

SPECIFICATION: **Fiberglass Tanks & Process Vessels**

CUSTOMER / PROJECT: _____

REQUIREMENTS

1.0 GENERAL

The manufacturer shall design, prepare detailed shop drawings, fabricate and test equipment, as covered by project specifications and purchase order. All equipment fabricated as part of this specification shall be of first quality, and shall be manufactured in accordance with the latest editions including addenda, amendments and revisions of the following:

- For All: ASME / ANSI RTP-1 Reinforced Thermoset plastic Corrosion Resistant Equipment
- For Hand Lay Up / Contact Molded Fabrications: ASTM D-4097 Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks
- For Filament Wound Fabrications: ASTM D-3299 Specification for Filament Wound Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks
- For Chop / Hoop 0°-90° Fabrications: ASME / ANSI RTP-1

Tanks and vessels shall be as manufactured by Composites USA, Inc.

2.0 PROJECT REQUIREMENTS

- 2.1 Suppliers shall submit with their proposal a list of all component materials that they intend to use for fabrication. The list shall include as a minimum, all resins, catalysts, promoters, flame retardant additives, tinting agents, surfacing veils and structural reinforcements. The owner shall have final approval over all resins and materials to be used.
- 2.2 If required, resin recommendations will be made by the vessel manufacturer based upon the customer's stated design conditions for the vessel, including chemical environment, operating and design temperatures, pressures, government agency requirements such as FDA, and local building code regulations specific to the project, if any.

- 2.3 Visual inspection of the vessel is to be carried out in accordance with ASME / ANSI RTP-1 Table 6-1 Level 2 RTP Visual Inspection Acceptance Criteria unless otherwise specified.

3.0 DESIGN

- 3.1 The general conditions for design shall be given by the customer on the design drawings or specifications that will usually show major dimensions. If possible, the ASME / ANSI RTP-1 Table 1-1 and the User's Basic Requirements Table, will be completed by the customer prior to project bid. This form generally provides all the information required by the vessel fabricator to properly design for the project requirements. If this is not available, an abridged requirements sheet such as that shown at the end of these specifications should be completed.
- 3.2 The fabricator will at a minimum need to know the desired volume, chemical to be stored, tank orientation, design pressure, design temperature, and installed location for compliance with local building codes.
- 3.3 Standard vessel construction will include a 0.100" nominal thickness corrosion liner. This corrosion liner will be included in the overall structural calculations unless otherwise directed by customer specifications. Minimum design thickness will meet the requirements of ASME RTP-1 unless otherwise specified.
- 3.4 Design is to be based upon a 10:1 factor of safety for internal pressure and or a 0.001 inch / inch allowable strain and the documented physical properties provided by the fabricator. A 5:1 factor of safety and or a 0.002 inch / inch allowable strain for external pressure is to be used in accordance with ASME RTP-1 guidelines.
- 3.5 Design of the vessel is to be by the fabricator's staff Professional Engineer, who must be experienced in fiberglass equipment structural design. Where applicable, calculations shall include, but are not limited to:
- Internal pressure
 - External pressure
 - Wind load
 - Seismic loads
 - Snow loads
 - Personnel loads of 250 lb / 16 in² of the top head unless otherwise specified
 - Design and upset temperature
 - Thermal gradient and thermal expansion stresses
 - Static head
 - Accessory loads from mixers, platforms, etc.
 - Internal supports
 - Transportation and erection loads
 - Stiffener rings
 - Flange thickness
 - Secondary bond overlays
 - Bottom knuckle and local reinforcement requirements
 - Hold down flanges, lift lugs, or ring supports
- 3.6 Drawings will be provided for customer review and approval of vessel dimensions, orientations, and construction details prior to fabrication.

4.0 DRAWINGS

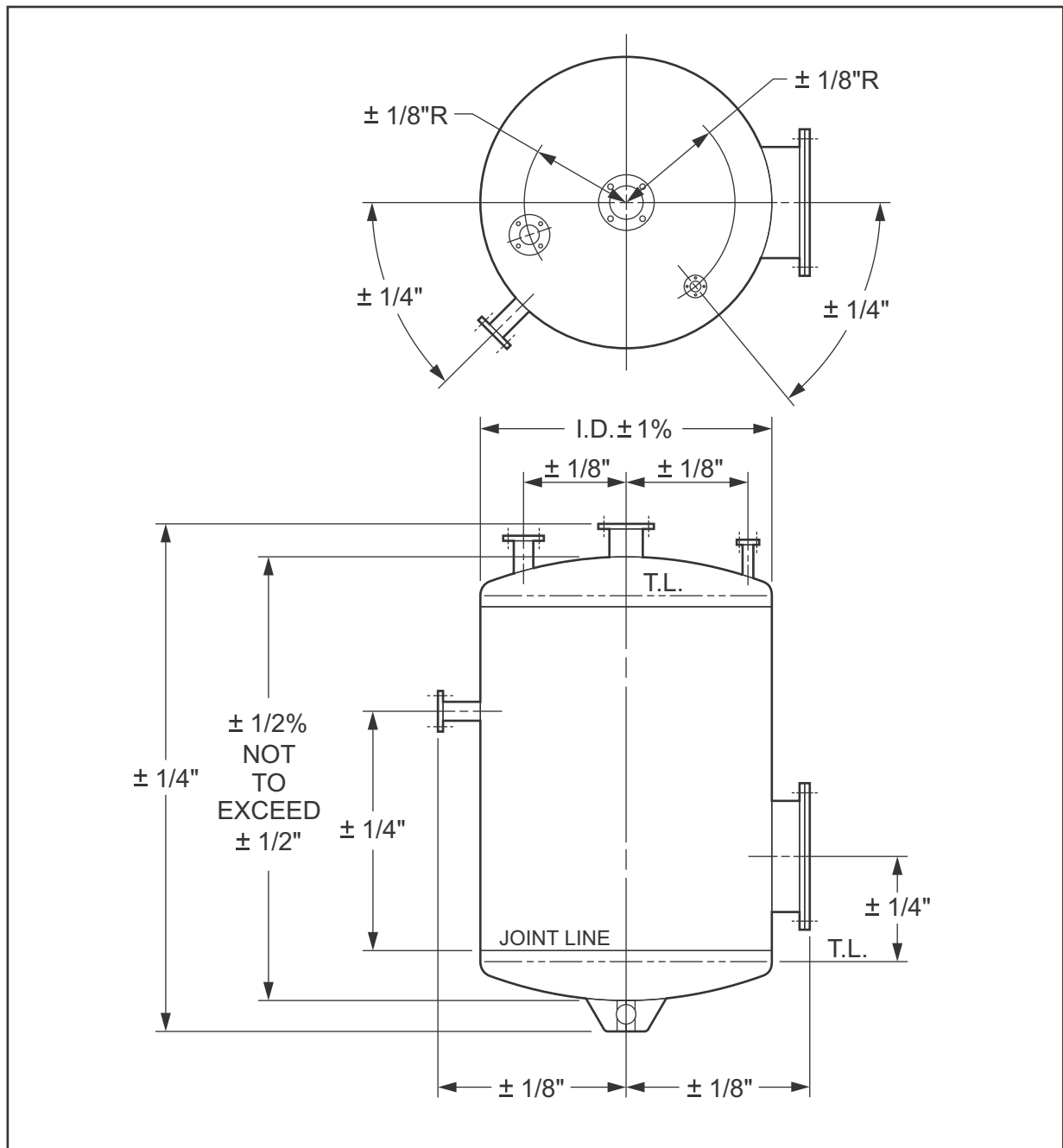
- 4.1 Approved Drawings are required for the complete fabrication of tank or vessel. Drawings will be provided in AutoCad format.
- 4.2 Drawings shall be complete and shall include as a minimum the following information:
- Item Number
 - Purchase Order Number
 - References: Supplier shall include on drawings a reference to all applicable codes and standards
 - External / internal design pressure and temperature, with specified specific gravity of fluid contained
 - Seismic and wind load requirements
 - Thickness and materials specifications for all components
 - Test requirements
 - Relevant fabrication, inspection and non-destructive examination requirements
 - Estimated weight of vessel empty and full of water
 - Pertinent dimensions, including joint locations, nozzle location and projection, location of vessel supports and other information necessary for complete description of the tank or vessel
 - Supplier's drawing shall show internal supports and nozzles numbered and lettered

5.0 MATERIALS

- 5.1 The fabricator must use the same resins and reinforcements during fabrication as used in the design basis, with the exception of the corrosion veil, which may be changed as required for corrosion resistance.
- 5.2 **Reinforcements:**
- All reinforcement shall be borosilicate glass unless specified otherwise on tank drawing(s).
 - Surfacing veil shall be organic or inorganic. Inorganic veils are to be Type C-glass 10 mils thick with a silane finish and styrene soluble binder. Organic veils, when specified, are to be polyester (Dynel or Nexus), Halar (ECTFE), or carbon veils. Thickness vary on the organic veils from 10-30 mils, depending upon the veil chosen.
 - Chopped strand mat shall be either 3/4 or 1-1/2 ounces per square foot, Type E-glass, with a silane finish and styrene soluble binder.
 - Continuous or woven roving shall be Type E-glass, 60 ends per strand, with silane finish.
 - Woven roving shall be a nominal 24 ounces per square yard.
- 5.3 **Resins:** The resin used will be a thermoset resin considered suitable for the application based upon its demonstrated prior success in similar applications or other test data. The type of resin to be used will be specified on the customer purchase order or job specification. Catalysts and promoters shall be those recommended by the resin manufacturer.

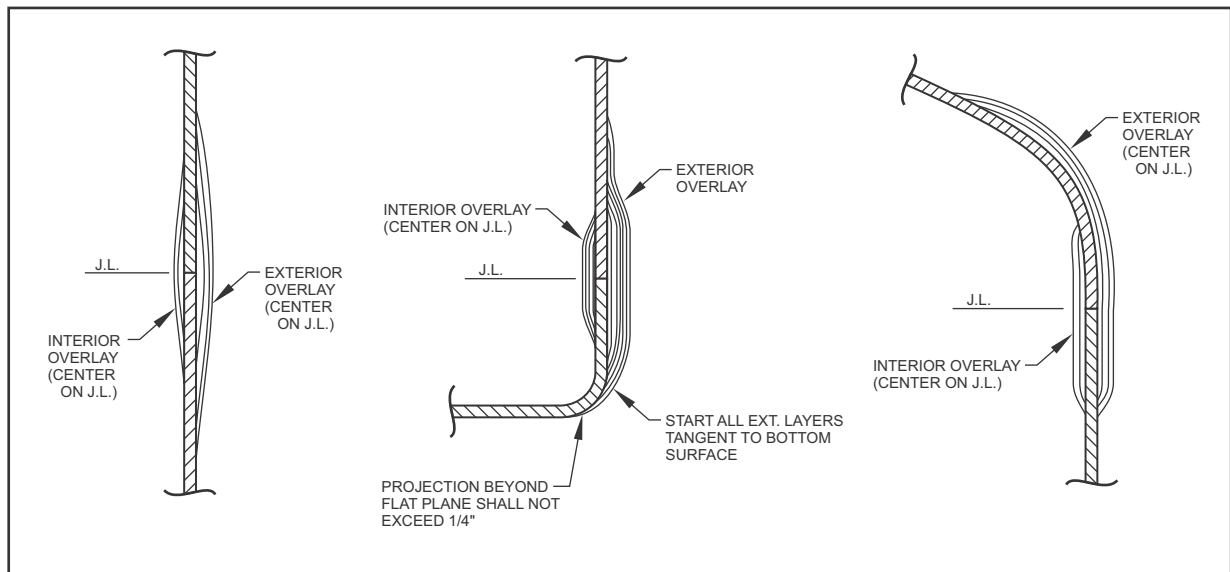
6.0 FABRICATION

6.1 All fabrication shall meet the requirements of the User's Basic Requirements Specification or other submitted user specification sheet and the fabricators design report, using the fabrication procedures below and the drawings provided. Typical tolerances are shown on the drawing below.



6.2 **Body Flanges:** Body flanges shall be flat and true to a required tolerance as follows: flanges less than or equal to 84" diameter, true to $+1/32''$, flanges over 84" through 108" diameter, true to $+1/8''$, and flanges over 108" diameter, true to $+3/32''$.

6.3 **Shell Joints:** Shell joints shall be either butt or bell and spigot construction as shown below for the bottom, top and side wall joints.



6.3.1 Secondary bond overlays shall be prepared as follows:

- All cured laminate surfaces to be overlaid shall be roughened with 36 grit (or coarser) sized abrasive for external and 60-80 grit abrasive for the final internal surface preparation.
- Fit up is to be as accurate as possible, minimizing the amount of any thixotropic putty required. If putty is used, it shall be formulated to be crack free after curing and shall be covered with a minimum of two layers of chopped strand mat and appropriate surface veils on all surfaces that are in contact with the corrosive environment.
- The thickness of the overlay shall be the thickness required for an equivalent hand lay up laminate regardless of the type of laminate being joined. If the vessel is specified as a Type I laminate (all chop strand mat), then a Type I overlay must be used. Otherwise, a Type II laminate incorporating woven roving in alternate layers with chopped strand mat may be used. Thickness of the overlay shall be as calculated in the design section above, with 0.22" the minimum allowable thickness.
- In applying the overlays, each successive layer of mat shall extend 1/2" beyond each side of the layer of mat applied previously. The inside bond should be finished with the surfacing veil, again extending 1/2" beyond the mat under it.
- The finished joint shall be smoothly contoured to blend the mat under it. The finished joint shall be smoothly contoured to blend into the pieces to be joined. Once the overlay has gelled, a paraffinated top coat of resin shall be applied over the surfacing veil and the adjacent roughened area.

6.4 Flanged Nozzles: Flanged nozzles are to be fabricated using Type I, all mat construction with veil to minimize the possibilities for delamination between dissimilar reinforcements during torqueing. Type II or Type X flange laminates, also allowed by ASTM and ASME RTp-1, may be used in special circumstances, or when specified by end user. Press molded, glue on flanges are not to be used for vessel fabrication.

Nozzle thicknesses are to be in accordance with ASME RTp-1 Fig. 4-6 and as follows, unless otherwise specified:

TABLE 1: Flanged Nozzles

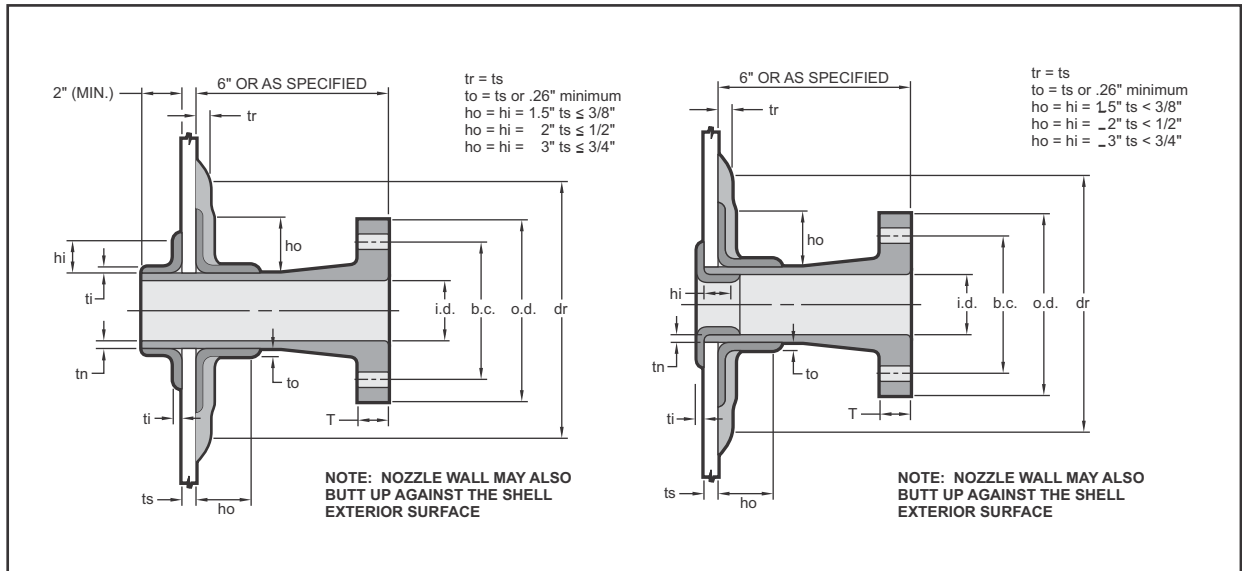
Size Nominal I.D.	Nominal O.D.	Bolt Circle Diam.	Flange Minimum Thick. Type I	Flange Minimum Thick. Type II	Nozzle Neck Minimum thick.	No. Bolts	Bolt Hole Dia.	Bolt Diam.	Washer O.D.	Bolt Torque ft-lb
1	4-3/4	3-1/8	.500	.500	.187	4	3/4	5/8	1-5/16	25
1-1/2	5-1/2	3-7/8	.500	.500	.187	4	3/4	5/8	1-5/16	25
2	6	4-3/4	.625	.563	.25	4	3/4	5/8	1-5/16	25
3	7-1/2	6	.625	.563	.25	4	3/4	5/8	1-5/16	25
4	9	7-1/2	.813	.688	.25	8	3/4	5/8	1-5/16	25
6	11	9-1/2	.938	.688	.25	8	7/8	3/4	1-1/2	25
8	13-1/2	11-3/4	1.125	.813	.25	8	7/8	3/4	1-1/2	25
10	16	14-1/4	1.25	.938	.25	12	1	7/8	1-3/4	25
12	19	17	1.438	1.063	.25	12	1	7/8	1-3/4	25
14	21	18-3/4	1.438	1.063	.313	12	1-1/8	1	2	30
16	23-1/2	21-1/4	1.563	1.188	.313	16	1-1/8	1	2	30
18	25	22-3/4	1.625	1.25	.375	16	1-1/4	1-1/8	2-1/4	35
20	27-1/2	25	1.813	1.313	.375	20	1-1/4	1-1/8	2-1/4	35
24	32	29-1/2	2.125	1.5	.438	20	1-3/8	1-1/4	2-3/8	40

Notes: All dimensions in inches unless otherwise noted. Gaskets shall be 1/8" elastomeric having a hardness of shore A60 +/- 5. The nominal rating of the nozzles above is 50 psig.

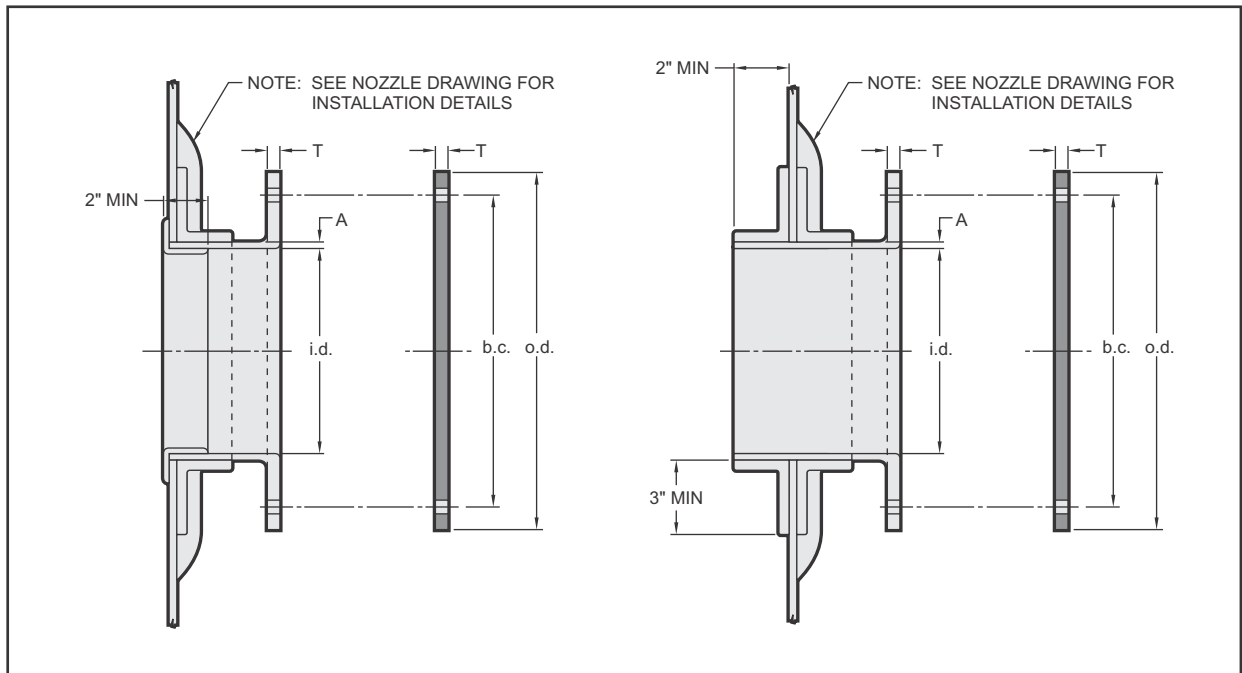
6.5 Bolt Holes: All bolt holes shall be back spot faced for washers in the dimensions shown in the table above. Bolt holes and spot facing shall be resin sealed. Overall machine facing of the back of flanges is acceptable, provided the hub is not undercut.

6.6 Installation of Nozzles: All nozzles and manways require reinforcement of the shell cut out area. Reinforcements shall be Type II, except for Type I laminate tanks, shall taper to the shell, and reinforcement joints shall be staggered. Reinforcement thicknesses shall be as called for in the vessel design.

6.6.1 The laminates used to install a nozzle or manway shall be made by hand lay-up using Type I or Type II laminates. If the vessel is filament wound, the reinforcement pad is to be of Type II construction. In addition, if the vessel is filament wound, the attachment laminate for nozzles 6" and above is to be Type II. Nozzles smaller than 6" diameter may be installed with Type I or Type II laminates if gusseted in accordance with RTp-1 Figure 4-11.



Actual installation may be either flush or penetrating, with inside welds seamed in accordance with ASME RTP-1, and as shown above. Bolt holes shall straddle the natural centerline of the tank, unless otherwise specified.



6.7 **Manways:** Manways shall have minimum dimensions of 20" diameter unless otherwise specified. Standard dimensions are as shown in Table 2 below:

6.8 **Post Cure:** Post cure may be required for some resin / catalyst cure combinations. If a vessel is to be post-cured, the resin manufacturer's recommendations are to be followed for time and temperature of the cure. Records documenting the cure cycle will become a permanent part of the job file.

TABLE 2: Manways

Size Nominal I.D.	Nominal O.D.	Bolt Circle Diameter	Flange Minimum Thickness	Nozzle Neck Thickness	No. Bolts	Bolt Hole Diameter	Bolt Diameter
Manway - Pressurized up to 15 psig							
20	27-1/2	25	1	3/8	20	3/4	5/8
22	30	27	1	3/8	20	3/4	5/8
24	32	29-1/2	1-1/4	3/8	20	3/4	5/8
30	38-3/4	36	1-3/8	9/16	28	3/4	5/8
36	46	42-3/4	1-3/4	9/16	32	3/4	5/8
Manway - Atmospheric pressure up to 0.5 psig							
20	27-1/2	25	3/8	1/4	20	1/2	3/8
22	30	27	3/8	1/4	20	1/2	3/8
24	32	29-1/2	3/8	1/4	20	1/2	3/8
30	38-3/4	36	1/2	5/16	28	1/2	3/8
36	46	42-3/4	1/2	5/16	32	1/2	3/8

7.0 VESSEL MARKING

7.1 The tank or vessel shall have securely and permanently attached a nameplate bearing the following information:

- Equipment Tag Number
- Name of the fabricator
- Date of manufacture
- Capacity
- All resins used
- Design temperature (maximum / minimum)
- Design pressure / vacuum
- Purchase order number
- Specific Gravity
- Inner surface reinforcements
- Any additional markings as required by local and state laws or codes
- Model number

8.0 INSPECTION

8.1 The fabricator shall allow the customer or their authorized representative access to the workplace involving any phase of the manufacture or inspection. The customer will advise of any required fabrication hold points for inspection prior to purchase order award.

8.2 The fabricator has the responsibility to comply with all the requirements of these specifications and design. The fabricator shall have a written Quality Control Manual, to include defined procedures and forms so as to control the process of fabrication. A copy of this Quality Control Manual is to be made available to the customer's inspector upon request.

8.3 In progress inspection:

- 8.3.1 In progress inspection by the fabricator's inspector will be made upon completion of all major components, including vessel shell, heads, nozzles and manways, prior to assembly. These in process checks will include but not limited to verification of part thickness, overall dimensions, and laminate quality. During assembly particular attention is to be given to shell joints for proper reinforcement and laminate quality.
- 8.3.2 During the course of fabrication, the fabricator shall make all checks necessary to assure that laminate imperfections are within the requirements of the specifications.

8.4 Final vessel inspection:

- 8.4.1 Final vessel inspection is to include checks for overall dimensional tolerances, laminate and secondary bond overlay visual checks, laminate cure tests, and completion of any additional customer required tests such as pressure or acoustic emission tests. Material certifications for raw materials used in fabrication of the vessel shall be supplied to the customer upon request.

9.0 HANDLING AND SHIPPING

- 9.1 The techniques and procedures used for handling and preparing RTP vessels for shipping should ensure delivery of damage free products.
- 9.2 The flexural, impact, and sheer properties of RTP laminated structures are significantly lower than those of metallic structures. Therefore, special consideration must be given to weight and weight distribution at contact points during handling, shipping, and storage of RTP vessels.
- 9.3 If any doubt exists regarding the handling procedures, the fabricator should be consulted.
- 9.4 Cylindrical vessels that are being shipped in horizontal position should be:
- Mounted on padded cradles. The cradles should be placed as close as possible to the top and bottom heads, and / or other stiffened areas.
 - The vessel should be secured to the truck with padded banding straps that are properly fastened to the bed of the vehicle.
 - The vessel should be blocked at the ends to prevent shifting in transit. The blocks should bear only on the knuckle radius of the flat or dished heads.
 - Open top tanks should be internally braced to maintain shape during transit.
 - Vessels being shipped in the vertical position should be secured to a pallet or skid, then fastened to the bed of the vehicle with padded banding for safe transit.
 - Flange faces should be covered for shipment. Flanges 48" diameter and smaller should be covered with plywood or some similar material.
 - All internals should be adequately secured and / or padded to ensure safe shipment.
 - Accessory pipe, fittings, and small parts should be crated or boxed. Crates or boxes exceeding 50 lb should be mounted on skids, in turn secured to the vehicle.



Fiberglass Tank / Process Vessel Worksheet

Date: _____
 Tel: _____
 Fax: _____

Size - Diameter: _____
 Size - Height: _____
 Straight Side Capacity: _____
 Nominal Capacity: _____

Plant: _____
 Location: _____
 Service: _____

Item Nos.: _____
 Quantity Required: _____
 Prepared By: _____

Top: Open ASME Dish Flat
 Cone Flanged Other

Bottom: Flat Sloped Dish Other

Criteria	Design	Operating
Liquid Contained & %:		
Liquid Specific Gravity:		
Temperature °F:		
Pressure:		
Vacuum:		
Wind:		
Seismic:		

Corrosion Allowance: _____
 Liner Veil: _____
 Resin - Corrosion Liner: _____
 Resin - Structure: _____
 Thickness, Top: _____
 Thickness, Bottom: _____
 Thickness, Shell: _____
 Gasket Material: _____
 Bolt Material: _____

Sketch:

NOZZLES, COUPLINGS, MANWAYS:

Mk.	Service	No.	Size	Rating	Style
M-1	Shell Manway				
M-2	Top Manway				
N-1	Inlet				
N-2	Outlet				
N-3	Thermowell				
N-4	Drain				
N-5	Vent				
N-6	Overflow				
N-7	Gage				
N-8					
N-9					
N-10					

ATTACHMENTS:

Lift Lugs: _____
 Hold Down Lugs: _____
 Support Clips Ladder: _____
 Support Clips Platform: _____
 Support Clips Pipe: _____
 Ladders: _____
 Top Platforms: _____
 Overflow Pipe: _____
 Dip Pipe: _____
 Baffles (plate / wedge): _____
 Insulation: _____
 Electric Heat: _____
 Internal Rings: _____
 Level Gage Glass: _____
 Level Gage Strip: _____
 Agitator Mount: _____
 Hydro Test: _____
 Post Cure: _____

Standards Referenced:

Remarks: