

SPECIFICATIONS

GLASS-FIBER REINFORCED POLYESTER (FRP) REHABILITATION MANHOLES

I. SCOPE OF WORK

This specification shall govern for the furnishing of all work necessary to accomplish and complete the installation of glass-fiber reinforced polyester rehabilitation manholes. Glass-Fiber Reinforced Polyester Rehabilitation Manholes shall be a one-piece monolithic designed unit constructed of glass-fiber reinforcements, supplier-certified unsaturated isophthalic polyester resin, and chemically enhanced silica to improve corrosion resistance, strength and overall performance. FRP manholes shall be manufactured in strict accordance with *ASTM D-3753 "Standard Specification for Glass-Fiber Reinforced Polyester Manholes"*, as manufactured by Containment Solutions, Inc., Conroe, Texas, FRP manholes, or engineer pre-approved equal.

II. GOVERNING STANDARDS

Manholes shall conform to the following design criteria:

- A. ASTM D-3753: Standard Specification for Glass-Fiber Reinforced Polyester Manholes.
- B. ASTM C-581: Practice for Determining Chemical Resistance of Chemical Thermosetting Resins Used in Glass-Fiber Reinforced Structures Intended for Liquid Service.
- C. ASTM D-2412: Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading.
- D. ASTM D-695: Test Methods for Compressive Properties of Rigid Plastics.
- E. ASTM D-2584: Test Method for Ignition Loss of Cured Reinforced Resins.
- F. ASTM D-790: Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and electrical Insulating Materials.
- G. ASTM D-2583: Test Method for Indentation Hardness of Rigid Plastics by means of a Barcol Impressor.
- H. AASHTO H-20: Axial Loading.

III. GENERAL DESCRIPTION

- A. Dimensions: The manhole shall be a circular cylinder, reduced at the top to a circular manway not smaller than 22 1/2" inside

diameter. Manholes shall be produced in whole foot increments of length +/- 2". Nominal inside diameters shall be 42". Tolerance on the inside diameter shall be +/- 1%. Manhole wall thickness shall be a minimum of 0.400". Other diameters as agreed upon between purchaser and the manufacturer are covered by this specification.

B. Configuration:

1. The Manway reducer must provide a bearing surface on which a standard ring and cover may be supported and adjusted to grade. The reducer shall be concentric and shall be joined to the barrel section at the factory with resin and glass fiber reinforcement, thus providing required monolithic design to prevent infiltration and/or exfiltration through the manhole.

Manway reducer cone section shall be self-centering to permit vertical height adjustment (raising or lowering) of manhole by contractor utilizing manufacturer provided materials and detailed written instructions.

- A. Class: The manhole shall be manufactured in one class of load rating. This class shall be H-20 wheel load (minimum 16,000 pounds dynamic wheel load).

- B. Manhole Liner Bottom: Resin and glass fiber reinforced manhole bottoms may be provided, upon engineer's request. Under special circumstances this request may be made by engineer, upon that request, Manhole Bottom shall be provided with glass reinforced bottom section designed to withstand the hydrostatic head pressure, empty and water to grade, of units at 25ft. burial depth. (Units deeper than 25ft. may require additional reinforcement as required). FRP ribs or FRP structural members may be utilized to meet the design criteria. Stiffeners shall be of non-corrosive materials encapsulated in fiberglass. FRP encapsulated wood or lumber shall not be permitted.

- C. Marking and Identification: All manholes shall be marked in letters no less than 1" in height with the following information:

1. Manufacturers Identification
2. Manufacturers Serial Number
3. Manhole Length
4. ASTM Designation
5. Installation assist marks (vertical lines 90° apart at base of manhole).

IV. MATERIALS

- A. Resin: The resins used shall be unsaturated, supplier certified, isophthalic polyester resins. Mixing lots of resin from different manufacturers, or "odd-lotting" of resins shall not be permitted. Quality-assurance records on the resin shall be maintained. Non-pigmented resin is required to allow for light or "sand" color of manhole surface in order to facilitate easy from grade interior inspection. UV Inhibitors shall be added directly to resins to prevent photodegradation. Exterior gel-coating shall not be permitted.

- B. Reinforcing Materials: The reinforcing materials shall be commercial grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric, or both, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.
- C. Surfacing Material: If reinforcing material is used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass or organic surfacing mat having a coupling agent that will provide a suitable bond with the resin.
- D. Fillers and Additives: Fillers, when used, shall be inert to the environment and manhole construction. additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used to meet the requirements of this standard. However, calcium carbonate mixed by the fabricator shall not be permitted. The resulting reinforced plastic material must meet the requirement of this specification.
- E. Laminate: The laminate shall consist of multiple layers of glass matting and resin. The surface exposed to the sewer/chemical environment shall be resin rich and shall have no exposed fibers.

V. MANUFACTURE

- A. Manhole cylinders, manway reducers, and connectors shall be produced from glass fiber-reinforced polyester resin. Manhole cylinders to 66" ID to be manufactured by "computer regulated continuous band mandrel process, 72" ID and larger to be manufactured by computer regulated steel mandrel process utilizing structural rib design.
- B. Interior Access: All manholes shall be designed so that a ladder or step system can be supported by the installed manhole.
- C. Manway Reducer: Manway reducers shall be concentric with respect to the larger portion of the manhole diameters through 60 inches. Larger manholes may have manway reducers that are either concentric or eccentric with respect to the larger portion of the manhole.
- D. Cover Ring and Support: The manhole shall provide an area from which a typical ring and cover plate can be supported without damage to the manhole.
- E. Assembly Joints: Product components, i.e., cylinders, reducers, bottoms, and connectors, may be joined together to form a complete manhole. (see 3A).

VI. REQUIREMENTS

- A. Exterior Surface: The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to *eliminate* fiber show. The exterior surface shall be

free of blisters larger than 0.5" in diameter, delamination and fiber show.

- B. Interior Surface: The interior surfaces shall be resin rich with no exposed fibers. Interior surface shall be smooth for improved corrosion resistance and reduced sludge build-up. The surface shall be free of crazing, delamination, blisters larger than 0.5" in diameter, and wrinkles of 0.125" or greater in depth. Surface pits shall be permitted up to 6' 2" if they are less than 0.75" in diameter and less than 0.0625" deep. Voids that cannot be broken with finger pressure and that are entirely below the resin surface shall be permitted up to 4' 2" if they are less than 0.5" in diameter and less than 0.0625" thick.
- C. Repairs: Any manhole repair is required to meet all requirements of this specification.
- D. Manhole Lengths: Manhole lengths shall be in whole foot increments +/- 2".
- E. Load Rating: The complete manhole shall have a minimum dynamic load rating of 16,000 lbs. When tested in accordance with ASTM 3753, 8.4 (note 1). To establish this rating the complete manhole shall not leak, crack, or suffer other damage when load tested to 40,000 lbs. and shall not deflect vertically downward more than 0.25" at the point of load application when loaded to 24,000 lbs.
- F. Stiffness: The cylindrical portion of the manhole is to be tested in accordance with ASTM Method D 2412. The manhole cylinder shall have the *minimum* pipe-stiffness values shown in the table below, when tested in accordance with ASTM 3753, Section 8.5, (note 1).

Manhole Length (ft)	PSI
3 - 6	0.72
7 - 12	1.26
3 - 20	2.01
21 - 25	3.02
26 - 35	5.24

- G. Soundness: In order to determine soundness, an air or water test is to be applied to the manhole test sample. While holding the pressure between 3-5 psi, the entire manhole must be inspected for leaks. Any leakage through the laminate is cause for failure of the test. Refer to ASTM 3753, Sec. 8.6.
- H. Chemical Resistance: Per ASTM C 581; (see ASTM 3753, Section 8.7), Flexural strength, flexural modulus, and barcol hardness are plotted versus time on log-log coordinates. The line defined by these points is extrapolated to 100,000 hours. The minimum extrapolation retention allowed for any of these properties is 50%. Test samples used are actual pieces of manhole or samples manufactured in a manner consistent in every way with the manhole component construction.

I. Physical Properties:

Flexural Strength (cone):	Hoop: 15.4 x 103 psi Axial: 17.2 x 103 psi
Flexural Strength (pipe)	Hoop: 22.5 x 103 psi Axial: 14.3 x 103 psi Compressive Strength: 18.9 x 103 psi

VII. TEST METHODS

- A. All tests shall be performed as specified in ASTM 3753, Section 8, Titled "Test Methods". See ASTM 3753, Section 8, Note 5, for Test method D-790 and test method D-695.

VIII. QUALITY ASSURANCE/QUALITY CONTROL

- A. Examination: Each manhole component part shall be examined for dimensional requirements, hardness, and workmanship.
- B. Composition Control: Controls on glass and resin content shall be maintained for all manufacturing processes and for each portion of manhole fabrication. Records shall be maintained of these control checks. Proper glass content may be shown by glass usage checks, by glass and resin application rate checks, in accordance with the material composition test in ASTM 8.8.1.
- C. All required ASTM 3753 testing shall be completed and records of all testing shall be kept and copies of test results shall be presented to customer upon written request within a reasonable time period.

IX. CERTIFICATION

- A. When requested by the purchaser on his order, a certification shall be made the basis of acceptance. This shall consist of a copy of the manufacturer's test report or a statement by the supplier, accompanied by a copy of the test results, that the manhole has been sampled, tested, and inspected in accordance with the provisions of ASTM 3753 and this specification, and meets all requirements. An authorized agent of the supplier or manufacturer shall sign each certification so furnished.

X. HANDLING AND STORAGE

- A. Do not drop or impact the fiberglass manhole. Lift manhole with two slings on spreader bar in horizontal position or by use of 4" x 4" timber inserted crosswise inside the manhole to the underside of the collar with a rope or chain attached to backhoe or other lifting device. Manhole may be rolled, however, insure that ground is smooth and free of rocks, debris, etc. Use of chains or cables in

contact with manhole surface is prohibited.

XI. INSTALLATION METHODS

- A. General: The manhole installation should strictly follow the manufacturers recommended installation procedures.
- B. Prepare Excavation: Excavate an area around the top of the existing manhole sufficiently wide and deep for removal of old castings (ring and cover) and reducer (cone) section.
- C. Rehabilitation Manhole Preparation: The bottom of the rehabilitation manhole must be cut to fit existing manhole invert as closely as possible - this procedure is absolutely essential when it must support H-20 wheel loads. Make cutouts in rehabilitation manhole wall to accommodate existing inlets, drops and cleanouts. Cuts should be precisely made with an electric or gasoline saw fitted with a masonry-type blade or with a special jigsaw.
- D. Set Manhole: To lift rehabilitation manhole, insert 4" x 4" timber crosswise inside the manhole to the underside of the collar with a rope or chain attached to backhoe or other lifting device. Lower rehabilitation manhole into existing manhole and quick-setting grout mixture. A good bottom seal should be obtained in order to prevent loss of grout from the annular space between the outside of the liner and the interior wall of the existing manhole. The installer should place a 6" height of quick-setting grout above the initial bottom seal.
- E. Liner Grouting: Fill the annular space between the rehabilitation manhole and the existing manhole with an economical Portland Cement and sand grout mixture. The concrete grout backfill shall be poured in layers of not more than 12" in even lifts.
- F. Backfill: Backfill should be place evenly around any exposed portions of the manhole in 12" maximum lifts and should thoroughly tamped to 95% standard proctor density before the next layer is installed. Backfill material shall be stabilized sand or crushed stone. The material chosen shall be free of large lumps or clods, which will not readily break down under compaction. Backfill material shall be subject to approval by engineer.
- G. Bring to Grade: Construct chimney on flat shoulder of manhole using precast concrete rings.

XII. INSPECTION

- A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the owner. Such inspections shall be made at the place of manufacture, or at site of delivery, and the sections shall be subject to rejection on account of failure to meet any of the specification requirements. Sections rejected after delivery to the job site shall be marked for identification and shall be removed from the job at once. All sections which have been damaged after delivery will be rejected, and if already installed shall

be acceptable if repaired or removed and replaced at the contractor's expense.

- B. At the time of inspection the material will be examined for compliance with the requirements of this specification and the approved drawings.

XIII. MEASUREMENT

This item will be measured will be measured by each type of individual structure completed. The depth will be measured from the flow line to the top of the rim. The size shall be nominal inside diameter. This item includes, but is not limited to the following:

- A. Structural excavation
- B. Loading, hauling, and disposing of all excess material
- C. Furnishing all labor and materials including fiberglass, concrete, mortar, bricks, drop pipe and fittings, manhole rings and covers
- D. Placing and compacting all backfill
- E. Final Grading

XIV. PAYMENT

- A. This item will be paid for at the contract unit price per bid per each structure for the various sizes, types, and various depths of structures complete in place and will be full compensation for all materials required, operations, labor, tools, equipment, and all other incidentals necessary to complete the work as shown on the drawings and specified herein.