

SPECIFICATION
FIBERGLASS REINFORCED PLASTIC
LIQUID CHEMICAL STORAGE TANKS

PART 1. GENERAL

1.1 WORK INCLUDED

- A. This section covers the work necessary to design, manufacture and supply stationary chemical storage tanks as specified herein.

1.2 GENERAL

- A. All FRP tanks shall be designed by an engineer experienced in designing ASME RTP-1 vessels. Tank manufacturing details shall be in accordance with ASME RTP-1. Tanks shall be stamped RTP-1 by and RTP-1 accredited fabricator. A UBRs for each vessel shall be included as part of the Request for Quotation documents.
- B. Like items of equipment provided hereunder, although in different services, shall be the end product of one fabricator in order to achieve standardization for appearance, operation, maintenance, spare parts and fabricator's service.

1.3 FABRICATOR'S SERVICES

- A. A fabricator's technical representative for the equipment specified herein shall be available if requested.

1.4 STANDARDS, SPECIFICATIONS AND CODES

- A. Tanks and equipment shall be designed, fabricated, inspected and delivered in accordance with the latest issue of the following Standards:
 - 1. American Society for Testing and Materials (ASTM), as listed herein.
 - 2. ASME RTP-1. Manufacturing details per ASME RTP-1 shall take precedence over all other specification referenced herein.

3. American National Standards Institute (ANSI) B16.5 Flange Dimensions.
4. Occupational Safety and Health Act (OSHA) Standards for Safety.
5. ASTM D2583, "Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impresser."
6. ASTM D2584, "Test Method for Ignition Loss of Cured Reinforced Resins."
7. ASTM D2563 "Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts".
8. ASTM C581, "Standard Practice for Determining Chemical Resistance of Thermoset Resins in Glass Fiber Reinforced Structures Intended for Liquid Storage."

1.5 BID SUBMITTALS

- A. The Bidder shall submit information in accordance with the requirements stated in the INSTRUCTIONS TO BIDDERS.
- B. In addition to the submittals required in the INSTRUCTIONS TO BIDDERS, the following shall be submitted with the bid documents by both the named fabricator and any "or equal" proposed item. The term "Fabricator," as used herein, refers to the company or organization responsible for the design and fabrication of the fiberglass equipment and appurtenances.
 1. Listing of previous installations, owners and references demonstrating the fabricator has a minimum of ten years experience with the manufacture of helically filament-wound fiberglass tanks for municipal or industrial service. This list should include the ten most recent jobs.
 2. Resume' of person who will be the Quality Control Manager for all equipment and appurtenances fabricated for this project.
 3. Resume' and Registration Certificate Number for the Registered Engineer on Staff who will be the engineer responsible for design of all FRP equipment and appurtenances.

4. Copy of the Fabricator's Quality Control Manual and description of the Quality Control Program that will be used during the manufacture of all FRP equipment. .

1.6 SUBMITTALS

- A. Submittals shall be made in accordance with GENERAL INQUIRY REQUIREMENTS. In addition, the following specific information shall be provided:
 1. Detailed description of the laminate and the type of reinforcing to be used. This shall be accompanied by a letter from the resin manufacturer stating:
 - a. That the laminate and reinforcing material used will provide chemical resistance for the intended application.
 - b. That the resin will meet the performance requirements stated and is suitable for the service conditions specified herein.
 2. Design calculations stamped by a registered Professional Engineer. Calculations shall include, but not be limited to, the following:
 - a. Dead loads.
 - b. Live loads.
 - c. Environmental loads (seismic wind and snow loadings).
 - d. Anchor design and configuration details.
 3. Detailed shop drawings showing weights and dimensions of equipment, all nozzles and manways, wall thickness, laminate makeup, fabrication techniques, and construction materials.
 4. Fabrication schedule and location of the fabrication site.
 5. Written instructions and recommended methods for unloading, storing and installing the fiberglass equipment and recommended lifting and handling procedures, including all bolt torques.

6. Certified test data on representative samples of standard materials which verify compliance with the physical property requirements. An example is lamination qualification testing for ASME RTP-1 accreditation.
 7. Color chart showing the available colors for external tank coating.
 8. Certification indicating that the quality control, testing and inspection have been completed and standards specified herein have been met prior to shipment to the jobsite. Certification shall be in the form of a letter signed by the Quality Control Manager. Certification shall also accompany each piece of equipment upon delivery to the jobsite.
 9. Copy of current ASME RTP-1 accreditation.
- B. Quality Control Submittals
1. Fabricator's Certificate of Compliance that vessel was manufactured in accordance with these Specifications.
- C. Contract Close-out Submittals: Furnish operation and maintenance manuals, as necessary..

1.7 QUALITY CONTROL PROGRAM

- A. All vessels in this Specification shall be fabricated under the following minimum quality control program:
1. Employment of a quality control manager with experience in the Plastics, FRP, or Composites industry. If this position is currently not staffed, then an outside person or service shall be retained at the Fabricator's expense for the duration of fabrication of the tanks in this Specification to fulfill this position. See Section 1.5.B.2.
 2. The quality control manager shall be independent of manufacturing production personnel.
 3. All phases of the tank fabrication shall be witnessed by either the quality control manager or his directly and solely supervised staff.
 4. A manufacturer's log of each tank's fabrication:
 - a. The start of fabrication and other production milestones.

- b. The names of qualified production personnel who worked on the tank.
 - c. The type and quantity of materials used for the tank construction.
 - d. The visual inspection results for individual vessel components taken before and after final assembly.
 - e. Test results for completed vessels as specified in Article FACTORY TESTING.
5. The quality control manager shall have a current production schedule available for inspection that identifies the vessel fabrication or storage location, current status, and expected completion date for each vessel.
6. All areas of the facility, where vessels are being fabricated or stored under this specification, shall be available for inspection during normal working hours.
7. Each vessel shall have a signed letter from the quality control manager stating that the vessel was fabricated in accordance with these Specifications. This letter shall be accompanied with the quality control documents. Vessels will not be approved at the jobsite without this documentation.
- B. Any violation of this quality control program is sufficient justification for rejection of any tanks that are involved in the violation.
- C. Prior to beginning vessel fabrication, the Fabricator shall have written approval of his quality control program.

PART 2. PRODUCTS

2.1 GENERAL

- A. The use of a manufacturer's name in no way pre-qualifies the Fabricator's product. All tanks must comply with the Specifications herein stated.

2.2 TANK EQUIPMENT NUMBERS AND NAME IDENTIFICATIONS

Tank Equipment Number Name Identification

- A. _____

* Configuration: Flat Bottom, Dish Top

2.3 FABRICATORS

- A. Liquid Chemical Storage Tanks
1. Belco Manufacturing Company
 2. Ershigs, Inc.
 3. R.L. Industries
 4. Tankenetics
 5. An-Cor Industrial Plastics
 6. Xerxes Corporation
 7. Augusta Fiberglass

2.4 SERVICE CONDITIONS

- A. Design Conditions
1. Tanks fabricated to this Specification, shall operate at temperatures ___ degrees F and shall be suitable for atmospheric pressure or ___ in. WC pressure and/or vacuum.
 2. Atmospheric tanks shall be fully vented. Vent should be sized by the tank manufacture if specification requires the use of pressure to load / unload tanks with no damage.
 4. Tank equipment number _____ will be subjected to the following conditions and shall be designed to withstand all stated conditions:

- a. Nominal capacity: _____gallons.
- b. Vertical/horizontal installation: _____|
- c. Inside tank diameter: ____ feet ____ inches.
- d. Straight side length: _____feet ____ inches.
- e. Design temperature: _____ degrees F.
- f. Operating pressure: _____
- g. Chemical (s) being stored: _____
- h. Concentration of chemical (s): _____
- h. Specific gravity: _____
- i. Ambient temperature: ____ to ____ degrees F.
 - Please advise is your location is Indoors?
- K. Environmental loads:
Seismic Zone ____ Wind _____ Snow ____
- L. Uniform Man Load: 250lbs / ft²

B. Heating / Insulation system: Customer shall determine if the vessels require insulation and/or heating. Customer shall provide fabricator with minimum chemical temperature requirements. Fabricator shall select and provide shop installed heat tracing or heat panels and insulation to meet the specified requirements.

2.5 LIQUID CHEMICAL STORAGE TANK DESIGN REQUIREMENTS

- A. The Fabricator shall be responsible for the basic design of the FRP tanks based on these Specifications and associated Drawings, including resin selection, wall thickness, methods and locations of support and stiffener requirements and methods for achieving secondary containment and/or leak detection. These details are subject to review and approval by the purchaser.
- B. The mechanical properties used for the design of any contact molded or filament-wound reinforced laminate shall meet or exceed all requirements of ASME RTP-1.

- C. Tanks shall be designed in accordance with ASME RTP-1 and shall meet all specific manufacturing detail requirements of that standard.
- D. All flanged nozzles on the tanks shall be rated at 50 psig minimum. The flange outer diameters and drilling shall be per ANSI 16.5.
- E. The back face of the flanges shall be spot-faced, flat and parallel to the flange face of sufficient diameter to accept a SAE metal washer under the bolthead or nut.
- F. All tank nozzles 4" and smaller shall be gusseted with either conical type or plate type gussets.
- G. The Fabricator shall be responsible for providing information and requirements for installation.
- H. The Fabricator shall provide flatness & uniformity requirements for tank foundation design.
- I. Closed top tanks shall be designed with a head knuckle radius of not less than 1.5 inches.
- J. Bottom knuckle radius of flat bottom tanks shall be a minimum of 1.5 inches. The reinforcement of the knuckle-radius area shall extend up the vertical wall a minimum of 12 inches.
- K. Tank heads with top fittings shall have a factory-applied non-skid coating.
- L. Nozzles shall have a 6-inch projection (8-inch for insulated tanks) as measured from the face of the flange to the outside wall of the tank.
- M. Shell nozzles shall be mounted radially, perpendicular to the side shell. Top nozzles shall be mounted parallel to the vertical axis of the tank with bolt holes straddling this principle axis. Nozzles shall be finished flush with the inside surface of the tank. Provide gaskets for blind flanges only.
- N. Tank manway shall be Fabricator's standard vapor-tight flanged and bolted manway, with gasket and hardware as specified.

2.6 EQUIPMENT

- A. Like items of equipment provided hereunder, although for different services, shall be the end products of one manufacturer.
- B. Tank Identification: Identify each tank with the Fabricator's name, capacity in gallons, design maximum temperature, design pressure, chemical service, including concentration, specific gravity, vessel "tag" number, vessel name, resin type, and date of manufacture.
- C. Lifting lugs shall be provided for all vessels weighing more than 100 pounds. Lifting lugs shall be zinc coated or stainless steel.
- D. Anchor components shall be zinc coated or stainless steel.

FOR DOUBLE WALL TANKS ONLY:

- E. Double Wall System Requirements: Tank shall have a double-wall containment design. Double wall system shall be designed so that if any liquid penetrates the inner wall it will run freely to a 1" Gusseted flange at the tank bottom. The 1" gusseted flange shall be installed so that it penetrates the outer wall only. A film shall separate the inner and outer wall, providing sufficient room for the liquid to move freely through the annular space. A 1" Flanged vent for the annular space shall be provided 6" down from the tank / dish top tangent. Vent flange shall penetrate the outer shell only. The inner surface of the outer containment wall and outer surface of the inner wall shall have a 20 Mil corrosion resistant veil applied. This will prevent deterioration of the tank in a situation where contents are introduced to that annular space.

FOR INSULATED WITH HEAT TRACING OR HEAT PANELS TANKS ONLY:

- F. FRP manufacturer to provide 2" polyurethane insulation covered with an exterior FRP skin of no less than 3/16" thick consisting of chop hoop construction.
- G. If heating is required, the manufacturer shall install either heat tracing or heat panels designed to maintain ____ ° F at outdoor ambient temperature of _____ ° F. Design of heating system to be supplied as part of the submittal process..

2.7 COMPONENTS

A. Resin

1. Resin system: Selected by the Fabricator, subject to approval by the ENGINEER and suitable for _____ service.
2. Resin: As recommended by the resin manufacturer. _____ resin will be used throughout the tank liner AND structure. Engineer may require that core samples be sent to a testing facility to confirm the submitted resin system was used (at buyer's expense).
3. The same resin shall be used throughout the structure. Dual resin systems shall not be used unless specifically requested by or approved by the ENGINEER.
4. No dyes, pigments or colorants shall be used except in the exterior coat. Exterior color shall be Fabricator's standard, unless specifically requested by or approved by the Engineer.
5. The resin shall not contain fillers or thixotropic agents unless specified.

B. Reinforcement

1. Inner Surface: veil will be one or two ply synthetic Nexus veil, or C veil, depending on resin manufacturer's recommendation. Nexus veil may be backed by one ply C glass veil to improve inner surface quality. Inner surface shall have a minimum of 85% resin content. Inner surface construction shall be the same for inner and outer shell of double wall vessel so that any fluid to prevent corrosion in the annular space in the event of a leak.
2. Interior layer: Two (2) layers of 1.5 oz/ft² chopped strand mat or equivalent chopped strand backing the veil. Application by chopper gun is acceptable if mechanically slaved and synchronized to the rotation of the mandrel. Interior layer shall have 68% to 78% resin content. Use no additive in the corrosion barrier. The corrosion barrier shall be considered non-structural for all design aspects.

3. Structural Layers:
Hand Lay-up (heads, joints, fittings):
Alternating layers of 1.5 oz/ft² chopped strand e-glass or equivalent chopped glass and 24oz/yd² woven roving. Woven roving shall be Type E glass, nominal 24 ounces per square yard, 4 x 5 weave, with silane type finish. Glass content for hand lay-up layers shall be 30%-45%.

Filament Wound (shell):
Continuous roving used for filament winding shall be Type E glass with a silane type finish, with a nominal yield of 250 strand yards per pound. Glass content for filament wound layers shall be 55%-70%. Uni-directional fabric may be interspersed between filament wound layers to achieve minimum axial tensile properties.
5. Laminate Quality: Meet requirements of the visual acceptance criteria in ASME RTP-1, Level II including, but not limited to, the following:
 - a. Appearance.
 - b. Defects.
 - c. Cut edges.
 - d. Construction joints.
- C. Post Curing: After fabrication and inspection, where recommended by the resin manufacturer, all tanks shall be post cured with heat. Post curing shall use indirect heaters or steam to avoid hot spots. Follow resin manufacturer's recommendations for post cure temperatures and times. Any material not meeting the recommended Barcol hardness after post curing shall be rejected. NOTE: synthetic veils, such as nexus, will reduce the Barcol readings by several points.

PART 3. EXECUTION

3.1 GENERAL

- A. Installation, handling and storage of the tanks shall be in strict accordance with the Fabricator's recommendations. Care shall be taken not to damage the tanks and the accessories.

3.2 INSPECTION

- A. Inspection of all products fabricated to this Specification is required prior to shipment unless specifically waived in writing by ENGINEER. This shall include:
 - 1. Visual inspection to the requirements of ASME RTP-1, Level II.
 - 2. Barcol hardness measurements per ASTM D2583.
 - 3. Acetone sensitivity test for all internal secondary bonds.
 - 4. Glass content by ignition loss on three cutouts per ASTM D2584.
- B. A clearance for shipment shall not relieve the Fabricator's responsibility as to warranty, quality of materials and workmanship and dimensional conformity with the Drawings.
- C. ENGINEER will be permitted access to the plant area at all times during fabrication and shall be notified one week prior to the estimated date of fabrication.
- D. Repairs authorized by ENGINEER shall be reinspected before final acceptance unless specifically waived.
- E. Noncompliance with this Specification or evidence of poor workmanship shall be cause for rejection.
- F. Field Testing/Inspection: After final installation, each tank shall be hydrostatically tested BY THE CONTRACTOR to detect any damage during shipment and installation.

3.3 FABRICATOR'S CERTIFICATE(S)

- A. Provide Fabricator's certificate(s) in accordance with Section 1.5 "Submittals". In addition, provide information from the resin manufacturer listing the nomenclature, composition and characteristics of the resin, which shall be furnished with each tank.

3.4 PREPARATION FOR SHIPMENT, SHIPMENT AND PROTECTION

- A. In addition to any special requirements for shipping, handling, storage and protection provided in this Specification, fiberglass tanks shall be prepared and protected for shipment and shipped in accordance with

Fabricators standard procedures for secure shipment of FRP equipment.

3.5 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping: Prepare and protect materials for shipment and ship as follows:
1. All materials fabricated to this Specification must be packaged, crated, or protected in such a manner so as to prevent damage in handling and while in transit. Details of these procedures shall be the responsibility of the Fabricator. Tanks shall be mounted on padded cradles if shipped horizontally or on a suitable skid if shipped vertically.
 2. All flanged nozzles shall be protected and secured.
 3. All unflanged components shall either contain rigid plugs inside the ends to prevent deflection or shall be protected by adequate exterior wrapping. The open ends of tanks shall be braced with suitable stiffening members to prevent deflection.
 4. No components or other pieces shall be shipped loose inside of the tanks.
 5. Tanks shall be loaded with at least 1" minimum clearance between the tank (including fittings) and the bulkheads or bed of the vehicle.
 6. Regardless of the mode of transportation, all components shipped must be firmly fastened and padded to prevent shifting of the load or flexing of components while in transit.
 7. Contractor is responsible to carefully inspect the tank upon arrival and shall note any shipping damage on the Bill of Lading, and will immediately contact the fabricator to arrange inspection and repairs, if necessary.