

SECTION {_____}

ENVIROTUBES FOR DREDGE MATERIAL CONTAINMENT AND DEWATERING

This guide specification has been prepared by Industrial Fabrics, Inc. to assist design professionals in the preparation of a specification section covering Envirotubes for dredge material containment and dewatering. It may be used as the basis for developing either a project specification or an office master specification. Since it has been prepared according to the principles established in the Manual of Practice published by The Construction Specifications Institute (CSI) including the use of section numbers and titles from the 1995 Edition of MasterFormat, this guide specification may be used in conjunction with most commercially available master specifications sections with minor editing.

The following should be noted in using this guide specification:

- *Optional text requiring a selection by the user is enclosed within brackets, e.g.: “Section [01330] [____].”*
- *Items requiring user Input are enclosed within brackets, e.g.: “Section [____ - ____].”*
- *Optional paragraphs are separated by an “OR” statement, e.g.:*

***** OR *****

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1 GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations in connection with the use of high strength Envirotubes for the containment and dewatering of dredged material as shown on the Plans.

1.2 RELATED SECTIONS

Edit the following paragraphs to coordinate with other sections of the Project Manual.

- A. Section [02300 Earthwork] [____ - ____].

1.3 UNIT PRICES

Include the following article only for unit price contracts or lump sum contracts with unit price adjustments. Delete for lump sum contracts.

- A. Method of Measurement: By the cubic meter (or cubic foot - as indicated in contract documents) of *in situ* sediment removed.
- B. Basis of Payment: By the cubic meter (or cubic foot - as indicated in contract documents) of *in situ* sediment contained within Envirotubes.

1.4 REFERENCES

The following article assumes that the date of each reference standard will be the latest edition as of the date of the project specification. This provision must be defined in Division 1; coordinate with Division 1 statements.

- A. AASHTO Test Standards:
 - 1. T 88 — Standard Test Method for Particle Size Analysis of Soils
 - 2. T 90 — Standard Test Method for Determining the Plastic Limit and Plasticity Index of Soils
 - 3. T 99 — Standard Practice for Determination of the Moisture Density Relations of Soils Using a 5.5 lb hammer and 12 in drop (Standard Proctor)
- B. American Society for Testing and Materials (ASTM):
 - 1. D 422 — Test Method for Particle Size Analysis of Soils
 - 2. D 4354 — Test Method for Sampling of Geosynthetics for Testing
 - 3. D 4355 — Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
 - 4. D 4491 — Test Method for Water Permeability of Geotextiles by Permittivity
 - 5. D 4533 — Test Method for Trapezoid Tearing Strength of Geotextiles
 - 6. D 4595 — Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
 - 7. D 4751 — Test Method for Determining the Apparent Opening Size of a Geotextile
 - 8. D 4759 — Test Method for Determining the Specification Performance of Geosynthetics
 - 9. D 4833 — Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
 - 10. D 4873 — Test Method for Identification, Storage, and Handling of Geotextiles
 - 11. D 4884 — Test Method for Seam Strength of Sewn Geotextiles
- C. Geosynthetic Research Institute (GRI) Standards:
 - 1. GT 10 — Standard Specification for Test Methods, Properties and Frequencies for High Strength Envirotubes used as Coastal and Riverine Structures
 - 2. GT 11 — Standard Practice for Installation of Envirotubes as Coastal and Riverine Structures
- D. Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP).
- E. International Standards Organization (ISO) 9002 - Quality System Certification.

1.5 DEFINITIONS

- C. Minimum Average Roll Value (MARV) — Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.
- D. Typical Roll Value — Property value calculated from average or mean obtained from test data.
- E. Envirotube — A large geotextile tube [greater than 4.6 in (15 ft) in circumference] fabricated from high strength woven geotextile in lengths greater than 6.1 m (20 ft). Envirotubes used in dewatering applications are most often filled hydraulically using a dredge or pump.
- F. Fill Port — Also called a fill spout or fill nozzle, fill ports are sleeves sewn into the top of the Envirotube into which the pump discharge pipe is inserted. Ports are typically 450 mm (18 in) in diameter and 0.9 to 1.5 m (3 to 5 ft) in length. Ports are spaced along the top of the tube to provide access to the contractor. Spacing is usually no closer than 7.6 m (25 ft) to accommodate sand slurry but can be as far apart as 30 in (100 ft) for some viscous fill materials. After pumping, ports are to be closed by tying, sewing or gluing shut, depending on the permanence of the installation. Fill ports are fabricated from the same geotextile as the main tube.
- G. Manufacturing Quality control (MQC) — A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications [ref. EPA/600/R-93/1 82]. This definition is expanded herein for Envirotubes and scour aprons to include fabrication, including sewing and packaging by the fabricator.
- H. Manufacturing Quality Assurance (MQA) — A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and finished geosynthetic products to assess the quality of the manufactured materials, MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project [ref. EPA/600/R-93/182].
- I. *In Situ* Sediment — Sediment as it exists in the lagoon, pond, lake, river or other water body, at the existing percent solids and percent moisture content.

1.6 SUBMITTALS

Edit the following to coordinate with Division 1.

- A. Submit under provisions of Section [01330] [____]:
 - 1. Certification:
 - a) The Contractor shall provide the Engineer a certificate stating the name of the Envirotube manufacturer, product name, style, chemical compositions of filaments or yarns, and other pertinent information to fully describe the geotextile. With this certification, submit one properly identified 4 by 6 in minimum size sample of geotextile to be used for the Envirotube and all other geotextiles required for construction of the Envirotube section.
 - b) The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request.

- c) The manufacturer's certificate shall state that the furnished geotextile meets requirements of the specification as evaluated under the manufacturer's quality control program. The certificate shall be attested to by a person having legal authority to bind the Manufacturer.
 - d) The Contractor shall provide a description of the seam assembly to be used in tube fabrication along with the sample of the seam to the Engineer upon request. The description shall include the seam type, sewing thread, and stitch density. If seams are to be sewn in both directions, samples of seams from both directions shall be provided.
 - e) GAI-LAP accreditation of the testing laboratory shall be submitted to the engineer.
2. Manufacturing Quality Control (MQC) MQC test results shall be provided by the Manufacturer upon request.
 3. Experience Level Envirotubes shall be installed by contractors having demonstrated successful experience filling at least 1,000 linear feet (300 m) of large Envirotubes, under the direction of a manufacturer's representative, with fine-grained sludges or dredged material having greater than 50% passing the No. 200 sieve. The contractor shall be required to prove this experience with a letter provided by the manufacturer. If chemical polymers are used to aid in dewatering, the contractor shall be required to prove this experience.
 4. Manufacturers Representative If the contractor can not satisfy the requirements of Paragraph 1 .6.A.3 above, the contractor shall fill one demonstration tube on site, under the direction of an on-site representative of the Envirotube manufacturer at the contractor's expense. The manufacturer's representative shall be required to prove demonstrated successful experience filling at least 1,000 linear feet (300 m) of large Envirotubes with fine-grained sludges or dredged material having greater than 50% passing the No. 200 sieve. If chemical polymers are used to aid in dewatering, the manufacturer's representative shall be required to prove this experience.
 - a) After the demonstration tube is filled, the manufacturer's representative will remain on-site at the contractor's expense as necessary to assure that the requirements of these specifications are satisfied.
 - b) The mobilization and filling of the demonstration tube are to be paid for by the project owner as part of this contract.
 5. Plan of Construction The contractor shall submit a Plan of Construction describing the sequence of operations for the filling and dewatering of the Envirotubes. The plan shall address site preparation, deployment and filling of tubes, water management and pump-out, {removal of dewatered material} and dewatering site restoration. Equipment to be used shall be specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Envirotubes shall be delivered only after the required submittals have been received and approved by the Engineer.
- B. Geotextile labeling, shipment and storage shall follow ASTM D 4873.
- C. Each packaged segment of Envirotubes shall be labeled with the manufacturer's name, geotextile type, and tube dimensions (length, diameter, gross weight, etc.).
- D. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.
- E. Each segment of Envirotube shall be wrapped in an opaque and waterproof layer of protective plastic during shipment and storage. Since polyester geotextile absorbs water, it is important to keep polyester tubes out of the rain.
- F. The protective wrapping shall be maintained during periods of shipment and storage.
- G. No hooks, tongs or other sharp instruments shall be used for handling geotextile. Geotextile shall not be dragged along the ground.

- H. During storage, Envirotubes shall be elevated off the ground and adequately covered to protect them from the following: Rain, site construction damage, extended exposure to ultraviolet (UV) radiation, precipitation, chemicals that are strong acids or strong bases, flames, sparks, temperatures in excess of 71 deg C (160 deg F) and any other environmental condition that might damage the geotextile.

1.8 QUALITY ASSURANCE SAMPLING, TESTING, AND ACCEPTANCE

A. Geotextile:

1. Geotextiles used to construct the tubes shall be subject to sampling and testing to verify conformance with this specification. All sampling and testing shall be in accordance with ASTM D 4354 and shall be performed at a laboratory accredited by GAI-LAP for tests required for the geotextile, at frequency exceeding ASTM D 4354.
2. Acceptance shall be in accordance with ASTM D 4759 based on testing of either conformance samples obtained using Procedure A of ASTM D 4354, or based on manufacturer's certifications and testing of quality control samples obtained using Procedure B of ASTM D 4354.
3. Quality Assurance Sampling and Testing will be waived for ISO 9002 Certified Manufacturing Facilities. Documentation of ISO 9002 Certification shall be provided upon request.

B. Sewn Seams:

1. Factory seams shall be provided to the engineer at the engineer's request and shall be from a roll of geotextile representative of that which is to be used on the project.
2. All factory sewn seams shall be 401 lock stitch using high tenacity polyester sewing thread.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Envirotubes: Industrial Fabrics, Inc., 510 O'Neal Lane, Baton Rouge, LA 70819, USA, Phone (225) 273-9600 or (800) 848-4500.
- B. Chemicals:
- C. Distributor:

Edit the following to coordinate with Division 1.

- D. Substitutions: Under provisions of Section [01630] [_____].

2.2 MATERIALS

A. Envirotubes:

1. Shall be constructed using high strength woven polypropylene or polyester geotextile in accordance with the following requirements.
2. The Envirotubes shall have a length of [30.5, 45.7, or 91.5 m (100, 150, or 300 ft)], having a nominal circumference equal to [4.6, 9.1, or 13.7 in (15, 30, or 45 ft)],
3. The geotextiles used to construct the tubes shall be resistant to ultraviolet degradation and to biological and chemical environments normally found in soils *and specifically resistant to {note here any known petrochemical constituents of the dredge material or high pH}*.

Include the following for Class 2 Tubes. Class 2 Tubes should be used under typical pumping and dredged material conditions.

4. The geotextile used for tube fabrication shall have the following properties, all are MARV values unless otherwise noted:

PROPERTY	NOTES	TEST METHOD	UNITS	REQUIRED VALUE ENVIROTUBES
Fill Port Diameter*		Measured	MM (in)	300 or 450 (12 or 18)
Wide Width Tensile Strength	Minimum Value in both directions	ASTM D 4595	kN/m (lbs/in)	70 x 105 (400 x 600)
Wide Width Elongation**		ASTM D 4595	percent	20 x 20
Puncture Strength		ASTM D 4833	N (lbs)	1155 (260)
Seam Strength	Minimum Value	ASTM D 4595	kN/m (lbs/in)	70 (400)
Apparent Opening Size	Values smaller than 40 sieve (i.e. looser) are not permitted	ASTM D 4751	Mm (US Std. Sieve)	0.425
Water Flow Rate	Maximum Value	ASTM D 4491	l/min/m ² (gpm/ft ²)	810 (20)
UV Resistance (percent retained at 500 hrs)		ASTM D 4355	percent	80

* Typical value

** Maximum average roll value

5. Manufacturing Quality Control: Testing shall be performed at a laboratory accredited by GAI-LAP for tests required for the geosynthetic, at frequency exceeding ASTM D 4354, with following minimum acceptable testing frequency:

Property	Test Method	Test Frequency per sq m (sq yd)
Wide Width Tensile Strength	ASTM D 4595	1/7,500 (1/10,000)
Wide Width Elongation	ASTM D 4595	1/7,500 (1/10,000)
Puncture Strength	ASTM D 4833	1/7,500 (1/10,000)
Trapezoidal Tear	ASTM D 4533	1/7,500 (1/10,000)
Seam Strength	ASTM D 4595	1/40,000 (1/50,000)
Apparent Opening Size ² .	ASTM D 4751	1/40,000 (1/50,000)
Water Flow Rate	ASTM D 4491	1/40,000 (1/50,000)
UV Resistance (percent retained at 500 hrs)	ASTM D 4355	1/year

B. Dewatering Chemicals (Polymer Addition):

1. To aide in dewatering and consolidation, certain dredged materials may require dewatering chemicals (polymers). The use of such products will be as recommended by the Envirotube manufacturer. The initial dosage set by the manufacturer's field representative.
 2. Dewatering chemicals must be approved for use by a state regulatory agency, and prior use in similar dredge dewatering applications must be documented. Dewatering chemistries must also be approved by the Envirotube manufacturer to eliminate the possibility of adverse effects on the geotextile.
 3. The combination of specific polymer and specific Envirotube fabric must be shown to be effective, either by prior dredge dewatering application, or by bench scale testing.
 4. Chemical (polymer) addition will be accomplished by using a Milton Roy chemical metering pump or equivalent, tapped into the pump discharge line at the appropriate distance from the tube to insure proper mixing. The pump must be capable of pumping against the system pump discharge pressures.
 5. All chemistries used in systems where the drainage water is discharged to a receiving body of water must meet all applicable standards.
5. The cost of chemicals (polymer) and chemical addition pump will be included in the unit cost to the owner as outlined in General Section 1.3.

Include the following for use with Class 2 Tubes, under typical dredged material conditions

7. The polymer used for chemical addition shall be a liquid polyamine, cationic, coagulant and have the following properties:

Property	Value
Relative Molecular Weight	High
Specific Gravity @ 25°C	1.14 - 1.18
Freeze Point	-18°C
Flash Point, Closed Cup	>93° C
% Solids	49.0—51.0
pH	5.0 - 7.0
Bulk Viscosity 25° C, cps	4,000 —6,000

C. Fill Materials:

1. Fill Material In situ sediment percent solids must be sampled and measured immediately prior to the start of the project. Percent solids at the dredge or pump discharge must be sampled and measured at least once daily.
2. Quality Control Gradation testing of hydraulic fill materials shall be conducted in accordance with ASTM D 422.

D. Equipment:

1. The plant and equipment used for the work required by this section of the specifications shall be determined by the Contractor, identified in the Plan of Construction, and shall be approved by the Engineer.
2. Dredge or pump discharge pressures at the tube fill port shall not exceed 33 kPa (5.0 psi) at any time.

3 EXECUTION

3.1 PREPARATION

- A. Tube installation shall be in accordance with the following specifications.
- B. The foundation for the placement of the Envirotube shall be smooth and free of protrusions which could damage the geotextile. Remnant timber piles, piers, footings, underground utilities, etc., at or below grade, shall be removed if located within 6.0 m (20 ft) of the project site.
- C. Weak or unsuitable foundation material shall be removed or stabilized.
- D. The dewatering area shall be graded to a maximum slope of 1%. The dewatering area shall have a nonerodable surface (gravel, grass, asphalt or concrete) or shall be lined with plastic sheeting.

3.2 DEPLOYMENT

- A. Tubes shall be aligned as straight as possible. Means of assuring that the tubes are properly aligned within the specified tolerances, shall be incorporated into the placement methodology presented in the Plan of Construction.
- B. The Envirotube shall be deployed along the alignment and secured in place as necessary to assure proper alignment after filling. No portion of the tube shall be filled until the entire tube segment has been fully anchored to the foundation along the correct alignment and pulled taut. Larger tubes may require concrete barriers to prevent the tubes from rolling during filling.

- C. All unused fill ports shall be tied closed.

3.3 FILLING

- A. After completing the deployment and anchorage of the Envirotube, filling with dredged material shall be accomplished in accordance with the approved Plan of Construction. The discharge line of the dredge shall be fitted with a "Y-valve" to allow control of the rate of filling. The Y-valve system shall be fitted with an internal mechanism such as a gate, butterfly valve, ball valve, or pinch valve to allow the contractor to regulate discharge into the Envirotube. Any excess discharge shall be directed away from the tubes toward the borrow area.
- B. The dredge discharge pipe shall be free of protrusions that could tear the fill port. It is generally accepted practice to support the dredge discharge pipe above the fill port in a manner which reduces stress on the fill port seams.
- C. The height to width ratio of the fully deployed tube shall not exceed a value of 0.5. Other height and width specification may be required by the Engineer to assure sliding, overturning, bearing capacity, and global stability of the tube system.
- D. If the tube is not to be externally backfilled, the area should be left in a neat and properly graded manner. If the tube is to be externally backfilled, the lines and grade on the Plan of Construction must be followed.
- E. The tubes shall not be filled higher than the manufacturer's recommended height.

3.4 PROTECTION

- A. At no time shall construction equipment be operated directly on the Envirotube or its ancillary materials. Filled Envirotubes and scour aprons can be traversed if a 300 mm (12 in) minimum of soil is covering the geotextile. No hooks, tongs or other sharp instruments shall be used for handling. The Envirotube or scour apron shall not be dragged along the ground.
- B. Any damaged Envirotubes resulting from the Contractor's failure to control filling rates and pressures or general lack of care shall be repaired or replaced to the manufacturer's original specifications at no additional cost to the Owner.

3.5 REMOVAL OF DEWATERED MATERIAL

- A. A sample of the dewatered material shall be taken from the center of the tube and tested prior to cutting the tube open. Small cuts can be made in the geotextile for purposes of sampling.
- B. After the dredged material within the Envirotube has dewatered (passes the <'paint filter test" or achieves a specified % solids), the tube can be cut open and the contents excavated. The material must be placed into trucks within 24 hours after cutting the tube to prevent re-suspension of the material be rain.
- C. Excavation of material and loading shall be in accordance with the Plan of Construction.

END OF SECTION