filament-wound tanks the design stress shall be determined using an allowable strain value of 0.0010 in/in max. For contact molded tanks, the design stress shall be 10 percent of the minimum ultimate tensile stress of the selected laminated thickness, thereby providing a factor of safety of 10:1 against shell or head rupture. Tanks shall have a minimum wall thickness of 5/16-inch, internal baffles [where necessary] [for mixing tanks, located at 90 degrees apart around the inside circumference, 7 inches wide, extending full height], manholes and accessories where indicated, and 1-1/2 inch radius sidewall knuckles. Tank sidewall thickness shall have a continuous taper not made of stepped

thickness courses. Flanged nozzles shall be conically gusseted with minimum strength requirements of 1500 ft lb of bending and 200 ft lb of torque and suitable for connection to PVC pipe. Unless otherwise indicated, 40-50 Durometer 1/8-inch thick full face gaskets shall be used.]

- C. **Cover and Connections:** The top heads shall be designed for an external live load of 250 lb on a 4-inch by 4-inch area. Tops may be dished, flat, or slight rise conical shapes as indicated. Tanks with flat tops shall have a split hinged cover, the fixed part of which shall have a reinforced mixer support pad, as required by the mixer manufacturer. Each tank shall also be furnished with pipe connections, liquid level connections, drain, and an overflow pipe as indicated. Each of the tanks, except open top tanks less than 5 feet in height, shall be provided with a sight glass gauge that will give visual indication of tank liquid level from a point 6 inches above the bottom of the tank to a point 6 inches below the junction of the side and top of the tank. The gauge shall be one or two piece design, minimum of 3/4-inch diameter for caustic storage, or 3-inch diameter for polymer storage. The glass tube shall be adequately protected from breakage by use of corrosion resistant cast or heavy duty sheet metal guards, extending the length of the gauge. At the connections to the tank, the gauge shall be provided with shutoff valves equipped with ball checks to prevent tank leakage in case of tube breakage. The valves shall be threaded directly to the fittings on the tank. All wetted hardware shall be Type 316 stainless steel, or as indicated, where stainless steel is not suitable.
- D. **Fiberglass Tank Schedule:** The following fiberglass tanks are included in this Section.

<u>I.D. No.</u>	<u>Location</u>	<u>Service</u>	<u>Size (inches)</u>	<u>Volume (gallons)</u>
[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]

0.1 **Seismic:** Tanks shall be designed to resist stresses created by a [ ] percent maximum seismic load when the tank is full of a 1.6 specific gravity liquid.

## 2.2 MATERIALS OF CONSTRUCTION

- A. **Resin:** [Resin shall be Derakane 411, Atlac 382, or equal. To insure that fresh resin is used, at the completion of the job, lot numbers of the resin used must be shipped with the completed tank. Fillers up to 2 percent by weight of thixotropic agent may be used for viscosity control in the paraffinated top coat on vertical surfaces, provided it will not interfere with visual inspection. The cure system used for the resin shall be in accordance with resin manufacturer's current recommendations. Proper curing of the resin is the fabricator's responsibility. All products fabricated in this Specification shall be cured to at least 90 percent of the minimum Barcol hardness specified by the resin manufacturer. The requirement applies to both interior and exterior surfaces. A separately cured, unreinforced gel coat shall not be used. No chemical-resistant surface, interior or exterior, shall be acetone sensitive. Where application of polyester film to prevent air inhibition of these surfaces is impractical, a wax containing resin coating, formulated according to the resin manufacturer's most recent recommendations, must be used. The minimum thickness of the polyester film shall be 4 mils. The outside surface of the tanks shall not be pigmented. By weight, 5 percent ultraviolet stabilizer shall be added to all exterior surfaces.]

- B. **Reinforcement:** [Chemical surfacing mat (veil) shall be Type C (chemical) glass, 10 mils thick, with a silane finish and a binder compatible with the lay-up resin. C-Glass shall be OCF M-514-236 or OCF M-514-234. Chopped strand mat shall be Type E (electrical borosilicate) glass, 1-1/2 oz per sq ft, with silane finish and a styrene-soluble reactive binder. Continuous roving used in chopper gun for spray-up shall be Type E glass. Woven roving shall be Type E glass, nominal 24 oz/sq yd, 4 by 5 weave, with silane-type finish. Continuous roving used for filament winding shall be Type E glass with a silane type finish.]

## 2.3 CONSTRUCTION

- A. **General:** [Tanks that can be constructed with a continuous shell shall be fabricated using the filament winding technique. Those tanks which must be built in sections, shall be constructed using the contact molded or filament wound technique. Tanks too small to filament wind may also be fabricated using contact molded techniques.]

- B. **Laminate Construction:** Laminate construction shall be as follows:

[1. **Chemical Resistant Barrier:** Tanks, whether they are constructed using the filament winding or contact molded process, shall consist of an inner surface and an interior layer which constitutes the chemical-resistant barrier, and an exterior or structural layer. The inner surface shall be free from cracks and crazing, with a smooth finish. The resin-rich surface shall be between 0.010 and 0.020 inches and reinforced with C-glass. The resin to glass ratio should be approximately 90 percent resin and 10 percent glass. The interior layer shall consist of either (1)-3 layers of 1-1/2 oz/sq ft E-glass chopped strand mat, or (2)-2 layers of 1-1/2 oz/sq ft E-glass chopped strand mat followed by one pass by the spray-up process. In no case shall the combined thickness of the inner surface and the interior layer be less than 0.100 inches. The glass content for the interior layer shall be 20-30 percent.]

[2. **Contact Molded Laminates:** The contact molded process includes fabrication by the hand lay-up, contact pressure molding, and spray processes or combinations thereof, according to ASTM D 4907, except as otherwise indicated. In addition, inner surface and interior layer shall be constructed as indicated in the preceding paragraph. The exterior layer or body of the laminate shall provide the additional strength necessary to meet the tensile and flexural requirements. Where separate layers such as mat or woven roving are used, all layers shall be lapped a minimum of one inch (two inches for woven roving). Laps shall be staggered as much as possible. If woven roving is used, a layer of chopped strand glass shall be placed as alternate layer. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. On laminates containing woven roving, cut edges exposed to the chemical environment shall be coated with resin, surfacing mat, and C-glass veil, and all machined flange faces shall be faced with C-glass.]

[3. **Filament-Wound Laminates:**

- a. **Materials:** Filament-Wound Glass Fiber Reinforced Polyester Chemical Resistant Tanks shall be according to ASTM D 3299, unless otherwise noted. In addition, inner-surface and interior layer shall be constructed as indicated above. The exterior or structural layer of filament-wound tanks shall include chopped glass strand interspersed between the windings to provide additional strength, and resistance to permeation and chemical attack. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections.]

NTS: The filament wrap angle is the only design parameter that provides any longitudinal strength in filament-wound tanks. It is our experience that some manufacturers tend to use large wrap angles (minimum material to attain design hoop strength - low longitudinal strength) in their products. Be sure to check shop drawings against the certified design for wrap angle.

[b. Filament Wrap Angle: The filament wrap angle (the projected angle between the longitudinal axis of the tank and the velocity vector of the filament as it leaves the wrapping head during fabrication) shall be small enough to provide sufficient longitudinal strength to resist all longitudinal stresses to be incurred by the tank, and shall agree with the wrap angle indicated in the certified tank design.]

[4. Outer Surface: When air-inhibited resins are cured with an air- exposed surface, a wax-containing resin coating, formulated according to the resin manufacturer's most recent recommendations, must be used.]

[5. Tank Connections: Unless otherwise indicated, all connections shall be flanged. Manways on storage tanks and equipment shall be 24-inch ID. Access opening on tops of mixing tanks may be removable sections, but shall be bolted down. All flanges shall be made by hand lay-up. Flanges shall be flat and true to a tolerance of plus or minus 1/32 inches. If machining is required, the machined surface shall be faced with "C"-glass veil. Machine facing of the back of hand lay-up flanges is not permitted. All bolt holes shall be spot faced for SAE-size washers if required. Flange drilling on pipe connections shall be in accordance with ANSI B-16.5 for 150 psi pressure class. Minimum flange thickness shall be based on 50 psi pressure rating. All nozzles, except manways, shall be reinforced with plate gussets. Conical gussets having comparable strength may be substituted for the plate gussets, but a drain hole must be provided in the base of the conical gusset at its lowest point of installation on the tank wall. Bolt holes in flanged nozzles are to straddle the vertical centerline. Tolerance in bolt hole locations and in diameter of bolt circle shall be plus or minus 1/16-inch. On all flanged joints, 1/8-inch thick full-faced elastomeric gaskets having a Return Shore A Durometer hardness of 60 plus or minus 5 shall be used. The reinforcement pad of nozzle and manhole openings in the vessel walls shall consist of alternate plies of mat and woven roving with the final top layer being of mat surfacing veil.]

2.4 WORKMANSHIP

[A. **Visual Defects:** ASTM D2563 shall be used for quality control of both filament-wound and hand lay-up construction. Acceptance levels shall be as follows:

<u>Process Surface:</u>	<u>Defects:</u>
Blisters	None
Burned Areas	None
Chips	None
Cracks	None
Crazing	None
Dry Spots	None

Entrapped Air	None at surface. If in laminate 1/16-in dia max and 5/sq in max.
Exposed Glass	None
Exposed Cut Edges	None
Foreign Matter	None
Pits	Max 1/8-in dia X 1/32-in deep, max 10/sq ft.
Scratches	None (coated)
Surface Porosity	None
Wrinkles	Max deviation 10 percent of wall thickness.
Sharp Discontinuity	None
<u>Non-Process Surface:</u>	<u>Defects:</u>
Blisters	Max 1/4-in X dia 1/16-in high.
Burned Areas	None
Chips	Max 1/4-in with max thickness of 20 percent of wall.
Cracks	None
Crazing	Slight
Dry Spots	Max 2 sq in/sq ft
Entrapped Air	1/8-in dia max; no more than 3 percent of area.
Exposed Glass	None
Exposed Cut Edges	None
Foreign Matter	None if it affects the properties of laminate.
Pits	Max 1/8-in dia X 1/16-in deep.
Scratches	None (coated)
Surface Porosity	None
Wrinkles	Max deviation 20 percent of wall thickness, but not to exceed 1/8-in.
Sharp Discontinuity	None

If the area fails to meet the requirements of entrapped air or voids in less than 40 percent of the total surface, those areas may be repaired and reinspected. If the defective areas exceed 40 percent of the total surface, the entire vessel shall be rejected.]

- [B. **Shop Inspection:** The CONSTRUCTION MANAGER and FRP engineer shall be permitted access to the plant area at all times during fabrication and shall be notified one

week prior to the estimated date of tests and/or inspections. Final inspection and approval shall be obtained prior to shipment unless written waiver is obtained. The shop inspection of the equipment shall include the following:

1. Check for compliance with drawing dimensions and adherence to construction standards.
2. An acetone wipe test to check surface cure. No surface tackiness is permitted.
3. A barcol hardness test; at least 90 percent of manufacturer's specified hardness must be attained.
4. Examination of laminated (nozzle) cutouts.
5. A hydrotest of at least 24 hours duration to check for leaks.]

## 2.5 BOLTS, ANCHOR BOLTS, WASHERS, SUPPORTS, AND HOLD DOWN LUGS

- A. The CONTRACTOR shall provide all bolts, anchor bolts, nuts, washers, and supports as required for all the plastic and fiberglass items indicated in this Section, and in accordance with the requirements of the manufacturers of the plastic and fiberglass items. All bolts, anchor bolts, washers, hold down lugs, and supports required in connection with the plastic or fiberglass items provided under the Section shall be of Type 316 stainless steel.

## 2.6 NAMEPLATES, TOOLS, AND SPARE PARTS

- A. **Spare Parts:** The WORK includes the following spare parts:
  1. 2 sets all washers, gaskets, and O-rings
  2. One set all gauge glasses
  3. One set all gauge glass valves and hardware
  4. One set all other hardware and valves attached to tanks

## 2.7 MANUFACTURERS

- A. Tanks of the type indicated shall be manufactured by one of the following (or equal):
  - [1. Beetle Plastics]
  - [2. Ershigs, Inc.]
  - [3. Pacific Tank Ltd.]
  - [4. Raven Industries, Inc.]
  - [5. Tankinetics, Inc.]
  - [6. Xerxes Corporation]

## PART 3 -- EXECUTION

### 3.1 INSTALLATION

- A. All fiberglass reinforced plastic tanks shall be installed on level concrete pads in accordance with the manufacturer's written instructions. All pipes and equipment connecting to the tanks shall be firmly supported, to avoid stresses on the tank.

### 3.2 FIELD INSPECTION

- A. The field inspection shall include the following:

- [1. An acetone wipe test of field laminated areas to check for surface cure. No surface tackiness is permitted.]
- [2. A barcol hardness test of field laminated areas, at least 90 percent of manufacturer's specified hardness must be attained.]
- [3. A hydrotest of at least 24 hours to check for leaks on field erected tanks.] [or] [an air test.]

\*\* END OF SECTION \*\*