

# FIBERGLASS REINFORCED PLASTIC (FRP) TROUGHS

## PART 1 GENERAL

### 1.1. SUMMARY

- A. This Section includes fiberglass reinforced plastic (FRP) troughs for clarifier effluent and other applications as shown on the Contract Drawings.

### 1.2. QUALITY ASSURANCE

- A. The material covered by these specifications shall be furnished by a reputable and qualified manufacturer of proven ability that is regularly engaged in the manufacture and installation of FRP products.
- B. Fabricator shall be experienced in successfully producing FRP products specified for this project, with sufficient production capacity to produce required units without causing delay in the work.
- C. Must be Manufactured in the U.S.A.
- D. Fabricator shall provide a list of ten (10) installations of comparable size in operation for at least ten (10) years.

### 1.3. SUBMITTALS

- A. The following shall be submitted in accordance with the General and Special Provisions.
  - i. Shop Drawings
    - a. Dimensions.
    - b. Job specific layout.
    - c. Sectional assembly.
    - d. Location and identification mark.
    - e. Weir locations and attachment
    - f. Scum Baffle locations and attachment.
    - g. Accessories, attachments, transition pieces.
    - h. Connection details.
  - ii. Manufacturer's catalog data showing:
    - a. Dimensions, spacing, and construction details
    - b. Materials of construction.
    - c. Description.
  - iii. Certificates
    - a. Submit Manufacturer's certification that all materials furnished are in compliance with the applicable requirements of this specification.

- iv. Manufacturer's Instructions
  - a. Submit complete information and instructions relating to the storage, handling, installation, and inspection of all equipment related to this Section.

#### 1.4. SHIPPING AND STORAGE INSTRUCTIONS

- A. All FRP components shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- B. The parts and assemblies that are shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.
- C. All FRP materials shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials.

## PART 2 PRODUCTS

### 2.1. MANUFACTURERS

- A. The following manufacturer is named to establish a standard of quality necessary for the Project:

**NEFCO, Incorporated, 8895 North Military Trail, Bldg. C, Suite 100,  
Palm Beach Gardens, FL 33410 (561-775-9303)**

### 2.2 DESIGN CRITERIA

- 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 piping, etc., shall also be considered.
- 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; specifically those induced 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 (contraction) between the trough and tank/support materials over temperature range of -10°F to 100°F.

- E. Torsional Stability - The trough system shall be designed to resist torsional oscillations induced by the flow of water over trough edges. Any or all of the following trough stabilization techniques shall be considered.
  - 1. Trough-to-trough stabilization
  - 2. Torsional stiffness
  - 3. Support spacing and rigidity
  - 4. Internal baffles and/or flow straighteners
- F. Deflection under Load - Maximum vertical deflection under full buoyant or gravity load shall be less than or equal to  $L/1000$ , where L is defined as the unsupported trough length in inches. Under no circumstances shall the maximum vertical deflection, measured at mid-point between trough supports, 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. Thermal Expansion/Contraction - The troughs shall be designed to accommodate a thermally induced expansion (contraction) of  $1/8$ " per 20 ft. length of trough over temperature range of  $-10^{\circ}\text{F}$  to  $100^{\circ}\text{F}$ , without exceeding the deflection or strain limitations set forth in the preceding sections

## 2.3 MATERIALS

- A. The trough laminate shall meet the following minimum physical and mechanical requirements:

Table 1. Laminate Mechanical and Physical Properties

<u>Property</u>	<u>Test</u>	<u>Value</u>
Tensile Strength	ASTM D-638	18,000 psi
Flexural Strength	ASTM D-790	28,000 psi
Flexural Modulus	ASTM D-790	$1.08 \times 10^6$ psi
Barcol Hardness	ASTM D-2853	40
Notched Izod	ASTM D-256	13 ft-lbs/in
Water Absorption	ASTM D-570	0.08%

- B. Resin - The resin shall be a commercial grade isophthalic polyester thermosetting resin, Corezyn COR75-AQ-010 or equivalent, which has either been evaluated in a laminate, or which has been determined to be acceptable for use in a waste treatment plant environment.

- C. Fillers: The resin shall contain no fillers. Thixotropic agents for viscosity control are acceptable. Colorants which have been determined by a least five years previous service to be acceptable for the service condition are acceptable. The standard color for the trough shall be green. Ultraviolet stabilizers are required in all trough laminates. Catalysts, accelerators and/or promoters shall be added to provide complete cure of the laminate and must meet the physical properties as indicated in Section 2.3 Table 1.
- D. Ultraviolet Resistance - Ultraviolet resistance is required in all laminates exposed to ultraviolet light, whether it be in the form of pigmentation or ultraviolet absorbers or a surface veil.
- E. Metal Reinforcement - When metal reinforcements are used, they shall be free of rust, oil and any foreign matter. They shall be completely encapsulated with a minimum of 1/8" thick laminate.
- F. Glass Mat Reinforcement - Glass mat reinforcement shall consist of chemically bonded surfacing mat and chopped strand or chopped strand mat as hereinafter described. Surfacing mat shall be 0.020 inches thick reinforced with a surfacing mat of Type C veil, 10 to 20 mils thick, with a silane finish and a styrene-soluble binder compatible with the resin; the glass content of this layer shall not exceed 20% by weight. Chopped strands shall be Type E glass, with silane finish and styrene-soluble binder.
- G. Woven Roving Reinforcement - The finished laminate shall include one layer of 24 ounce woven roving reinforcement over the entire trough surface.
- H. The content of the finished laminate shall be adequate to produce mechanical and physical properties conforming to Section 2.3, Table 1.
- I. Other Reinforcement – Additional reinforcement in the form of foam or balsa sheet for high stress areas at the sides and bottom of the trough shall be completely encapsulated within the laminate. Care shall be taken to insure that these areas of the trough laminate are not designated as attachment points or drilled for any purpose.
- J. Laminate Construction –
  1. Inner trough surface shall be a resin rich layer 0.020 inches thick reinforced with a 10-20 mil 'C' veil surfacing mat. This resin rich layer shall contain less than 20% by weight of the reinforcement veil. A gelcoat interior surface may be provided.
  2. Structural layers shall consist of plies of chopped strand mat with a maximum of 2 ounces per square foot per spray-up pass. Inter-layered between two layers of mat shall be one layer of 24 ounce woven roving over the entire trough structure. Each successive pass of reinforcement shall be thoroughly wetted with resin and shall be well rolled to exclude all air pockets and bubbles prior to the application of additional reinforcement.
  3. Outer trough surface shall consist of a resin rich layer not less than 0.020 inches thick. The outer layer resin shall be applied after cure of the structural layer and suitably embed all reinforcing fibers.

4. Finished trough shall be a minimum of 30% fiber reinforced with a minimum thickness of not less than 1/4". The laminate tolerance thickness shall be  $\pm 10\%$ .
- J. Materials used in the manufacture of the FRP troughs shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.

## 2.4 DESIGN AND MANUFACTURE

- A. The inner surface of the trough shall be smooth and resin rich. The outer surface shall be reasonably smooth, resin rich, and no glass fibers shall be exposed. The size and number of air bubbles shall be held to a minimum. Laminations shall be dense and without voids, dry spots, cracks or crazes.
- B. The top edges of the trough shall be level and parallel with a tolerance of plus or minus 1/8" (measured when the trough is not loaded).
- E. The length of a trough section shall have a tolerance of  $\pm 1/8$ " per 10 ft. length.
- F. Horizontal stiffening flanges shall be integrally molded along the top edge of each trough side. These flanges shall be 1" to 3" wide, depending upon the trough configuration and shall face outward.
- G. End flanges, where required to bolt trough sections together, and blind ends for securing to a wall, shall be a minimum of 1-1/2 times the nominal thickness of the trough.
- H. An integrally molded water stop shall be provided on the trough whenever the trough is grouted into and/or passes through a wall.
- I. Horizontal stiffeners shall be provided across the width of the trough to increase the structural rigidity of the trough system. The stiffeners shall be 1" diameter PVC pipe with an internal 1/2" stainless steel rod threaded on both ends and fastened through the trough walls on 2-foot centers, or as recommended by the manufacturer.
- J. After fabrication, all cut edges, holes and abrasions shall be sanded smooth and sealed with a compatible resin coating to prevent the intrusion of water.

## 2.5 TROUGH SUPPORTS AND HARDWARE

- A. Manufacturer shall be responsible for the design and fabrication of supports suitable for installation of the troughs specified herein.
- B. Trough supports may be hot dip galvanized steel, type 304 stainless steel, or FRP.

- C. All trough fasteners and anchors shall be Type 304 or 316 stainless steel and shall be supplied by the trough manufacturer.

## 2.8 GUARANTEE

- A. The equipment manufacturer shall guarantee each unit being supplied to the Owner against defects in workmanship and material for a period of two years under normal use, operation and service. The guarantee shall be in printed form.
- B. In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the manufacturer shall provide a replacement part without cost to the Owner. The contractor shall provide, without cost, such labor as may be required to replace, repair or modify all materials and equipment provided pursuant to this specification.

## EXECUTION

### 3.1 STORAGE

- A. Should it be necessary to store product prior to installation, precautions should be taken to prevent cracking, twisting, warping, distortion, bending, breaking, chipping or damage of any kind to the materials.

### 3.2 INSTALLATION

- A. Install troughs and supports in accordance with manufacturer's instructions and approved shop drawings.
- B. Field cutting of troughs is allowed if necessary. All field cut edges and field drilled holes shall be sealed per the manufacturer's instructions.
- B. Ensure that troughs and supports are installed plumb and true, free of warp or twist, within the tolerances specified by the manufacturer and as shown on the drawings.
- C. After the manufacturer has approved the installation, and prior to startup, the Contractor shall clean all surfaces in accordance with the manufacturer's instructions.

END OF SECTION