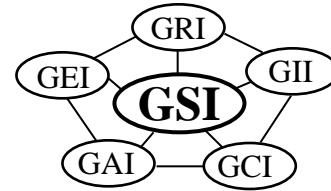


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Original: January 15, 2021

### **GRI-GT16 Standard Specification\***

Standard Specification for

#### **“Test Methods, Properties and Frequencies for Geotextile Grout Filled Mattresses (GGFM)”**

This specification was developed by the Geosynthetic Research Institute (GRI) with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

#### 1. Scope

- 1.1 This specification covers geotextile test properties for subsequent use to form geotextile grout filled mattresses (GGFM).
- 1.2 This specification sets forth physical, mechanical and chemical properties that must be satisfied by the geotextile being manufactured.
- 1.3 In the context of quality systems and management, this specification represents a manufacturing quality control (MQC) document.

Note 1: Manufacturing quality control represents those actions taken by a manufacturer to ensure that a product represents the stated objective and properties set forth in the specification.

- 1.4 This standard specification is intended to ensure good quality and performance of geotextiles used as grout filled mattresses but is possibly not adequate as the complete specification for specific situations. Additional tests, or more restrictive values for the tests indicated, may be necessary under conditions of a particular application.

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\*This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

1.5 This standard specification does not address installation practices or design guidance.

1.6 GGFM are used in the following applications areas;

- Erosion protection of river, canal, dykes and groins against wave attack and flowing water
- Sealing of watercourses, canals and lagoons
- Erosion protection in the intertidal zone
- Protection of inshore/offshore pipelines and structures
- Splash zone protection of surface impoundments

## 2. Referenced Documents

### 2.1 ASTM Standards

- D 4491 Test Methods for Water Permeability of Geotextiles by Permittivity
- D 4533 Test Method for Trapezoidal Tearing Strength of Geotextiles
- D 4595 Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
- D 4751 Test Method for Determining Apparent Opening Size of a Geotextile
- D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- D 4873 Guide for Identification, Storage and Handling of Geotextiles
- D 7238 Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus

### 2.2 GRI Standards

- GS17 Determining the Percent Open Area (POA) of Various Geosynthetics

## 3. Definitions

3.1 Geotextile Grout Filled Mattress (GGFM) - These mattresses are used for erosion protection in hydraulic engineering as they have a high resistance to hydraulic loads, readily adapt to the ground profile, have a high UV and abrasion resistance giving them a long service life. The mattresses consist of two high-strength woven layers connected together by interweaving or the use of spacers. GGFM are filled on site with a pumped cement grout and can be installed above or below water. Depending on their layout and structure, GGFM come in several types, with different infills and thicknesses. GGFM are an economic erosion protection system with many applications in land improvement, hydraulic engineering and coastal protection. GGFM can be supplied in various versions tailored to suit a particular application. These materials are also referred to as Fabric Formed Concrete (FFC) or Fabric Formed Concrete Revetments (FFCR) in ASTM D18.25 and D35.05.

- 3.2 Fill Port - Also called a fill spout or fill nozzle, they are sleeves sewn into the top of the GGFM into which the grout is pumped. Ports are typically 4 to 8 inches (100 to 200 mm) in diameter and 3 to 5 feet (0.9 to 1.5 m) in length. Ports are spaced along the top of the GGFM to provide access for the contractor. Fill ports are fabricated from the same geotextile as the main tube.
- 3.3 Grout GGFM Infill - Consisting of a mixture of Portland cement, fine aggregate, water proportioned and mixed to provide a pumpable slurry, with an efflux time between 9-12 seconds when tested using ASTM C939, Flow Cone Method.

#### 4. Specification Requirements

- 4.1 The fabric used for GGFM shall conform to Table 1. Please note all results are for one ply of material. The tables are given in English and SI (metric) units. The conversion from English to SI is soft.
- 4.2 The tables are subdivided into physical, mechanical, hydraulic and endurance test categories. Each item is accompanied by the appropriate test method designation and the minimum frequency of performing the test.

Note 2: Please note that strip tensile was used in place of the wide width testing. Strip tensile is considered an index test instead of a performance test. It is also the method used in the endurance evaluation.

Note 3: The targeted value of apparent opening size (AOS) is the largest opening size of the fabric's voids. Thus, the sieve size number is intended to specify the minimum sieve opening size. When specified in units of mm, AOS is the maximum dimension allowed.

Note 4: A minimum water flow rate is specified in both tables via ASTM D4491. This is a constant head permeability test usually resulting in the permittivity of the fabric. En route to permittivity one measures the water flow rate (i.e., the "flux") which is requested in the specification. The two terms are interrelated by the thickness of the fabric.

- 4.3 The various properties shall be tested at the minimum frequency shown in Tables 1 and 2. If the specific manufacturer's quality control guide is more stringent and the product is certified accordingly, it must be followed in like manner.

Note 5: This specification is focused on manufacturing quality control (MQC). Conformance testing and manufacturing quality assurance (MQA) testing are at the discretion of the purchaser and/or quality assurance organization.

5. Workmanship and Appearance

- 5.1 The finished fabric shall have good appearance qualities. It shall be free from such defects that would affect the specific properties of the geotextile, tube or apron.
- 5.2 General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.

6. MQC Sampling

- 6.1 Sampling shall be in accordance with the specific test methods listed in Table 1. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire width of the geotextile.
- 6.2 The number of replicate tests shall be in accordance with the appropriate test methods listed in Tables 1.
- 6.3 The average of the test results should be calculated per the particular standard cited and compared to the value listed in these tables.

7. MQC Retest and Rejection

- 7.1 If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

8. Packaging and Labeling

- 8.1 The finished GGFM shall be rolled on a stable core or accordion folded into a bundle for handling, storage and shipment. The GGFM is to be protected by an outer wrapping or plastic bag. The manufacturer's identification label shall be clearly visible on the outer wrapping and in a manner consistent with the established policy of the manufacturer.
- 8.2 Handling of the rolls or bundles shall be by forklift stinger or carpet pole, or by dedicated slings and spreader bars consistent with the weight of the unit. No hooks, tongs or other sharp instruments shall be used for handling. The GGFM shall not be dragged along the ground.
- 8.3 GGFM shall be stored elevated off the ground in areas where water cannot accumulate and where they are protected from conditions that will affect the properties or performance of the geotextile.

8.4 GGFM shall be labeled, shipped, stored, and handled in accordance with ASTM D4873 and as specified herein. Each segment of GGFM shall be wrapped in an opaque layer of plastic during shipment and storage. The plastic wrapping shall be placed around the unit in the manufacturing facility and shall not be removed until deployment. Each packaged segment of GGFM shall be labeled with the manufacturers name, geotextile type, lot numbers, roll numbers, and dimensions (length, width, gross weight).

9. Certification

9.1 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

**Table 1: GGFM**  
(all are minimum average values unless noted otherwise)

Property	Test Method ASTM	English Units		Metric Units	
		Property	Frequency	Property	Frequency
<u>Physical</u>					
Thickness	D5199	13 mil	10,000 yd <sup>2</sup>	0.33 mm	n/a
Mass	D5261	5 osy	10,000 yd <sup>2</sup>	170	n/a
<u>Mechanical</u>					
Strip Tensile Strength	D5035	1000 × 1000 lb/in.	10,000 yd <sup>2</sup>	35 kN/m	7500 m <sup>2</sup>
Strip Elongation (max.)	D5035	20%	10,000 yd <sup>2</sup>	20%	7500 m <sup>2</sup>
Trapezoidal Tear Strength	D4533	150 × 100 lb	10,000 yd <sup>2</sup>	670 N × 445 N	7500 m <sup>2</sup>
Seam Strength (factory)	D4884	200 lb./in.	50,000 yd <sup>2</sup>	35 kN/m	40,000 m <sup>2</sup>
<u>Hydraulic</u>					
Apparent Opening Size (AOS)	D4751	12 mil (max.)	50,000 yd <sup>2</sup>	0.297 mm (max)	40,000 m <sup>2</sup>
Water Flow Rate	D4491	90 gpm/ft <sup>2</sup>	50,000 yd <sup>2</sup>	3660 l/min/m <sup>2</sup>	40,000 m <sup>2</sup>
Percent Open Area (POA)	GS17	20-35% (range)	50,000 yd <sup>2</sup>	20-35% (range)	40,000 m <sup>2</sup>
<u>Endurance</u>					
Accelerated UV Resistance (% retained after 10,000 lt. hrs.)	D7238	65%	formulation	65%	formulation

**Revision Schedule**

**for**

**GT Specification for GRI-GT16**

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