ENERGY ABSORBING MANHOLES

1. REFERENCE SPECIFICATIONS, CODES, AND STANDARDS
	1. AASHTO H-20 – Axial Loading.
	2. ASTM C581 – Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service.
	3. ASTM D256 – Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
	4. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
	5. ASTM D785 – Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
	6. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
	7. ASTM D 2563 – Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
	8. ASTM D2583 – Standard Test Method for Indentation Hardness of Rigid Plastic by Means of a Barcol Impressor.
	9. ASTM D2584 – Standard Test Method for Ignition Loss of Cured Reinforced Resins.
	10. ASTM D3753 – Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells.
	11. All references shall be of the latest revision.
2. SUBMITTALS
	1. Units
		1. All submittals, specifications, drawings, brochures, installation instructions, descriptive literature, etc. shall have all units of measurement in both Imperial and SI units.
	2. Drawings
		1. Project specific drawings, showing:
			1. Overall structure length, width, and height.
			2. Critical elevations.
			3. Ladder, top, coupling, and energy absorbing structures.
			4. Joints, connections, fasteners.
			5. Sizes, spacing, and locations of structural members, ribs, anchoring clips, and dimensional bracing.
			6. Materials and thicknesses of construction.
		2. Generic layouts or check marked brochures shall be rejected without review.
	3. Specifications
		1. Project specific specifications.
		2. Generic or check marked specifications shall be rejected without review.
	4. Receiving, Handling, and Storage Instructions
	5. Installation Instructions
	6. Operation and Maintenance Instructions
	7. Product Warranty
	8. Test Data
		1. Manhole
			1. Test result data confirming full compliance with ASTM D3753 for manhole barrel and reducer structures as required under Section 11 of the standard.
		2. Channel
			1. Test results confirming diversion structure material properties.
	9. Laminate Sample
		1. 6-inch [15.24 cm] square samples of representative manhole barrel and energy absorbing structure laminates, upon request.
	10. Quality Assurance Data
		1. Fabricator’s Certificate of Compliance with fabrication requirements.
		2. Qualifications of fabricator’s Quality Assurance Supervisor.
		3. Copy of fabricator’s Quality Assurance Program.
		4. Quality Assurance Inspection with:
			1. In-production Quality Assurance Inspection report(s).
			2. Certificate of post-production Quality Assurance Inspection report(s).
3. RECEIVING, HANDLING, AND STORAGE
	1. Receiving
		1. Inspect for damage
			1. All parts should be inspected upon delivery to the site, noting any missing items or visible damage.
			2. The end connections, couplings, base mounting flange, and top should be inspected.
			3. For smaller boxed items make sure to verify that all packaging seals are in place and that there is no visible damage to the packaging.
		2. Investigate for order correctness and count
			1. Once the order has been received review the packing list against what has been received. Should any items not appear to be present or the configuration of the items does not match the description on the packing list, contact Openchannelflow immediately.
			2. Small connection hardware (nuts, bolts, etc.) not attached to the manholes ship inside the manhole in individual boxes – with those contents clearly marked. Special care should be taken to secure these and any other small items that can be misplaced on a job site.
	2. Handling
		1. When cranes, hoists, and other machinery are used to lift manholes or manhole sections, spreader bars and lifting straps should always be used. When performing any overhead lift, all lifting eyes must be used in conjunction with good rigging practices. Rigging and lifting sequences and schedules of equipment are solely the responsibility of the installing party.
		2. Taglines should be used to control the movement of the structure during lifting.
		3. Manholes must be lifted by using nylon or similar fabric slings or lifting lugs, if furnished on the unit. Chains, ropes, and the like should never be used to move or position any fiberglass item as they may serrate the fiberglass laminate or compromise the protective gel coat surfaces.
		4. Manholes should never be dropped, rolled, slid, or impacted.
	3. Storage
		1. Manholes not intended for immediate installation may be stored until the site is ready for their installation.
		2. Manholes should only be stored in a location that is clean, level, free of sharp objects and protected from construction traffic.
		3. When shipped on pallets, manholes should be left on those pallets until such time as they are needed. Care should be taken to ensure that the base flange and end connections are protected from damage. Tarp or cover any manhole to be stored for an extended period of time before installation.
		4. Chocks and / or tie downs should be used to prevent rolling or movement due to wind.
4. MANUFACTURER
	1. Supply Energy Absorbing manholes as manufactured by:
		1. Openchannelflow (phone: 855.481.1118 / fax: 855.3316475 / www.openchannelflow.com).
			1. Locally represented by:
				1. XX.
5. SUBSTITUTIONS
	1. Manufacturers wishing consideration as acceptable substitutes must follow the steps outlined below.
	2. Include a copy of this specification section with all applicable plans sheets / details, addendum updates, and all referenced / applicable sections.
	3. Each paragraph must be check marked to indicate complete compliance with the specification or clearly marked to indicate a request for deviation from the specification requirements.
		1. Use check marks (✔) to denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested, underline each deviation and denote by a number in the margin to the right of the identified paragraph.
		2. The remaining portions of the paragraph not underlined will signify compliance on the part of the Manufacturer with the specifications.
		3. Include a detailed, written justification for each numbered deviation.
		4. Failure to comply with the above is sufficient cause to summarily reject the entire request for substitution.
	4. Requests for substitution must be made in writing and be received by the engineer’s office a minimum of ten (10) business days before the bid opening.
	5. Manufacturers not pre-approved shall not be given consideration.
	6. Manufacturers requesting pre-approval must have been regularly engaged in the application, design, and manufacturing of open channel primary devices for at least ten (10) years.
	7. To ensure strict quality control, the Manufacturer may incorporate raw materials from outside vendors, but the Manufacturer must fabricate the final product.
		1. Job shopping or outside fabrication / sourcing shall not be acceptable.
	8. In addition, the request for substitution must provide information regarding a minimum of ten (10) comparable North American installations, including:
		1. Owner’s name, location, and contact information.
		2. Application and performance specifications.
		3. Date of installation.
		4. Operational history.
		5. Equipment arrangement, including configuration and materials of construction.
6. WARRANTY
	1. Energy Absorbing Manholes shall be warranted to be free of defects in workmanship and materials for five (5) years with a completed warranty registration.
	2. The warranty period shall begin from the date of shipment.
7. SYSTEM DESCRIPTION
	1. Configuration
		1. Energy Absorbing Manholes shall be monolithic, watertight, corrosion resistant units consisting of (as a minimum): manhole barrel, top, confined space entry warning sign, coupling, energy absorbing structure, end connections (pipe stubs / flanges / caulking collars), base, and mounting flange.
		2. Diameter
			1. 48-inches [1.22 m] I.D.
			2. 60-inches [1.52 m] I.D.
			3. 72-inches [1.83 m] I.D.
			4. 96-inches [2.44 m] I.D.
			5. Inside diameter tolerance: +/- 1%.
		3. Top style
			1. Aluminum top
				1. A 2/3rds opening aluminum cover rated for 300 psf [14.36 kPa] pedestrian loading, mounted at the top of the manhole barrel and constructed from 1/4-inch [0.635 cm] thick aluminum diamond plate with stainless steel hardware.
				2. The hatch shall be provided with the following standard equipment:

Stainless steel piano hinge, recessed lift handle, and staple for user-supplied padlock.

* + - 1. H-20 traffic reducer
				1. A purpose-built fiberglass reducer cone providing a bearing surface for grade rings and frame / cover system, designed and tested to meet or exceed AASHO H-20 wheel loading (minimum 16,000 pounds [7,257 kg] vertical dynamic wheel load).
				2. Reducer shall be factory joined to the manhole barrel with resin and glass fiber reinforcement to provide a monolithic, waterproof unit.
				3. The reducer opening shall be:

Ø48-inch [121.9 cm] manholes.

Concentric Ø31 3/4-inch [80.65 cm].

Concentric Ø22 1/2-inch [57.15 cm].

Concentric Ø38-inch [96.52 cm].

Eccentric Ø22 1/2-inch [57.15 cm].

Ø60-inch [152.4 cm] manholes.

Concentric Ø31 3/4-inch [80.65 cm].

Concentric Ø38-inch [96.52 cm].

Eccentric Ø36-inch [91.44 cm].

Ø72 inch [182.9 cm] manholes.

Concentric Ø31 3/4-inch [80.65 cm].

Concentric Ø38-inch [96.52 cm].

Eccentric Ø36-inch [91.44 cm].

* + - * 1. H-20 options

Composite grade rings, frame, and cover

Grade rings:

Grade rings shall be provided in sufficient quantity and heights so as to allow the installation of the manhole frame and cover to be installed 12-inches [30.48 cm] above the shoulder of the manhole reducer.

Grade rings shall be composed of 100% recycled post-consumer and industrial waste materials and shall conform to ASTM D4976.

Sufficient quantities of hydrophobic polyurethane adhesive / sealant shall be provided to bond the grade rings to the manhole frame and reducer.

Frame and cover system:

Frame and cover system shall contain a minimum of 45% fiber reinforcement in a thermoset resin matrix resulting in a minimum strength to weight ratio of 750:1.

The cover surface shall have a permanently molded slip resistant surface with a minimum coefficient of 0.6 per ASTM C1028.

Load carrying capacity shall meet AASHTO M306-05, H-20, & H-25.

Cover shall be held in place by (2) quarter turn-paddle locks.

* + 1. Height
			1. The manhole shall be \_\_\_\_\_-feet \_\_\_\_\_-inches [\_\_\_\_\_ cm] high as measured from the manhole base to:
				1. Domed fiberglass style:

Surface grade plus 12-inches [30.48 cm].

* + - * 1. Aluminum top style:

Surface grade.

* + - * 1. H-20 traffic reducer style:

Manhole reducer shoulder, typically 12-inches [30.48 cm] below surface grade to allow for the installation of the grade rings, frame, and cover.

* + 1. Construction
			1. One-piece construction.
			2. Two-piece construction, with watertight adhesive joint, field assembly by others.
		2. Energy Absorbing Structure
			1. Baffle
				1. Reinforced fiberglass baffle plate, consisting of 1-inch [2.54 cm] of high density, structural polyurethane foam encapsulated between fiberglass laminate layers not less than 1/4-inches [0.635 cm] thick, rigidly affixed at the base to the manhole floor and at the top by fiberglass or T-304 stainless steel square tube attached to the manhole barrel.
			2. Direction cheeks
				1. Curved fiberglass cheeks to direct the dampened flow to the outlet end connection with integral benches atop each cheek with a factory molded (non-applied) non-slip diamond pattern.
		3. End Connections
			1. Inlet
				1. \_\_\_\_\_-inch [\_\_\_\_\_ cm] O.D. pipe stub

Elastomeric polyvinyl chloride coupling with stainless steel bands to connection to \_\_\_\_\_-inch [\_\_\_\_\_ cm] O.D. pipe.

* + - * 1. ANSI 150 lb. pattern, flat faced fiberglass flange to connect to \_\_\_\_\_-inch [\_\_\_\_\_ cm] flange.
				2. Fiberglass caulking collar with internal Ø\_\_\_\_\_-inches [\_\_\_\_\_ cm].
			1. Outlet
				1. \_\_\_\_\_-inch [\_\_\_\_\_ cm] O.D. pipe stub

Elastomeric polyvinyl chloride coupling with stainless steel bands to connection to \_\_\_\_\_-inch [\_\_\_\_\_ cm] O.D. pipe.

* + - * 1. ANSI 150 lb. pattern, flat faced fiberglass flange to connect to \_\_\_\_\_-inch [\_\_\_\_\_ cm] flange.
				2. Fiberglass caulking collar with internal Ø\_\_\_\_\_-inches [\_\_\_\_\_ cm].
	1. Materials of Construction
		1. Manhole
			1. Fiberglass reinforced plastic laminate composed of:
				1. Unsaturated, single lot, isophthalic polyester resin with U.V. inhibitors
				2. E-glass reinforcement.
				3. Chemically enhanced silica for improved corrosion resistance, strength, and overall performance.
				4. Wall thickness shall be sufficient to meet or exceed ASTM D3753 and shall be a minimum of 1/2-inch [1.27 cm] thick.
			2. Interior
				1. Smooth, resin rich, corrosion resistant to minimize sludge build-up.
				2. Naturally light tan with no added pigments to aid in the visual inspection of the manhole barrel laminate for resin odd-lotting and the inclusion of any voids, contaminants, etc.
				3. Free of exposed fibers, crazing, delamination, blisters larger than Ø1/2-inch [1.27 cm], and wrinkles with a depth of 1/8-inch [0.3175 cm] or greater.
				4. Pigments or gel coating of the interior manhole surface violated ASTM D3753 and are not allowed for any reason.
			3. Exterior
				1. Gray 15 mil (cured) gel coat with U.V. inhibitors on all exterior surfaces.
				2. Patterned / rolled glass exterior surface with no exposed fibers, sharp projections, or blisters larger than Ø1/2-inch [1.27 cm].
			4. Sign
				1. Self-adhesive polyester “Confined Space Entry” sign on the manhole interior, at or above the first ladder rung.
				2. Sign to comply with ANSI Z535.2 and OSHA 1910.145.
			5. Coupling
				1. Ø2-inch [5.08 cm] FNPT fiberglass coupling for power or control cabling laminated to the manhole barrel.
			6. Ladder
				1. Fiberglass ladder thru-bolted and laminated to the manhole barrel.
				2. Ladder rungs

Pultruded fiberglass 18-inches [45.72 cm] wide x Ø1 1/2-inches [3.81 cm] x 1/4-inch [0.635 cm] thick.

Reinforced with Ø1/4-inch [0.635 cm] threaded stainless steel rod secured by solid pultruded fiberglass spacers.

Spaced no more than 12-inches [30.48 cm] on center.

Each rung shall have either an integrally molded non-slip surface or a full width, factory applied, coarse grit surface with a minimum dry coefficient of friction of 1.0.

At the first ladder rung there shall be a fixed open cell grating platform to aid in entering / exiting the manhole (domed, aluminum hatch, and Ø48-inch [121.9 cm] manholes).

* + - * 1. All manholes with 48-inches [121.92 cm] or more of depth between the diversion cheeks and the top reference elevation of the manhole (manhole top – domed, hatch surround - aluminum hatch, reducer shoulder – H-20) shall be equipped with a factory installed ladder.
				2. Ladders shall meet or exceed OHSA 1910.27 for fixed ladders.
			1. Base
				1. The manhole base shall be not less than 1/2-inch [1.27 cm] thick.
			2. Mounting flange
				1. 4-inch [10.16 cm] wide x 3/4-inch [1.905 cm] thick integrally molded around the circumference of the manhole barrel for anchoring the manhole to the concrete pad.
			3. Pad
				1. Expanded polystyrene bead board for placement between the base of the manhole and the concrete slab.
		1. Directional cheeks
			1. Fiberglass reinforced plastic laminate.
				1. ISO certified polyester laminating resin:

Low HAP.

Properties shall meet or exceed:

Tensile Strength (ASTM D638) 14,000 psi [96.53 MPa].

Flexural Strength (ASTM D790) 22,000 psi [151.7 MPa].

Flexural Modulus (ASTM D790) 900,000 psi [6.205 GPa].

ANSI/AWWA F101 Type II.

Barcol Hardness (ASTM D2583) 30.

Water Absorption (ASTM D2583) <0.15%.

Allowable Defects (ASTM D2563) Level I.

* + - * 1. E-glass:

Minimum of 30% of laminate content by weight.

Silane coupling agent.

C-glass shall not be allowed.

* + - * 1. Laminate thickness:

1/4-inch [0.635 cm] inside manhole barrel.

1/2-inch [1.27 cm] outside manhole barrel.

* + - 1. Gel coat:
				1. 15 mil cured thickness.
				2. U.V. inhibitors in all gel coat formulations, regardless of application or installation location.
				3. Gray.
1. FIELD ASSISTANCE
	1. Qualified factory representative shall provide on-site assistance, consisting of:
		1. (\_\_\_) days of installation observation.
			1. Factory representative shall complete a Certification of Installation Observation.
			2. Installation observation shall not alleviate installing party from proper installation liability.
		2. (\_\_\_) days of operator training.
2. MANHOLE ACCESSORIES
	1. Customization
		1. Custom gel coat color
			1. Manhole exterior gel coat color other than standard gray, with U.V. inhibitors, from manufacturer supplied color chart.
				1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
	2. Equipment Mounting / Access Options
		1. Panel
			1. 18-inches [45.72 cm] wide x 18-inches [45.72 cm] high fiberglass equipment mounting panel secured to the manhole interior for mounting flow meters, wireless transmission modules, or other small equipment.
		2. Shelf
			1. 18-inches [45.72 cm] x 12-inches [30.48 cm] deep fiberglass equipment shelf secured to the manhole interior.
	3. Ventilation
		1. Passive Ø4-inch [10.16 cm] vent
			1. Ø4-inch [10.16 cm] duct extending to within 24-inches [60.96 cm] of the energy absorbing structure and secured with T-304 stainless steel pipe brackets.
			2. Integral insect screen.
3. EXECUTION
	1. Examination
		1. Verify that the manhole dimensions are correct and that the site conditions are suitable for installing the structure.
	2. Installation
		1. The site must be of adequate size to accommodate the manhole and provide safe working room for the installing personnel.
		2. Do not allow groundwater or surface water runoff to accumulate in the open excavation.
		3. Provide a concrete foundation slab on which to mount / secure the manhole. The slab should extend a minimum of 12-inches [30.48 cm] on all sides beyond the manhole, base mounting flange, connecting pipes / flanges, and any structure integrated into the manhole.
		4. The thickness of the slab should be a minimum of 6-inches [15.24 cm], but as local soil conditions may vary, the final design of the slab and anchoring details are the responsibility of the installing party and must be sized so as to prevent shifting and flotation of the manhole structure.
		5. The concrete foundation slab must have a smooth, troweled surface to provide uniform support over the entire base structure. The slab must be level in both directions to within 1/8-inch [0.3175 cm] and free from exposed aggregate and debris.
		6. Place the foam pad on the concrete slab where the manhole barrel will rest.
		7. Lower the manhole onto the concrete slab – taking particular care to secure the manhole from overturning during movement and lowering.
		8. Manholes supplied with pipe stubs may also be supplied with flexible couplings and stainless steel bands. Considerable force must be exerted by the coupling sealing surfaces during installation, if the coupling installs with little effort or appears loose, stop and contact the coupling manufacturer.
		9. Place the flexible couplings (when provided) on the manhole pipe stubs.
		10. Loosely secure the manhole to the concrete slab with anchor bolts (by others – wedge style recommended).
		11. Level the manhole.
		12. Once the level has been verified, complete the tightening of the anchor bolts to secure the manhole to the concrete slab.
		13. Complete the connection of the manhole to the inlet / outlet piping.
	3. Backfilling
		1. Backfill should be placed evenly around the manhole in lifts of no more than 12-inches [30.48 cm]. Care should be taken to ensure that no void area exist between the concrete slab and any portion of the structure (i.e. under the pipe connections).
		2. Fill material should be imported sand or pea gravel material (naturally round aggregate 1/4-3/8-inch [0.635-0.9525 cm] in size).
		3. If backfilling with another material avoid rocks, concrete, or soil lumps larger than 1-inch [2.54 cm] in size.
	4. Adjust and Clean
		1. Verify that the complete installation meets the criteria above and any additional criteria supplied by the Engineer.
		2. Clean the flow surfaces in accordance with the manufacturer’s operation and maintenance instructions.
		3. Remove all trash and debris, leaving the site in a clean condition.