WEIR FLOW MONITORING 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. ISO 1482 – Hydrometry – Open Channel Flow Measurement Using Thin-Plate Weirs.
	12. 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 primary device orientations.
			4. Joints, connections, fasteners.
			5. Sizes, spacing, and locations of structural members, ribs, anchoring clips, and dimensional bracing.
			6. Materials and thicknesses of construction.
			7. Minimum and maximum flow rates.
		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. Discharge Tables
		1. Primary device level-to-flow discharge tables, showing:
			1. Flow equations.
			2. Submergence transition, where published.
			3. Accuracy, where published.
			4. Plan view layout showing critical dimensions and primary point of measurement (Ha).
			5. Discharge table source.
	5. Receiving, Handling, and Storage Instructions
	6. Installation Instructions
	7. Operation and Maintenance Instructions
	8. Product Warranty
	9. Test Data
		1. Test result data confirming full compliance with ASTM D3753 for manhole barrel and reducer structures as required under Section 11 of the standard.
	10. Laminate Sample
		1. 6-inch [15.24 cm] square samples of representative manhole barrel and weir plate laminates, upon request.
	11. 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. Verify that the weir has not been damaged, loosened, or otherwise compromised during transit.
			3. End connections, couplings, base mounting flange, and top should also be inspected.
			4. 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. Weir Flow Monitoring Manholes are specialty items and are fabricated to strict dimensional tolerances. While rugged and designed for a long service life, they must be handled with care. In particular, the nappe of the weir plate is particularly important and in handling Weir Flow Monitoring Manholes this should always be kept in mind.
		2. 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.
		3. Taglines should be used to control the movement of the structure during lifting.
		4. 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.
		5. 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 Weir Flow Metering 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. Weir Flow Monitoring 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. Weir Flow Monitoring Manholes shall be monolithic, watertight, corrosion resistant units consisting of (as a minimum): manhole barrel, top, confined space entry warning sign, coupling, weir plate, 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. Domed fiberglass
				1. A full diameter, fully opening reinforced domed fiberglass cover with stainless steel hardware (hinge, padlockable hasp, and cover support gas strut), fiberglass hinge block, and a neoprene sealing gasket applied to the manhole barrel lip.
				2. The cover shall be designed and tested to withstand a minimum 1,000 lb. [453.6 kg] static load.
				3. For operator safety, the cover support gas strut shall be sized and mounted so that cover opens at any position unless locked.
			2. 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 inlet pipe invert 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. Baffle Plate
			1. 1/4-inch [0.635 cm] thick fixed upstream baffle plate.
		3. Weir
			1. Fixed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ weir plate.
				1. 16 gauge T-304 stainless steel construction
			2. Mounted to 1/4-inch [0.635 cm] thick fixed weir carrier.
			3. Sized to handle:
				1. Minimum flow rate: \_\_\_\_\_\_\_\_\_\_ gpm [\_\_\_\_\_\_\_\_\_\_ l/s].
				2. Maximum flow rate: \_\_\_\_\_\_\_\_\_\_ gpm [\_\_\_\_\_\_\_\_\_\_ l/s].
		4. Level:
			1. High-visibility two-axis spirit level mounted at the primary point of measurement, Ha.
		5. 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, sampling, sensor, or other 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 top of the weir 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. 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. Platforms
			1. Half diameter
				1. Narrow opening fiberglass grating with slip resistant top surface mechanically attached to a fiberglass support base thru-wall bolted and laminated to the manhole barrel.
			2. Full diameter
				1. Narrow opening fiberglass grating with slip resistant top surface mechanically attached to a fiberglass support base thru-wall bolted and laminated to the manhole barrel.

Platform to have open access cutout to lower ladder.

Platform to have secured grating section over lower ladder access.

* + 1. Shelf
			1. 18-inches [45.72 cm] x 12-inches [30.48 cm] deep fiberglass equipment shelf secured to the manhole interior.
	1. 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 top of the weir and secured with T-304 stainless steel pipe brackets.
			2. Integral insect screen.
1. WEIR ACCESSORIES
	1. Flow / Level Options
		1. Bubbler tube
			1. Field removable / replaceable T-304 stainless steel bubbler tube mounted in recessed cavity open to the flow stream and secured though the use of (2) wing nuts on the top flange of the weir structure.
			2. Single piece 1/4-inch [6.35 mm] tube swaged at the top to accept standard 1/8-inch [3.175 mm] vinyl bubble line. Compression couplings shall be not allowed.
		2. Staff / level gauge
			1. High visibility, direct read level gauge with 3/4-inch [1.095 cm] black letters / numerals on a high visibility yellow-green background.
			2. Dual scale gradated in cm, 1/10-foot, and 1/100-foot increments.
			3. Gauge must be molded into the weir structure sidewall. Surface applied gauges shall not be allowed.
		3. Ultrasonic mounting bracket
			1. Horizontally and vertically adjustable T-304 stainless steel ultrasonic mounting bracket for transducers up to Ø1 inch [2.54 cm] NPT.
	2. Parameter Monitoring Options
		1. Probe holder
			1. Field removable / replaceable T-304 stainless steel probe holder (for pH, DO, conductivity, etc. probes) mounted in recessed cavity open to the flow stream and secured though the use of (2) wing nuts.
			2. Holder to extend 1-inch [2.54 cm] below crest of the weir to aid in keeping the probe wetted.
		2. Probe well
			1. Ø2-inch [5.08 cm] diameter tube with Ø2-inch [5.08 cm] opening laminated to the weir structure sidewall and extending 3-inches [7.62 cm] below the crest (floor) of the weir structure (for pH, DO, conductivity, etc. probes).
		3. Sampler tube
			1. Field removable / replaceable T-304 stainless steel sampler tube mounted in recessed cavity open to the flow stream and secured though the use of (2) wing nuts.
			2. 3/8-inch [9.525 mm] tube to accept standard 3/8-inch [9.525 mm] suction line.
	3. Customization
		1. Bolt down cover
			1. Removable flat bolt down fiberglass cover over the weir pool, with free (non-encapsulated) T-304 stainless steel hardware. Gel coat on all covers surfaces.
			2. Removable clear, U.V. stable polycarbonate (Lexan) flat cover over the weir pool, with free (non-encapsulated) T-304 stainless steel hardware.
		2. Recessed grating
			1. Removable, recessed, narrow opening fiberglass grating with slip resistant top surface over the weir pool.
2. 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.
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 so that the weir is level from front-to-back and from side-to-side.
		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. Manhole Shoulder
		1. If the weir pool is constructed in such a way that inside the manhole there are void spaces between the interior of the manhole barrel and the exterior of the weir pool, the void spaces should be filled with supporting material to the top of the structure so that water does not collect. Sulfate resistant grout capping pea gravel or compacted sand is typical.
		2. The finished surface or shoulder of grout should be even with the top of the weir pool and should be sloped so that any overflow will drain back in to the weir pool or downstream catchment area.
	5. 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.