

# **SPECIFICATION: FIBERGLASS REINFORCED PLASTIC (FRP) LAUNDER TROUGH**

## **PART 1 – GENERAL**

### **1.01 Description of Work**

The work covered by this section shall include materials and installation for the fiberglass reinforced plastic (FRP) Launder Trough and supports, which includes but is not limited to:

- A. FRP Launder Troughs.
- B. FRP, galvanized steel or stainless-steel support brackets.
- C. Stainless steel fasteners and connections.

### **1.02 Quality Assurance**

- A. FRP launder troughs and associated FRP component materials shall comply with ANSI/AWWA standards as applicable for water and wastewater treatment applications with the following exceptions:
  - a. Maximum vertical deflection under full buoyant or gravity load shall be a maximum of 3/16" to ensure weir level control is maintained and aligned with the AWWA F101 standard. The L/D requirement of 1,000, while feasible for most troughs up to 24" in width and/or height, is not suitable for very large troughs.
  - b. Fiber stress limitations for normal operating conditions shall include an 8:1 factor of safety. For upset or occasional load conditions (e.g., seismic), a 3:1 factor of safety shall be used which takes into account modern construction methods not addressed in the current AWWA F101 standard.
- B. The manufacturer must be ISO 9001 certified and must manufacture the FRP launder troughs in their own facilities.
- C. The contractor shall be responsible for verifying all field dimensions for development and approval of manufacturer's drawings and shall coordinate the FRP products with the any other participating equipment manufacturers.
- D. Launder trough components (excluding any associated concrete items) shall be provided by a single manufacturer to ensure coordination and compatibility of component parts.
- E. The Manufacturer shall maintain a continuous quality control program with supporting documentation.
- F. The manufacturer shall warrant the launder troughs to be free of defects in materials and workmanship for a period of one year after delivery.

### **1.03 Product Substitutions**

- A. Substitutions shall be considered only if the consulting engineer has received a written request at least two weeks prior to the bid date. All bidders shall be notified by addendum if substitutions are acceptable prior to the bid.
- B. Requests for substitutions shall include technical information and any other information required for evaluation.

### **1.04 Performance Testing**

- A. Materials shall comply with Federal and Local laws or ordinances, applicable codes, standards, regulations, and/or regulatory agency requirements including:
  1. ASTM D 638, Standard Test Method for Tensile Properties of Plastics
  2. ASTM D 790, Standard Test Method for Flexural Strength and Flexural Modulus Properties of Plastics
  3. ASTM D 570, Standard Test Method for Water Absorption of Materials
  4. ASTM D 256, Standard Test Method for Izod Impact (Notched)
  5. ASTM D 2853, Standard Test for Barcol Hardness

### **1.05 Design Criteria:**

Contact molded fiberglass troughs shall be designed in accordance with AWWA Standard F101 for Contact-Molded Fiberglass-reinforced Plastic Wash-Water Troughs and Launderers and as follows:

- A. Gravity Load - Downward vertical loads shall include the weight of the trough and appurtenance attachments, such as weir plates, baffles, and spreader bars, together with the weight of water to fill the trough. Any additional loads, such as connection piping, etc., shall be considered separately.
- B. Buoyant Load - The buoyant load shall act vertically upward, its magnitude equal to the weight of displaced water (trough weight neglected). The line of action passes through the centroid of the submerged cross-sectional area.
- C. Lateral Load - Loads acting against the trough sidewalls by differential water levels on either side of the trough walls. The maximum possible differential, existing when the trough is empty and the tank is full, or, when the trough is full and when the tank is empty, shall be used when calculating deflection, fiber stress, etc.
- D. Thermal Stresses - The troughs shall be designed to accommodate temperature induced stresses resulting from differences in coefficients of thermal expansion and contraction between the trough and tank/support materials.
- E. Torsional Stability - The trough system shall be designed to resist torsional oscillations induced by the flow of water over trough edges. Provide wall-to-wall stabilizers as required to prevent torsional oscillation, and at a minimum in accordance with AWWA F101. If there can be absolutely no braces or other members interfering with the flow of water over the weir edge of the trough, then wall-to-wall stabilizers that run from one trough to another are not allowed. Provide torsional stability using other methods in accordance with AWWA F101.

- F. Deflection under Load - Maximum vertical deflection under full buoyant or gravity load, measured at mid-point between trough supports, shall not exceed 3/16".
- G. Maximum trough sidewall horizontal deflection under full lateral load shall be less than or equal to D/100, where D is defined as the trough depth, in inches. Under no circumstances shall the maximum bottom deflection exceed 3/16".
- H. Trough bottom deflection (oil canning) under full buoyant or gravity load shall be less than or equal to W/100, where W is defined as the trough width, in inches. Under no circumstances shall the maximum bottom deflection exceed 3/16".
- I. The minimum design factor of safety shall be 8:1 in accordance with AWWA F101 for normal operating conditions and 3:1 for upset or occasional loads (e.g., seismic).
- J. Trough supports shall allow +/- 1/2" of vertical and horizontal adjustment.
- K. Thermal Expansion/Contraction - The troughs shall be designed to accommodate a thermally induced expansion and contraction over temperature range of -10°F to 100°F, without exceeding the deflection or strain limitations stated.

**Standard Design Parameters (Imperial or Metric):**

Tank design (wall mount or inset launder) = _____	Trough width = _____
Tank wall inner radius = _____	Trough depth = _____
Weir wall inner radius (for internal launder) = _____	Effluent outlet size and location = _____
Weir invert elevation = _____	Known obstructions = _____

**1.06 Submittals**

Submittals shall include, but not be limited to:

- A. Drawings include dimensional layouts, product description, connection details; fastener types and location spacing, bill of materials, shipping, handling, storage and protection information, and installation guidelines.
- B. Information from the manufacturer including materials of construction, resin and glass fiber content, material certifications, physical samples, catalog information, warranty information, certified test reports of physical and mechanical properties of the product, preliminary installation, operation, and maintenance (if applicable).

**PART 2 – PRODUCTS**

**2.01 Manufacturer(s)**

- A. The standard for design and characteristics shall be based on materials and components provided by:
  1. Enduro Composites, Inc., Houston, TX (713) 358-4000, [www.endurocomposites.com](http://www.endurocomposites.com)
  2. Approved equal by Engineer.

**2.02 Materials**

A. FRP launder troughs and appurtenances shall be nominal 1/4" thickness (minimum) of fiberglass reinforced plastic molded to produce uniform smooth surfaces, free of voids and porosity, without dry spots, crazes, or unreinforced areas. Resin shall be Isophthalic polyester with corrosion-resistance properties. Launder trough glass reinforcement shall be an ECR or boron-free glass suitable for production process (e.g.: gun roving for spray-up / chopping; woven roving for vacuum molding / resin infused) and shall include glass fiber reinforcements 30% (minimum) of the material weight embedded within UV stabilized polyester resin. The color shall be standard dark gray. FRP material shall have resin rich inside surface (mold surface) and resin rich outside bottom and/or side surface after sanding, no glass fibers shall be exposed. Factory cut edges and drilled holes shall be sealed with compatible approved resin material.

B. FRP Launder Troughs shall exhibit these minimum properties of the laminate, unless otherwise noted:

a.	Tensile Strength	14,000 psi	ASTM D 638
b.	Flexural Strength	27,500 psi	ASTM D 790
c.	Flexural Modulus	1.00 x 10 <sup>6</sup> psi	ASTM D 790
d.	Izod Impact (Notched)	20.0 ft-lb/in	ASTM D 256
e.	Water Absorption	.20% maximum	ASTM D 570
f.	Barcol Hardness	40 (nominal)	ASTM D 2853

C. FRP Launder Troughs

1. The trough shall consist of a mold smooth inner surface, a structural layer and an exterior or outer relative smooth surface with no exposed glass fibers. The inner surface shall be (0.010 in to 0.020 in) thick of isophthalic polyester resin reinforced with a Type C veil surfacing mat containing less than 20%, by weight, of the reinforcing material. Gel-coat surface not allowed, inside or outside.
2. Subsequent structural layer reinforcement shall consist of plies of chopped strand mat or spray-up passes with other structural reinforcing materials such as cloth, minimum one layer of 24 oz. woven roving throughout or unidirectional roving's as required to meet the design requirements.

3. The exterior or outer surface shall consist of a resin rich layer to prevent air inhibition and to ensure suitable embedment of all structural reinforcing fibers.
4. The top edges of the trough shall be level and parallel with a tolerance of plus or minus 1/8" per 10 ft. length as measured when the trough is not loaded.
5. Metal reinforcing members, where required, shall be free of rust, oil, and any foreign matter, and shall be completely encapsulated with minimum of 1/8" thick overlay laminate material and shall, where feasible, extend beyond the metal members a minimum of 2 in.
6. Structural elements such as core reinforcements or molded stiffening flanges, where required, shall be integrally molded into the design along the trough side or floor.
7. Connecting flanges to secure the trough ends to each other or a tank wall and trough closed ends shall be laminated or molded to the trough.
8. Trough ends grouted into and/or passing through a tank wall shall have an integrally molded water stop laminated onto the trough end outer surface to prevent short circuiting from one tank chamber to another.
9. Internal stiffeners shall be 1" diameter FRP tube or larger with an internal 1/2" stainless steel rod threaded horizontally across the width of the trough to increase the structural rigidity of the trough. Stiffeners are placed along the trough length at appropriate spacing with both ends secured through each trough wall with washers and hex head nuts.
10. After fabrication, all cut edges, holes and abrasions shall be sanded smooth, and then sealed with a compatible resin coating to prevent the intrusion of water.

### **2.03 TROUGH SUPPORTS AND HARDWARE**

- A. Trough supports: Design and fabrication shall be the responsibility of the trough Manufacturer, suitable for the requirements of the installation.
- B. Trough support material: Shall be hot dipped galvanized steel, Type 304 stainless steel, Type 316 stainless steel, or FRP as required.
- C. Trough anchors and fasteners shall be 316 stainless-steel and other structural hardware (as indicated).
  - i. Mounting anchors shall be expansion (wedge) type or adhesive type (sized as required).
  - ii. Trough lap and connection fasteners shall be nut and bolt type assembly with washers and lock washers.

## **PART 3 – EXECUTION**

### **3.01 Material Handling**

- A. At the time of delivery, all materials shall be inspected for shipping damage. The freight company and the manufacturer shall be notified immediately of any damage or quantity shortages noted.
- B. The contractor shall protect FRP materials from cuts, scratches, gouges, abrasions, and impacts. When lifting crated FRP materials, spreader bars shall be used with straps (not wire slings unless materials are fully protected). FRP components shall not be dragged across one another unless separated by a non-scratching spacer.

### **3.02 Installation**

- A. Before placing and attaching components, the contractor shall confirm the alignment and location of the trough across the entire installation. All contact surfaces must be solid, free of voids or grout, relatively smooth, level, clean and free of debris.
- B. Unacceptable surfaces shall be corrected, modified, or even replaced by the contractor to create a level or smooth surface for trough system attachment.
- C. Installer shall erect the troughs according to sequence shown or stated on the approved installation drawings. Troughs shall be properly aligned by the installer at all mounting and connection conditions to form a professional-looking rigid structure.
- D. Unless noted otherwise, FRP troughs shall be attached to the supporting structure as follows:
  - a. For concrete structures - use design sized stainless steel concrete wedge or adhesive type anchors.
  - b. For other structures like steel tanks - use design sized stainless steel hex head type fasteners.
 Refer to manufacturer's instructions in the Enduro Installation - Operation - Maintenance manual (IOM) and approved drawings for proper fastener selection and procedure.
- E. The installer shall field cut materials only as directed by Enduro Composites according to Enduro IOM manual. Field modifications (cuts, copes, holes, etc.) unless shown on the drawings are not allowed without the manufacturer's written approval.
- F. The installer shall seal field cut edges and field drilled holes with a compatible approved material as required.
- G. FRP troughs shall be properly aligned by the installer at all mounting and lap connection conditions to form a professional looking rigid structure.
- H. The installer shall install other miscellaneous components or hardware as shown on the approved drawings.

### **3.03 Adjust and Clean**

- A. Surfaces are to be cleaned according to manufacturer's instructions according to Enduro IOM manual.
- B. Remove excess materials of construction and trash to leave site in a clean condition for subsequent operation.