SECTION 08310

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Exterior floor access doors.

1.02 SUBMITTALS

A. Product Data.

B. Shop Drawings: Show the following:
   1. Access door attachment to structure in each typical condition.
   2. Locations of access doors.
   3. Structural calculations.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Identify type and size of each door in way not to damage finish prior to delivery.

B. Deliver products only after proper facilities are available.

C. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.

D. Handle carefully to prevent damage and store on clean concrete surface or raised platform in safe, dry area. Do not dump onto ground.

E. Protect access doors during shipment and storage to prevent warping, bending, and corrosion.

PART 2 PRODUCTS

2.01 TYPE F3 EXTERIOR FLOOR ACCESS DOORS

A. Manufacturers: One of the following or equal:
   1. The Bilco Co., Type JD - AL H20.
   2. Babcock-Davis Associates, Inc., Model B-FGA H20.

B. Style: Double leaf, aluminum, capable of withstanding minimum live load of 300 pounds per square foot, and supporting AASHTO H-20 wheel load, channel frame, with drainage components.

C. Door Leaf: Minimum 1/4-inch aluminum diamond pattern plate capable of withstanding a live load of 300 pounds per square foot, and reinforced to support AASHTO H20 wheel load with maximum deflection of 1/150th of the span.

D. Frame: 1/4-inch aluminum channel with anchor flange around perimeter.

E. Hardware:
   1. Hinges: Equipped with a minimum of two heavy forged brass hinges with stainless steel pins.
   2. Lock: Snap lock with removable handle mounted on door leaf.
   3. Grip Handle: Provide vinyl grip handle designed to release cover for closing.
   4. Operating Mechanism: Spring operators designed for ease of operation and automatic hold-open arm with release handle.
   5. Drainage Assembly: Provide 1-1/2-inch drainage coupling located in front right corner of channel frame.

2.02 FINISHES

A. Floor Access Door Types:
   1. Aluminum: Manufacturer's standard mill finish.
   2. Aluminum In Contact With Dissimilar Metals and Concrete: Manufacturer's standard bituminous coating.
   3. Steel: Manufacturer's standard red oxide primer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine construction to receive access door and verify correctness of dimensions and other supporting or adjoining conditions.

3.02 PREPARATION

A. Coordinate details with other work supporting, adjoining, or requiring access doors.

B. Verify dimensions, profiles, and fire-resistive rating for each opening.

C. Verify that location will serve portion of work to which access is required. Where proposed functional location conflicts with other work, notify the ENGINEER before installation.

D. Apply bituminous coating to aluminum surfaces that will be in contact with dissimilar metals or concrete when there is none.

3.03 INSTALLATION

A. Install access doors in accordance with manufacturer's instructions.

B. Ensure correct types and adequate sizes at proper locations.

C. Securely attach frames to supporting work and ensure doors, frames and hardware operate smoothly and are free from warp, twist and distortion.

3.04 ADJUSTING

A. Adjust doors, frames and hardware to operate smoothly, freely, and properly, without binding.

3.05 CLEANING

A. Thoroughly clean surfaces of grease, oil, or other impurities, touch-up abraded prime coat.

END OF SECTION

SECTION 13206A

FIBERGLASS REINFORCED PLASTIC TANKS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Fiberglass reinforced plastic aboveground storage tanks.

B. Provide at a minimum the following tanks:
   1. Chemical Storage Tanks: Provide three 30,000-gallon horizontal tanks for storage of sodium hypochlorite at 12.5 to 15 percent concentration.

C. Related Sections:
   1. Section 01612 - Seismic Design Criteria.
   2. Section 01614 - Wind Design Criteria.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. ASME/ANSI RTP-1, Reinforced Thermoset Plastic Corrosion Resistant Equipment.

B. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
   2. B16.5 - Pipe Flanges and Flanged Fittings.

C. American Society for Testing and Materials (ASTM):
   1. C 581 - Standard Practice For Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures, Intended for Liquid Service.
   2. C 582 - Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment.
   3. D 2240 - Standard Test Method for Rubber Property - Durometer Hardness.
   4. D 2563 - Standard Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts.
   5. D 2583 - Standard Test Method of Indentation Hardness of Rigid Plastics by Means of Barcol Impresser.
   6. D 2584 - Standard Test Method for Ignition Loss of Cured Reinforced Resins.
   7. D 3299 -Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Corrosion Resistant Tanks.
   8. D 3567 - Standard Practice for Determining Dimensions of “Fiberglass” (Glass- Fiber - Reinforced Thermosetting Resin) Pipe and Fittings.
   9. D 4097 - Standard Specification for Contact Molded Glass Fiber Reinforced Thermoset Resin Corrosion Resistant Tanks.

D. International Conference of Building Officials (ICBO):
   1. Uniform Building Code (UBC).

E. National Bureau of Standards Voluntary Product Standards (PS):
   1. PS 15-69 - Custom Contact-Molded Reinforced-Polyester Chemical-Resistant Process Equipment.

F. National Fire Protection Association (NFPA):
   1. NFPA 30 Flammable and Combustible Liquid Code.

1.03 DEFINITIONS

A. The terminology of this specification is consistent with ASTM D 883 - Terminology Relating to Plastics.

B. Fiberglass Reinforced Plastic: Fiberglass Reinforced Plastic or glass fiber and resin fabrication consisting of approximately 35 to 55 percent glass fiber reinforcement by weight for hand lay-up structural laminates and 55 to 70 percent glass for filament wound structural laminates, unless otherwise specified.

C. Equipment: The fiberglass reinforced plastic equipment, including ancillary equipment, work, and materials as described in this specification.

D. Fabrication Drawings: Those drawings produced by the Fabricator or CONTRACTOR, with the intention of providing the necessary information to construct or install the equipment.

E. Mat: Fibrous material consisting of randomly oriented chopped or swirled filaments loosely held together with a binder.

F. Chopped Glass: Fibrous material consisting of randomly oriented chopped filaments applied directly to a mold surface or laminated under construction by a chopper gun.

G. Fiber Prominence (Jackstraw): The distinct visibility of individual glass strands causing a loss of translucency of the laminate.

H. Useable Capacity: Useable capacity shall be defined as the capacity stored between the overflow elevation and the tank outlet elevation. Actual capacity may be more than usable capacity.

1.04 SYSTEM DESCRIPTION

A. Tanks:
   1. Number: 3
   2. Rated Volume: 30,000 gallons (per tank).
   3. Maximum Tank Diameter: 12 feet.
   4. Tank Configuration: Horizontal.

B. Each tank shall be provided with integral support saddles as indicated on the Drawings. Each tank shall have side mounted and top mounted 24-inch diameter manways as indicated on the Drawings.

C. Tanks shall be constructed of materials compatible with 12 to 15 percent sodium hypochlorite.

1.05 DESIGN CRITERIA

A. Design fiberglass reinforced plastic tanks following the procedures and methods, utilizing the equations and formulas, and incorporating safety factors and allowable design stresses and strains set forth in ASME/ANSI RTP-1. For other design features not in conflict with ASME/ANSI RTP-1, refer to ASTM D 3299 and D 4097.

B. Use safety factors and allowable strains specified in ASME/ANSI RTP-1 unless otherwise specified. Do not use safety factors and allowable strains less than the following:
   1. Allowable hoop and axial strain shall be 0.001 inch/inch for filament wound tanks.
   2. A safety factor of 10 for hand lay-up components in tension, flexure, or other loading conditions where elastic stability is not in question.
   3. A safety factor of 5 for external loading (vacuum) or local buckling due to seismic or wind loading.

C. Tanks shall be designed for long-term (service life 20 years) with minimum reasonable maintenance requirements. Tank service life shall be defined as service for 20 years in uncovered, outdoor containment structure without major structural failure or leakage. The design shall include as a minimum, engineering calculations, materials selection and documented physical and mechanical properties, and detailed drawings required for fabrication and assembly of the equipment.

D. Design tanks, saddle supports, and anchorage in accordance with applicable national, regional, and local design and building codes. Seismic design forces shall be determined in accordance with the Uniform Building Code and Section 01612. Wind design forces shall be determined in accordance with the Uniform Building Code and Section 01614. Resistance to overturning shall not include the weight of the liquid contained in the tank.
   1. Wind design calculations shall be prepared for conditions when tank is empty and when tank is at maximum operating level. The worst case shall govern.
   2. Seismic loading on vessel shall include the impact of sloshing loads in addition to seismic loading as outlined in RTP-1.
   3. Tank seismic hold down lugs and anchor bolts shall be designed for wind and seismic loads as specified herein without taking in to account the weight of the liquid contents inside the tank to resist overturning forces.
   4. Secondary bonds used for tank seismic hold-down brackets or lifting lugs: shear stress loads on the secondary bond resulting from seismic and/or installation loads at the lugs shall not exceed 200 psi allowable shear strength in accordance with RTP-1.
   5. Tank cylinder shell: Able to support a single 250-pound load on a 4-inch by 4-inch area without damage and with a maximum deflection of 1/2 percent of the tank diameter at the area the load is applied.
   6. Saddle supports:
      a. Minimum saddle support width: 18 inches.
      b. Minimum support circumference: 120 degrees.
      c. Supports shall be FRP construction compatible with wall construction to minimize differences in coefficient of expansion/contraction.
      d. Supports shall be hollow and open on top to allow for fill with concrete.
      e. Anchor lugs shall be included in the FRP saddle construction, designed to meet specified loads.

7. Design support attachments as required including external lugs for anchor bolts, lifting lugs, and ladders using a maximum of 200 pounds per square inch shear stress for secondary bonds.

E. Allow for the most severe combination of conditions which may include, but not be limited to, the following:
   1. Internal pressure.
   2. Static head of contents.
   3. Mass of tank structure and contents.
   4. Superimposed loads, such as seismic and hydrostatic forces.
   5. Localized loads acting at supports, lugs, and other attachments.
   6. Loads due to heating or cooling and thermal gradients.
   7. Loads applied during transport or erection.

F. Provide test reports or other documentation for laminate properties used in the design. Laminates shall be similar in construction, layer sequence, resin type, and cure to those used to determine tested properties. Properties shall be adjusted to reflect reductions at operating temperatures. Test reports shall be provided for tanks showing conformance with specified strength requirements.

G. The corrosion liner shall be a minimum of 100 mils in thickness, and documentation shall be provided verifying veil type, liner thickness, and resin cure. Consider the entire 100 mils of the corrosion liner as sacrificial and do not include it in determining structural wall thickness. Corrosion liner shall include two layers of surfacing veil.

H. Tank structural wall thickness shall be determined based on design seismic and wind loading and design criteria specified herein.

I. Laminate types may include hand lay-up, helical winding, and hoop/chop construction methods. In laminates with helix angles greater than 80 degrees and in hoop/chop laminates, orientate approximately 10 percent of the structural wall thickness at 0 degrees (longitudinal direction). Apply this reinforcement in at least 2 layers of weft unidirectional fabric and equally spaced within the structural wall.

J. Nozzles, manways, and shell reinforcements: thickness and reinforcing shall be according to the tables and formulas in ASME/ANSI RTP-1.

K. Tanks shall be designed to store sodium hypochlorite solution at concentrations between 12 and 15 percent under atmospheric conditions and ambient temperatures ranging from 38 degrees Fahrenheit to 110 degrees Fahrenheit.

L. Tanks shall be fully vented to atmosphere with vent piping sized based on chemical off-loading using compressed air at 30 psig with fill nozzle sizes as indicated on the Drawings. Provide vent size as needed for chemical off-loading and purging of the fill line with plant air, but in no case shall vent piping be less than diameter indicated on the Drawings. Vent sizing shall take into account screen covers over vent piping as specified.

1.06 SUBMITTALS

A. Submit as specified in Section 01330. In addition, submit the following:
   1. Statement that fabrication shall be in accordance with these Specifications, referenced ASTM standards, and per ASME RTP-1.
   2. Submit general arrangement and fabrication drawings, locations of nozzles and attachments, and anchor bolt details.
   3. Gasket material and statement of compatibility with chemical being stored.
   4. Warranty.

B. Calculations:
   1. Design calculations for tank including wall thickness (shell, head, and base) for loadings as specified herein.
   2. Weight of tanks for laminate sequence as specified herein. Include weight of tank with and without corrosion barrier. Tank anchor lug design shall include weight of corrosion barrier, however tank wall structural design shall not include corrosion barrier thickness in design calculations for the structural wall thickness required to meet design loadings herein.
   3. Seismic and wind design calculations for tanks and their anchorage system in accordance with Sections 01612 and 01614. Calculations shall be stamped and signed by a Professional Engineer registered in the State of California.
   4. Tank Saddle Supports: Tank saddle supports shall be designed by the tank manufacturer in accordance with Section 01612 and shall take into account all possible conditions of the tank, from empty to full of chemical. Structural calculations shall be stamped and signed by a structural engineer registered in the State of California. Tank saddle support connection to tank wall shall be designed to meet allowable shear strength as specified herein and per RTP-1.

C. Certified Shop and Erection Drawings Showing:
   1. Dimensions of tanks and saddle supports.
   2. Locations and sizes of fittings and nozzles.
   3. Locations of accessories including level gauges, anchor bolt locations, pipe brackets, conduit supports, and other integral parts of the tank.
   4. Tank bottom/top attachments with knuckle configuration, overlays, and thicknesses.
   5. Tank support and anchor lugs, including attachment details.
   6. Tank nozzles and installation, including cutout reinforcement, gusseting, and similar items.
   7. Level gauge details including mounting and support of stilling well inside the tank, and support details for level gage and sight glass outside the tank for the reverse-float type level gage as specified.

D. Tank Construction Details: Construction details for assembly and other special configurations, including:
   1. Tank saddle attachment to tank wall and saddle anchor bolt details to concrete supports.
   2. Tank saddle stiffener details.
   3. Tank reinforcing details around saddle attachment and openings including overlays, and thicknesses.
   4. Tank nozzles and installation, including cutout reinforcement, gusseting, and similar items.

5. Tank platform and handrail fabrication drawings including support details, platform attachment to tank, platform columns and attachment at grating and base support details for attachment to concrete floor.

E. Tank Fabrication Details:
   1. Chemical resistance for all tank materials of fabrication that will come in contact with tank contents. Include a statement from the manufacturer that the various materials used, including resins and gaskets are suitable for the intended service.
   2. Test reports or other documentation for strength properties for tank wall construction using laminates similar in construction, layer sequence, resin type and cure to those proposed.
   3. Recommendation for Each Resin Selection from Resin Manufacturer:
      a. Type and amounts of fillers, catalysts, promoters, ultraviolet light absorbers.
   4. Nominal corrosion liner description.
   5. For Contact Molded Laminates:
      a. Reinforcement types and glass content range.
      b. Laminate thicknesses.
      c. Ply sequences.
   6. For Filament Wound Laminates:
      a. Helix angle.
      b. Glass content range.
      c. Strand yield.
      d. Strand per inch in the winding band.
      e. Ply thickness.
      f. Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate.
   7. For Secondary Overlays: Laminate thicknesses, ply sequences, and widths.

F. Instructions for Handling, Storage, and Installation of Tanks:
   1. Recommended lifting and handling procedures.
   2. Foundation design requirements including requirements for padding, levelness, etc.

G. Quality Control Submittals:
   1. Quality Assurance Plan.
   2. Certificate of compliance that the tank was manufactured in accordance with these specifications, referenced ASTM standards, and per ASME RTP-1.
   3. Submit factory test reports and quality control reports before shipment.
   4. Manufacturer's field testing requirements.
   5. Inspection records, laminate glass content test results including glass content and tensile/flexural test results following installation.
   6. ASME RTP-1 certificate.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of proposed corrosion resistant fiberglass reinforced plastic tanks for a minimum of 5 years with satisfactory performance record.

B. Tanks shall be constructed per ASME/ANSI RTP-1.

C. Quality Assurance Plan: Fabricator shall be responsible for implementation of a comprehensive quality assurance plan. The quality assurance plan describes procedures with the following minimum requirements.
   1. Designated personnel to inspect equipment while in-process and after completion to assure compliance to ASME/ANSI RTP-1, and every aspect of the specifications, and fabrication drawings. Inspection shall include, as a minimum, checks for visual defects, laminate thickness and sequence, glass content, Barcol hardness, dimensional tolerances, adherence to construction details, surface preparation, and environmental conditions. Fabricator's inspector shall complete a report of the findings for each tank:
      a. Prior to use of resins in fabrication, fabricator shall verify resin type and quality, and if altered after receipt by adding styrene, promoters, or other additives, take samples from each drum or portion thereof mixed with additives.
      b. Inspect glass reinforcement prior to use in fabrication. Ensure that glass material has not been wetted and meets specified requirements. Record measured weight per square yard of material used.
      c. Retain nozzle cutouts and clearly mark each to identify its original location. These laminate samples shall become the property of the OWNER.
   2. Fabricator shall verify glass content on available samples in accordance with ASTM D 2584. Complete this test and submit the results complete for each major component where samples are available.

D. Prior to final shipment of the equipment, Fabricator shall submit ENGINEER a complete quality control report, consisting of copies of records maintained for compliance with this section.

E. Fabricator must be a certified ASME RTP-1 facility. ASME RTP-1 certificate to be supplied with the vessels.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Supplier shall require the manufacturer to assume responsibility for packaging to prevent normal transit and handling damage to the tanks.

B. Flange faces shall be protected from damage. All openings are to be securely covered to prevent entrance of dirt, water, and debris.

C. Tanks shall be mounted on skids or protective framework so constructed as to provide for easy handling with lifting lugs, and to permit handling by crane. Nozzles, manholes, or other fittings shall not be used for lifting.

D. Tanks shipped horizontally shall be supported by padded cradles supporting 120 degrees of the tank circumference.

1.09 WARRANTY

A. Manufacturer shall provide a full warranty against defects in workmanship and materials, and warranted against failure for use with chemicals stored/contained within. The warranty shall be for a minimum of 7 years and shall not be pro-rated:
   1. Warranty period shall start upon substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the Following or Equal:
   1. Ershigs, Inc.; Bellingham, WA.
   2. Belco Manufacturing Co.; Belton, TX.
   3. Xerxes Corporation; Anaheim, CA.

2.02 TANK DESIGN

A. Capable of withstanding a positive vapor pressure of 10 inches of water gauge and filled to the top with a liquid with specific gravity of 1.28. Provide a minimum of 15 percent overflow capacity.

B. There shall be no vertical joints (in axial direction) in the cylindrical shell.

C. Tanks shall be suitable for design temperatures and pressures as specified herein.

D. Construct tanks with a minimum 0.100 inch thick corrosion barrier. Corrosion barrier shall not be used in determining structural wall thickness.

E. Provide tanks with minimum structural wall thickness as determined through structural calculations.

F. Tanks shall be designed per User's Basic Requirement Specification (UBRS) as required by ASTME/ANSI RTP-1. The UBRS is to be completed by the ENGINEER.

2.03 MATERIALS

A. Resin: Provide premium grade vinyl ester resin. Use same resin throughout laminates:
   1. Manufacturers: One of the following or equal:
      a. Derakane, 411.
      b. Ashland Hetron 922.
      c. Interplastic VE 8300.
      d. Reichhold Dion, VER 9100.
      e. AOC Vipel F010.
   2. Resins shall be cured to at least 90 percent of the minimum Barcol Hardness specified by the resin manufacturer.
   3. No chemical resistant surface, interior or exterior, shall be acetone sensitive.
   4. Resin shall comply with applicable specifications ASTM C 581, ASTM D 3299, ASTM D 4097, and ASME/ANSI RTP-1 with verification of properties. Physical properties may include tensile, flexural, and compression modulus of elasticity and ultimate strengths, limiting strains, Poisson ratios, coefficients of expansion and other directional properties as required for the design of the tank.
   5. Employ no fillers, additives, or pigments in the corrosion liner. A thixotropic agent for viscosity control may be used as recommended by the resin manufacturer, however thixotropic agent shall not be used in the corrosion liner or on outer surfaces to be in contact with the corrosive environment.
   6. Resin putty shall contain milled glass fibers. The use of silica flour, grinding dust, or other fillers is not allowed.

B. Reinforcement Materials:
   1. Glass type and sequence of reinforcements shall be in conformance with RTP-1.
   2. With the exception of surfacing veils, all fiberglass reinforcement shall be Type E per RTP-1 requirements.
   3. Use glass fiber reinforcing having a surface finish and binder that is specifically recommended by the glass manufacturer for the particular resin system to be used.
   4. Glass Reinforcement shall Conform to the Following:
      a. Use Type C (chemical grade) glass, 10 mils (0.01 inches) thickness, or polyester surfacing veil, such as Nexus surfacing veils.
      b. Use Type E (electrical grade) glass, 1-1/2 ounces or 3/4 ounce per square foot, with nominal fiber length of 1.25, within 0.75 inches mat.
      c. Continuous glass roving used in chopper guns for spray-up shall be Type E chopper roving.
      d. Woven roving shall be 24 ounces per square yard Type E glass and have a 5 by 4 plain weave.
      e. Continuous roving used in filament wound structures shall be Type E glass winder roving with a yield of 200 yards or more per pound.
      f. Use Type E glass unidirectional fabric. Weft unidirectional fabric shall be 15.7 ounces per square yard.

C. Gaskets: Use 1/8-inch thick full-faced elastomeric gaskets having a Shore A Durometer hardness of 60, within plus or minus 5, as determined by ASTM D 2240 for flanged joints. Elastomer for sodium hypochlorite applications shall be viton.

D. Pipe, Ladder, Lifting Lugs, Anchor Bolt Lugs, and Conduit Supports: Type 316 stainless steel, laminated onto tank wall.

E. Anchor Bolts: Type 316 stainless steel. Minimum size 1/2-inch diameter or greater as required per seismic design calculations.

F. Ladder and Platform: FRP.

G. Ultra Violet Stabilizer: Add to the resin used in the wax coat for exterior surfaces in the type and amount recommended by the resin manufacturer. Color to be selected by the OWNER.

2.04 FABRICATION

A. Fabrication Method: Hand lay-up or filament wound at construction with integral molded bottom knuckle.

B. Chemical Resistant Barrier for Filament or Contact Molded Tank Laminates shall meet the following requirements:
   1. Inner Surface:
      a. Free from cracks and crazing, with a smooth and glossy finish.
      b. Resin rich surface with thickness between 0.010 and 0.020 inches and reinforced with surfacing veil (C-glass or double Nekus).
      c. Comprised of approximately 90 percent resin and 10 percent glass.
   2. The Interior Layer:
      a. Comprised of between 70 and 80 percent resin, and 20-30 percent glass.

b. Glass shall consist of 1-1/2 ounces per square foot mat in the number of layers specified on the fabrication drawings.
c. An exotherm interruption is specifically prohibited within the corrosion liner.

3. The combined thickness of the inner surface and the interior layer shall be a minimum of 0.106 inches:
   a. Consider the entire 100 mils thickness of the corrosion barrier as sacrificial and do not include it in determining structural wall thickness.
4. Chopped glass applied by manual chopper gun is not allowed in the corrosion liner. Application by chopper gun is acceptable if mechanically slaved and synchronized to rotation of the mandrel.
5. Plies of the inner surface and interior layer are to gel completely before proceeding with the structural laminates.
6. Use no thixotropic material in the resin for the liner.
7. Do not use a separately cured unreinforced gel coat.

C. Contact molded or hand lay-up laminates: Fabricated by hand lay up, contact pressure molding and spray processes or combinations thereof, according to ASTM D 4097, except as otherwise noted. Contact molded laminates shall meet the following requirements:
1. For hand lay-up structural laminates, reinforcement shall consist of mat and woven roving in the sequence specified on the fabrication drawings. 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).
2. All edges of layers of reinforcement shall be overlapped a minimum of 1 inch with laps staggered as much as possible when woven roving is used.
3. A layer of ply mat or chopped strand glass mat shall be placed between each layer of woven roving, and outside the outermost layer of woven roving. Two adjacent plies of woven roving are not permitted.
4. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. A layer of glass surfacing mat shall be applied to the exterior of all laminates.
5. 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.
6. Laminates containing primarily 1-1/2 ounces per square foot mat layers in conjunction with woven roving shall contain not less than 35 percent or more than 45 percent glass (by weight).
7. Laminates containing primarily 3/4 ounce per square foot mat layers in conjunction with woven roving are considered to be high strength laminates and shall contain not less than 45 percent or more than 55 percent glass by weight.

D. Filament-Wound Laminates: Filament wound glass fiber reinforced polyester chemical resistant tanks shall be according to ASTM D 3299, unless otherwise noted. Filament-wound laminates shall meet the following requirements:
1. 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.
2. The exterior surface shall be relatively smooth with no exposed or sharp projections.

3. For filament wound structural laminates, reinforcement shall consist of continuous strand fiberglass roving applied with a minimum of interruptions until the specified minimum thickness is attained. This laminate shall contain 55 to 70 percent glass by weight.
4. Each complete cycle of filament winding shall form a closed pattern of winding bands which completely covers the surface with 2 bi-directional layers. Each layer shall be a maximum of 1 roving in thickness. Uniformly space the filaments across the winding band without bunching or gaping.
5. Specify the helix angle of winding on fabrication drawings, as measured from the centerline of revolution of the equipment shell. Tolerance on helix angle shall be plus or minus 2 degrees.
6. The fabrication drawings may require that layers of unidirectional roving be interspersed within the continuous filament winding. Apply the unidirectional roving with the glass strand aligned in the axial direction, to within plus or minus 5 degrees.
7. If layers of mat or chopped glass are needed to insure proper bonding of unidirectional roving, or within the filament winding to accommodate the Fabricator's manufacturing methods, consider the layers' extra material that will result in a thickness greater than specified. The amount of filament winding and unidirectional roving specified must still be applied.

E. Outer Surface:
1. Provide a resin rich layer with glass fiber surfacing veil minimum of 0.01 to 0.02 inches on top of the final mat ply of the structural layer. Resin rich layer is required for corrosion resistance on the outer tank surface to protect against spillage. Resin shall match that being used in the corrosion liner and construction of the tank walls.
2. Apply a paraffinated resin coat over the resin rich layer. Paraffinated resin coat, when cured, shall pass the acetone test per ASTM C 582.
3. Provide minimum 15 mil thick clear or pigmented paraffinated resin coating with an inhibitor to protect against ultraviolet degradation of the tank laminate. Pigments shall not be applied until the laminate inspection has been completed, and the tank certified as passing inspection as specified elsewhere in this section. Color shall be as selected by the OWNER during submittal review.

F. Laminates:
1. Determine specified glass content in accordance with ASTM D 2584.
2. Consider laminate thicknesses shown on the fabrication drawings as construction minimums. Verify that minimum thicknesses are obtained using the laminate sequences specified. When only total laminate thicknesses are specified or indicated on the Drawings, the minimum allowable structural laminate thickness shall be the total laminate thickness less the specified corrosion liner thickness.
3. Interruptions in laminating sequence shall follow the application of a ply of mat and be succeeded by a ply of mat.
4. The interruption shall not exceed 24 hours, and the in-process surface must retain acetone sensitivity until laminating is resumed. Lack of compliance with these aspects or indication that contamination of the surface has occurred shall require that surface preparation be accomplished before resuming.

5. Chopped strand glass applied by chopper gun is allowed in lieu of mat layers in the structural laminates only. Chopper gun application of the corrosion liner is not allowed.

G. Outer Surface:
   1. The outer surface of the finished laminate shall be a separately applied parraffinated resin coat that, when cured, passes the acetone test per ASTM C 582. Outer surface to be applied over a resin-rich layer. Provide a ultraviolet stabilizer in the type and amount recommended by the resin manufacturer in the parraffinated resin coat.
   2. A resin-rich layer shall be applied over the final mat ply of the structural layer prior to application of the paraffinated resin coat. The resin-rich layer shall use the same resin as applied in the construction of the tank and corrosion liner, and shall be reinforced with a surfacing veil providing a thickness of 0.01 to 0.02 inches.
   3. Incorporate pigmenting in the parraffinated top coat as required to provide a white pigmented surface coat. Do not apply resin-rich layer or parraffinated top coating until laminate has been inspected by the Engineer.

H. Joining Laminates:
   1. Reinforce FRP joints with an overlay of glass reinforcement and resin which extends equally within plus or minus 1/2 inch on each side of the joint. Use minimum thickness, ply sequence, and ply widths of fiberglass reinforced plastic joints as indicated on fabrication drawings.
   2. Restrain parts to be joined to prevent movement until completion and cure of the joint overlay.
   3. Fit-up parts and verify that tolerances and assembly requirements are satisfied. Completely fill the void between component parts with resin putty, taking care not to extrude an excessive amount of putty into the interior.

2.05 FITTINGS

A. Tank Nozzles and Fittings: All tank fittings and nozzles shall be flanged.

B. Flanged Nozzles shall Meet the Following Requirements:
   1. Design pressure rated at 15 psig minimum per ASME RTP-1.
   2. 2 inch through 24 inch: Flange dimensions, except thickness, and bolt hole drilling shall be for 150 pound flanged connections per ANSI B 16.5. Flange thickness shall be per ASTM RTP-1.
   3. Nozzles 4 inches and smaller: Reinforced with plate or conical gussets per ASME RTP-1, ASTM D 3299 for filament wound vessels, and ASTM D 4097 for contact-molded vessels.
   4. Nozzles shall project a minimum of 6 inches as measured from the face of the flange to the inside wall of the tank.
   5. Top nozzles shall be mounted parallel to the horizontal axis of the tank.
   6. Flange faces shall be perpendicular to the centerline of the tank within 1 degree and shall be flat to plus or minus 1/32 inch up to and including 18-inch equivalent diameter and plus or minus 1/16 inch for equivalent diameters greater than 18 inches.
   7. Flanges shall be made by hand lay-up construction with nozzle neck and flange made integrally in one piece.
      a. Press molded or filament wound flanges not allowed.

b. Extend layers of reinforcement in the nozzle neck and hub uninterrupted into the flange.
c. Build-up additional hub thickness using alternating layers of 1-1/2 ounces per square foot mat and 24 ounces per square yard woven roving.
d. Build-up additional thickness in the flange using "ring" cutouts of mat, evenly distributed throughout the flange thickness.
e. Resin coat bolt holes and other cut surfaces so that no fibers are exposed.
f. Depressions or projections in flange face shall be no greater than 1/32 inch.

C. Fittings and Appurtenances for Each Tank:
1. Location of fittings shall be as indicated in the Drawings.
2. One Gooseneck or Mushroom Style Vent Located on the Top of the Tank:
a. Vent shall be sized per RTP-1.
b. Vent shall be equipped with Type 316 stainless steel screen to prevent debris from entering tank.
3. Each tank shall be furnished with one 24-inch flanged top access manway and one 24-inch flanged side access manway:
a. Manways shall be rated for 15 psig pressure and constructed in accordance with RTP-1 Table 4-2 (manway detail for pressurized manways up to 15 psig).
b. Minimum Diameter of Flanges and Covers: 32 inch.
c. Flanges and covers shall have a minimum thickness of 1-1/4 inch.
d. Manway covers shall be furnished by the tank manufacturer and shall be furnished with 1/8-inch thick full-face viton gaskets.
e. Provide each manway flange and cover with no less than 20-bolts, sized for minimum 5/8 inch diameter, Type 316 stainless steel bolts.
4. One - minimum 3 inch flanged inlet nozzle at top of tank end wall.
5. One - minimum 3 inch flanged outlet nozzle located on the underside of the tank. Location shall allow drainage of the entire tank contents.
6. One - minimum 3 inch flanged drain nozzle located on the underside of the tank. Location shall allow drainage of the entire tank contents.
7. One - 3 inch flanged overflow nozzle located near the top of the tank end wall.
8. One - 2 Inch Flanged Nozzles for Mounting Level Gauges:
a. Nozzle shall be located on top of the tank.
9. One - 4 inch flanged nozzle on the top of the tank for mounting tank ultrasonic level element (furnished under separate specification section).

D. Tank Vents:
1. Each tank shall be provided with gooseneck or mushroom style vents equipped with Type 316 stainless steel screens to prevent debris from entering tank.
2. Size tank vents per ASTM RTP-1.

E. Reinforcement of Nozzle and Manhole Openings in Vessel Walls:
1. In accordance with RTP-1 for filament-wound contact-molded and hand lay-up vessels.
2. When reinforcing materials are cut to facilitate placement around an installed nozzle or opening, stagger joints in successive reinforcing layers to avoid overlapping and do not place so that the joints are parallel to the axis of the

tank. The principle fiber direction of the woven roving reinforcement (0 degree/90 degree) shall be parallel to the tank axis.

F. Lifting lugs shall be Type 316 stainless steel.

2.06 ACCESSORIES

A. Accessories for Each Tank:
   1. Provide each tank with a ladder and platform to access the top of the tank and access manway.
   2. Provide each tank with a level gauge.
   3. Provide each tank with anchor bolt tie down lugs and lifting lugs.
   4. Furnish Type 316 stainless steel anchor bolts for each tank. Anchor bolts shall meet requirements specified in Section 01612. Anchor bolts to be supplied and installed by CONTRACTOR based on tank manufacturer's recommendations.

B. Tank leveling pad: Provide neoprene rubber pad between tank saddle supports and concrete support in accordance with the manufacturer's recommendations. Thickness and hardness of the neoprene pad shall be as required by the manufacturer, but shall not be less than 1/4-inch thick of 60 durometer.

C. Ladder and Platform: Size and configuration as indicated on the Drawings and as follows:
   1. Ladder: fabricated from fiberglass reinforced plastic.
   2. Elevated Platform and Structural Members: Fabricated from fiberglass-reinforced plastic for access to the top of tank and top manway. Manufacturer shall design and supply platform support system. Platform shall be supported from storage tank top on one side by FRP structural column supports to the containment area slab on the ladder side of the platform as indicated on the Drawings. Columns, baseplates, and anchor attachment to floor and tank shall be designed and supplied by tank manufacturer.
   3. Ladder and Platform shall be in accordance with Occupational Safety and Health Administration (OSHA) standards.
   4. FRP Platform support reinforcing at tank top shell attachment shall be designed for loading on platform assuming a live load of 250 pounds.
   5. Safety cages shall be provided in accordance with OSHA standards.
   6. Provide fiberglass reinforced plastic handrail around the platform. Handrail shall be designed and fabricated in accordance with Section 06616.
   7. Fasteners: Type 316 stainless steel.
   8. Anchor bolts: Type 316 stainless steel.
   9. Secure ladder to the tank using support lugs integrally wound into tank wall. Support lugs shall be constructed of Type 316 stainless steel.
   10. Structural Calculations:
      a. The entire system shall be designed for the seismic and wind criteria as specified in Sections 01612 and 01614. Submit structural calculations signed and sealed by a registered Professional Engineer in the State of California.
      b. Calculations shall include, but not be limited to, the following:
         1) Dead loads.
         2) Live loads.
         3) Seismic loading in accordance with Section 01612.
         4) Wind loading in accordance with Section 01614.

5) Anchor lug attachment of scrubber vessel to tank and for tank to concrete base. Assume scrubber vessel is full of caustic solution for calculations.
6) Design unit to be capable of withstanding hydrostatic loading assuming storage tanks are filled to capacity with 12 - 15 percent solution of sodium hypochlorite.
7) Design internal beams and support attachments using a maximum of 200 pounds per square inch shear stress for secondary bonds. Also apply this to design of external lugs required for ladders, platforms, and other attached items.

D. Level Gauge:
11. Provide Each Tank with:
a. Level gauge. "reverse float type," with minimum 2-inch diameter PVC or PVDF stilling well tube mounted inside the tank.
b. Float, constructed of PVC
c. Polypropylene rope.
d. Clear polyvinyl chloride sight tube mounted outside the tank and provided with staff gage for visual observation of tank level.
12. All materials used in the construction of the wetted portions of the level gage shall be suitable for use with sodium hypochlorite solution as specified .
13. Tank Level Staff Gauge:
a. Provide aluminum or stainless steel gage material resistant to abrasion and corrosion.
b. Level gage shall be mounted on the tank adjacent to the indicator. Provide integrally would support attachments for the tank level gage. Supports shall be provided with spacing not to exceed four feet on center.
c. Calibrated in nominal 500-gallon increments.
14. Level gage to be designed to bolt to a single 2-inch flanged nozzle mounted on the top of the tank.
15. Provide stilling well inside the tank with interior supports provided at no less than two locations. Supports shall be integrally wound into the tank structural layer and constructed of non- metallic materials for attaching and supporting the stilling well for the float gage inside the tank.

E. Pipe Supports:
1. Provide support attachments for vertical pipes on tank walls at maximum spacing of 5 feet 0 inches on center.
2. Supports shall be integrally wound into tank structural layer and shall be constructed on non-metallic materials.

2.07 TANK LABELS

A. Shipping Label Identifying:
1. Tank capacity.
2. Chemical service.

B. Permanent Labels:
1. Identification Label Showing the Following Information:
a. Name of manufacturer.
b. Date of manufacture.
c. OWNER’s purchase order number.

d. Tank name and tag number.
e. Resin number and manufacturer.
f. Design pressure and temperature.
g. Vessel diameter, height, and weight.
h. Gallons per inch.
i. Gallons per foot.
j. Total tank gallons.
k. Useable gallons.
l. Chemical service.
m. Specific gravity.
n. Design wall thickness.
o. Tank resin type.
p. Inches of height between center of tank outlet and bottom of overflow.

C. National Fire Protection Association (NFPA) label: Provide each tank with a minimum of two NFPA placards specifically coded for the tank contents in accordance with NFPA 30.

2.08 SOURCE QUALITY CONTROL

A. Source Quality Control:
1. Visual Defects: ASTM D 2563, shall be used for quality control of both filament wound and hand lay up construction.
2. Visual defects in areas of the equipment shall not exceed the maximum allowable levels of visual defects set forth in Table A.
3. Presence of visual defects in excess of the allowable levels of Table A shall be grounds for rejection of tanks. Listed quantities apply to small localized areas and shall not be averaged over larger areas.
4. For the Purpose of Table A, Use of the Following Definitions Apply:
a. Inner Surface - Interior process surface, thickness of surfacing veil(s), and interface between veils and mat layers. Includes surfacing veils on internal joints.
b. Interior Mat Layers - Layers of mat following the inner surface, and interface between liner and structural wall. Includes mat layers on internal joints.
c. Structural Wall - Layers of filament winding or alternating layers of mat and woven roving following the corrosion liner, and layers of mat and woven roving in internal overlays.
d. Exterior Surface - The exterior surface of the laminate and the thickness of the surfacing veil.
e. Dimensions listed in Table A refer to the largest dimension measured for defects.

B. Final inspection and approval shall be obtained prior to shipment. The manufacturer's shop inspection records shall provide the following information:
1. Check for compliance with drawing dimensions, visual laminate quality, and adherence to construction standards:
a. Thickness measurements.
b. Measurements showing compliance with dimensions and tolerances in diameters, lengths, squareness of ends, angles of fittings and flanges and flatness of flanges.

c. Laminate quality: presence of pits, foreign inclusions, dry spots, air bubbles, pinholes pimples and delamination.

2. An acetone wipe test to check surface cure. No surface tackiness is permitted.
3. Barcol Hardness measurements per ASTM D2583: At least 90 percent of manufacturer's specified hardness shall be attained.

C. Factory Inspection Submittals:
1. Submit final quality control and inspection records performed by the manufacturer. Include test reports.
2. Submit all cutouts from the tank, marked indicating their original location prior to tank delivery.
3. The tank manufacturer shall furnish, upon request, copies of test reports on tensile modulus for each laminate thickness and laminate construction used in the filament wound portion of the tank.

D. Factory Curing:
1. Perform a four-hour 200 degree Fahrenheit hot air post cure to insure optimum laminate cure and drive out residual styrene in the laminate. Post curing shall be done in accordance with resin manufacturer's instructions.

E. Factory Hydrostatic Testing:
1. Perform leak test for each tank.
2. Leak test using water for a period of not less than 6 hours with all fittings installed and blinded prior to shipment.
3. Factory leak testing shall demonstrate no measurable drop in liquid surface.
4. Repair any leaks and re-test for an additional 6 hours minimum.
5. Note reason for leak and method of repair and submit to the Engineer.
6. Any defects or leaks which have not been adequately repaired will be cause for rejection of the tank.
7. Evidence of poor workmanship or lack of compliance with aspects of the Contract Documents will be grounds for rejection of the equipment.

F. Additional Factory Testing:
1. Perform hardness tests on liner surface using the Barcol impressor, Model GYZJ 934-1, calibrated at 2 points in accordance with ASTM D 2583 on cutouts for the tank nozzles. Ten readings will be taken in a localized area, deleting the 2 highest and 2 lowest, and averaging the remaining 6. Minimum acceptable Barcol hardness will be a reading of 30 unless otherwise specified. Submit results.
2. Perform acetone sensitivity test. Evidence of a sticky or tacky surface following rubbing with an acetone-saturated cloth will be grounds for rejection of the equipment.

G. Prior to shipping, the interior of each tank must be pressure-washed to ensure tank is cleaned and ready to be placed into operation.

TABLE A MAXIMUM ALLOWABLE LEVELS OF VISUAL DEFECTS				
Condition/ Defect	**Inner Surface**	**Interior Mat Layers**	**Structural Wall**	**Exterior Surface**
Chip	None	None	None	None
Crack	None	None	None	None
Crazing	None	None	None	None
Delamination	None	None	See Air Bubble	See Air Bubble
Dry Spot	None	See Air Bubble	See Air Bubble	See Air Bubble
Foreign Inclusion	None	Maximum Diameter 1/32"	See Air Bubble	See Air Bubble
Fracture	None	None	None	None
Air Bubble/ Void	Less than 1/64" Ø unlimited. 1/64" to 1/16" Ø 2 / sq. in. Maximum Diameter 1/16"	Less than 1/32" Ø unlimited. 1/32" to 1/8" Ø 5 / sq. in. Maximum Diameter 1/8"	Less than 3/16" Ø unlimited. 3/16" to 1/4" Ø 2 / sq. in. Maximum Diameter 1/4"	Less than 3/16" Ø unlimited. 3/16" to 1/4" Ø 2 / sq. in. Maximum Diameter 1/4"
Blister	See Air Bubble	See Air Bubble	See Air Bubble	See Air Bubble
Burned	None	None	None	None
Pit (Pinhole)	Less than 1/32" Ø 50/square feet 1/32" to 1/16" Ø 10/square feet Maximum Diameter 1/16" Maximum Depth 1/32"	N/A	N/A	Less than 1/32" Ø 50/square feet 1/32" to 1/16" Ø 10/square feet Maximum Diameter 1/16" Maximum Depth 1/32"
Resin Pocket	None	Maximum 1 square inch per occurrence.	Maximum 1 square inch per occurrence.	Maximum 1 square inch per occurrence.
Wrinkle	Allowable if laminate is glass reinforced. No sharp edges allowed.	Allowable if laminate is glass reinforced and full mat layer thickness and total thick- ness are maintained.	Allowable if laminate is glass reinforced and full mat layer thickness and total thick- ness are maintained.	Allowable if laminate is glass reinforced and full mat layer thickness and total thick- ness are maintained.
Scratch	None	N/A	N/A	None
Fiber Prominence	None	Maximum 10 fibers visible per square inch	Maximum 20 fibers visible per square inch	Maximum 20 fibers visible per square inch

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Transportation, handling, storage of the tanks, and installation shall be in accordance with the manufacturer's printed instructions.
   2. Repair any damage to tank components due to transportation or installation.
   3. Install in accordance with manufacturer’s written instructions.
   4. Install piping to tank with sufficient flexibility to allow tank movement of 1 inch in any direction without damage to piping.
   5. Tanks shall be thoroughly cleaned prior to placing in service.

B. Provide leveling grout or other material per tank manufacturer’s recommendation to provide continuous support for FRP saddle supports.

C. Ensure that the installation surface is completely free from any debris including sand, gravel, rocks, or any construction related material. If required by the manufacturer, provide any additional materials required for proper installation of the tank.

D. All anchor lugs or leg pads shall be set on a minimum 1 inch thick layer of non-shrink grout. Do not use hard shim to fill void between the lugs and foundation. Do not place grout until tank has been filled.

E. Unless otherwise agreed, independently support all piping so as not to apply loads to the vessel nozzles. Isolate potential load due to thermal expansion of piping from the vessel. During installation, do not force piping into alignment, which can create excessive stresses in the tank.

F. Do not mate raised-face flanges or ring gaskets to full-faced fiberglass reinforced plastic nozzles.

G. Vertically support ladders at the tank foundation or platform. Ladder lugs attached to the vessels shall provide lateral support only.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Service.
   1. Inspect the installed tanks for proper installation.
   2. Instruct plant operations and maintenance personnel on maintenance of the tanks.

3.03 FIELD INSPECTION AND TESTING

A. The Field Inspection shall Include the Following:
   1. An acetone wipe test of field laminated areas (if any) to check for surface cure. No surface tackiness is permitted.
   2. A barcol hardness test of field laminated areas (if any). At least 90 percent of manufacturer's specified hardness shall be attained.

B. CONTRACTOR shall conduct a field hydrostatic test of at least 24 hours with all tanks full of water. No leakage is permitted. Test tanks according to the

manufacturer's recommended testing requirements in addition to the field hydrotest. Provide written report after verification of no leakage.

END OF SECTION