

# Appendix C

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## **Jellyfish<sup>®</sup> Filter Standard Specifications Water Quality Filter Treatment Device**



Notes



# Part 1- General

## 1.1 Work Included

Specifies requirements for construction and performance of an underground stormwater quality filter treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation and membrane filtration.

## 1.2 Reference Standards

- ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
- ASTM D 4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks
- ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
- ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- ASTM D 4101: Specification for Copolymer steps construction

## 1.3 Shop Drawings

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure precast concrete and/or fiberglass (FRP) components.

## 1.4 Handling and Storage

Prevent damage to materials during storage and handling.

# Part 2 - Products

## 2.1 General

### 2.1.1

The device shall be circular or rectangular and constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications. Alternatively, the device shall be constructed of fiberglass (FRP), installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

### 2.1.2 Fiberglass Insert (Cartridge Deck)

The concrete device shall include a fiberglass insert bolted and sealed watertight inside the precast concrete chamber. Alternatively, the fiberglass device shall include a fiberglass insert bolted and/or chemically welded watertight inside the fiberglass chamber. The fiberglass insert shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges; (d) a conduit for conveyance of treated water to the effluent pipe.



### 2.1.3 Membrane Filter Cartridges

Filter cartridges shall be comprised of cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 27 inches (690 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid and based on a design flux rate determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum flux rate shall be 0.21 gpm/ft<sup>2</sup> (0.142 lps/m<sup>2</sup>).

Each lightweight membrane filter cartridge shall allow for manual installation and removal and shall have a dry installation weight not to exceed the following:

Cartridge Length		Maximum Cartridge Dry Weight for Installation	
27 inches	690 mm	20 pounds	9 kg
54 inches	1,370 mm	25 pounds	12 kg

### 2.1.4 Backwashing Cartridges

The filter device shall have a weir extending above the cartridge deck that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir shall collect a pool of water during inflow events that subsequently automatically backwashes the hi flo rate cartridges when the inflow event subsides. All filter cartridges shall allow for use of a manual backwashing or filtration membrane rinsing procedure to restore flow capacity and sediment capacity and extend cartridge service life.

### 2.1.5 Maintenance Access to Captured Pollutants

A Maintenance Access Wall shall enclose an opening in the cartridge deck that has minimum diameter of 18 inches (450 mm) and thereby provide suitable access for removal of accumulated floatable pollutants and sediment.

### 2.1.6 Bend Structure

The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 66-degrees or less in the stormwater conveyance system.

### 2.1.7 Double-Wall Containment of Hydrocarbons

The precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck and the precast vessel wall. Alternatively, a device constructed of fiberglass (FRP) does not require double-wall containment as fiberglass is resistant to hydrocarbon penetration.



### 2.1.8 Separator Skirt

The device shall provide a flexible separator skirt that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The separator skirt shall serve as a baffle to protect the membrane filter elements from contamination by floatables and coarse sediment.

### 2.1.9 Sump

The device must include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer.

## **2.2 Precast Concrete Sections**

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer.

## **2.3 Gaskets**

All gaskets used for the concrete joints shall be manufactured using neoprene or nitrile rubber gaskets to prevent deterioration from presence of captured petroleum hydrocarbons. Mastic sealants or butyl tape are not an acceptable alternative as they are prone to leakage of petroleum hydrocarbons.

## **2.4 Frame and Cover**

Frame and covers must be manufactured from cast-iron and embossed with the name of the device manufacturer or the device brand name.

## **2.5 Doors and Hatches**

If provided shall meet designated loading requirements at a minimum for incidental traffic.

## **2.5 Concrete**

All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

## **2.6 Fiberglass**

The fiberglass portion of the water treatment device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

## **2.7 Steps**

Steps shall be constructed according to ASTM D4101 of copolymer polypropylene and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

## **2.8 Inspections**

All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.



## Part 3 – Performance

### 3.1 General

#### 3.1.1 Function

The stormwater quality filter treatment device functions to remove pollutants by the following unit treatment processes; sedimentation, floatation and membrane filtration.

#### 3.1.2 Pollutants

The stormwater quality filter treatment device removes oil, debris, trash, sediment, sediment-bound pollutants, metals and nutrients from stormwater during frequent wet weather events.

#### 3.1.3 Bypass

The stormwater quality filter treatment device typically operates off-line.

#### 3.1.4 Treatment Flux Rate

The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum treatment flux rate across the membrane filter cartridges of 0.21 gpm/ft<sup>2</sup> (0.142 lps/m<sup>2</sup>).

### 3.2 Field Test Performance

At a minimum, the stormwater quality filter device shall have been field tested with a minimum 20 TARP qualifying rain events and field monitoring conducted according to the TARP or TAPE field test protocol.

#### 3.2.1 Suspended Solids Removal

The stormwater quality filter treatment device shall have demonstrated a minimum mean TSS removal efficiency of 85%, and a minimum mean SSC removal of 95%.

#### 3.2.2 Fine Particle Removal

The stormwater quality filter treatment device shall demonstrate the ability to capture fine particles as indicated by an effluent d<sub>50</sub> of 15 microns or lower for all monitored storm events, and an effluent turbidity of 25 NTUs or lower.

#### 3.2.3 Nutrient (Total Phosphorus & Total Nitrogen) Removal

The stormwater quality filter treatment device shall have demonstrated a minimum mean Total Phosphorus removal of 55%, and a minimum mean Total Nitrogen removal of 50%.

### 3.3 Lab Test Performance

#### 3.3.1 Suspended Solids Removal

The stormwater quality treatment device shall demonstrate the ability to remove a minimum of 85% of Sil-Co-Sil 106 (d<sub>50</sub> = 22 microns), measured as SSC, with a 95% confidence interval at the system's 100% operating rate with influent sediment concentrations ranging from 100 to 300 mg/L.



### 3.4 Inspection and Maintenance

The stormwater quality filter device shall have the following features:

- 3.4.1 The membrane filter elements shall be designed to last three years prior to requiring replacement.
- 3.4.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade.
- 3.4.3 Manual backflushing of the filter cartridges shall be possible to restore the flow capacity and sediment capacity of the filter cartridges and therefore extend cartridge service life.
- 3.4.4 Filter treatment shall have a minimum 12 inches (610 mm) of sediment storage depth.
- 3.4.5 Sediment removal from the filter treatment device shall be conducted using a standard maintenance truck and vacuum apparatus, and a single point of entry through the cartridge deck that is unobstructed by filter cartridges.
- 3.4.6 Filter cartridges be easily maintained without the use of additional lifting equipment.

## Part 4 – Execution

### 4.1 Precast & Installation

#### 4.1.1 Construction Sequence

The installation of a precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes. Selected sections of a general specification that are applicable are summarized below.

The precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- riser section and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.



Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the stormwater quality treatment device has been constructed, any lift holes must be plugged watertight with mortar or non-shrink grout.

#### 4.1.2 Inlet and Outlet Pipes

Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight.

#### 4.1.3 Frame and Cover Installation

Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

### **4.2 Fiberglass (FRP) Installation**

#### 4.2.1 Construction Sequence

The installation of the FRP device should conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices. Selected sections of a general specification that are applicable are summarized below, For detailed installation instructions refer to the submitted drawing and installation details.

Structural - Proposed installation details shall conform with all federal, provincial, state, municipal or other local specifications as may be applicable, including all building code requirements.

Water Quality Device Construction Sequence - The water quality FRP device is installed in the following sequence:

- Water quality device as delivered to site placed on prepared bedding or slab using spreader bars and the lifting lugs provided on the structure. Avoid lifting chains or cables from contacting sides of tank. Do not drop, roll or slide vessel.
- Backfill using approved back fill material
- Pour anti-buoyancy slab as required per the drawing
- Connect inlet and outlet pipes
- Riser sections and/or transitions (if required and if shipped separately)
- Frame and access cover

#### 4.2.2 Frame and Cover Installation

No direct structural connection shall be permitted to any FRP maintenance access surface riser pipe. No vertical structural connection shall be permitted to any FRP component under any circumstances unless approved by the manufacturer.

A minimum 1-inch (25 mm) gap shall be left around and above any required FRP maintenance access surface risers (i.e. not a buried installation), with this gap filled with pea gravel or approved fill material against the surrounding structure that must support the frame and cover in its entirety.



### 4.3 Maintenance Access Wall

In some instances the Maintenance Access Wall will require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

### 4.4 Filter Cartridge Installation

Filter cartridges shall be installed in the cartridge deck after the construction site is fully stabilized, unless otherwise specified by the design engineer.

### 4.5 Filter Cartridge Installation

Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed after site is stabilized and unit is ready to accept cartridges. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction. For systems with cartridges installed prior to full site stabilization and prior to system commissioning, the contractor can plug inlet and outlet pipes to prevent stormwater from entering the device. Plugs must be removed after the device has been commissioned.

## Part 5 – Quality Assurance

### 5.1 Clean Up and Restoration

Each component of the water quality treatment device shall be inspected by the Owners Representative prior to final acceptance. The contractor shall remove soil and debris created by the storm drainage work from the structure. At the completion of all work, the structure and surrounding area shall be left in a neat, safe and orderly condition.

### 5.2 Inspection and Maintenance

#### 5.2.1

The manufacturer shall provide an Owner's Manual upon request.

#### 5.2.2

After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines.

#### 5.2 Replacement Filter Cartridges

When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

