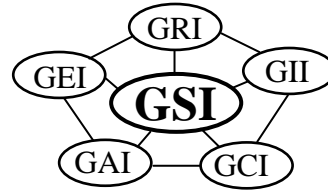


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GRI -GM22*

Standard Specification for

“Test Methods, Required Properties and Testing Frequencies for Scrim Reinforced Polyethylene Geomembranes Used in Exposed Temporary Applications”

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 It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part.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, warrants or indemnifies any materials produced according to this specification either at this time or in the future.

1. Scope

- 1.1 This specification covers scrim reinforced polyethylene geomembranes in thicknesses of 0.50 mm (20 mil), 0.30 mm (12 mil) and 0.20 mm (8 mil).

Note 1: A complimentary specification for nonreinforced polyethylene used in exposed temporary applications is being developed and will be added to this specification in due course.

- 1.2 This specification sets forth a set of minimum physical, mechanical and durability properties that must be met, or exceeded by the geomembrane being manufactured.

- 1.3 In the context of quality systems and management, this specification represents manufacturing quality control (MQC).

Note 2: Manufacturing quality control represents those actions taken by a manufacturer to ensure that the product represents the stated objective and properties set forth in this specification; see definitions in Section 3.

*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 and is kept current on the Institute's Website at <<geosynthetic-institute.org>>.

- 1.4 This standard specification is intended to assure good quality and performance of exposed temporary geomembranes in general applications, but is possibly not adequate for the complete specification in a specific or unique situation. Additional tests, or more restrictive values for the tests indicated, may be necessary under some conditions of a particular application.
- 1.5 The specification does not cover geomembrane installation or seaming since these activities are usually performed by contractors and installers independent of the manufacturer. Such activities are considered to be construction quality control (CQC) and construction quality assurance (CQA); see definitions in Section 3.

Note 3: For information on installation and seaming, users of the standard are referred to the literature which is abundant on the subject.

2. Referenced Documents

2.1 ASTM Standards

- D 751 Test Methods for Coated Fabrics; thickness, mass/unit area, tongue tear, grab, hydrostatic resistance and bonded seam strength
- D 1765 Classification System for Carbon Blacks Used in Rubber Products
- D 3895 Test Method for Oxidative Inductive Time of Polyolefins by Differential Scanning Calorimetry
- D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
- D 5884 Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes
- D 5885 Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
- D 6241 Test Method for the Static Puncture Strength of Geotextiles and Geotextile Related Properties Using a 50-mm Probe
- D 7003 Test Method for Strip Tensile Properties of Reinforced Geomembranes
- D 7004 Test Method for Grab Tensile Properties of Reinforced Geomembranes
- E 96 Test Methods for Water Vapor Transmission of Materials

2.2 GRI Standards

- GM 11 Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation Exposure Device
- GM 16 Observation of Surface Cracking of Geomembranes

- 2.3 U. S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities," EPA/600/R-93/182, September 1993, 305 pgs.

3. Definitions

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-93/182.

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 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.

Construction Quality Control (CQC) - A planned system of inspections that are used to directly monitor and control the quality of a construction project. Construction quality control is normally performed by the geosynthetics manufacturer or installer, or for natural soil materials by the earthwork contractor, and is necessary to achieve quality in the constructed or installed system. Construction quality control (CQC) refers to measures taken by the installer or contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project, ref. EPA/600/R-93/182.

Construction Quality Assurance (CQA) - A planned system of activities that provide assurance that the facility was constructed as specified in the design. Construction quality assurance includes inspections, verification, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA organization to assess if the installer or contractor is in compliance with the plans and specifications for a project, ref. EPA.600/R-93/182.

Formulation, n - The mixture of a unique combination of ingredients identified by type, properties and quantity. For polyethylene geomembranes, a formulation refers to the exact type and percentages of resin, additives, and (for black geomembranes) carbon black. Thus, it can refer to the supplier of the base polyethylene resin as well as the individual suppliers of other ingredients. The individual suppliers must meet the manufacturer's internal quality control specification.

4. Material Classification and Formulation

4.1 This specification covers polyethylene geomembranes with a formulated density of the polyethylene being 0.930 g/cc, or greater.

- 4.2 The additive package for the polyethylene shall be adequate to pass the endurance testing of the specification. While the specifics are usually proprietary, the manufacturer can be requested to attest that acceptable use of the formulation has been achieved in similar applications.
 - 4.3 For black geomembranes, the carbon black must be N-110 or higher specific surface areas per ASTM D1765.
 - 4.4 This specification focuses on scrim reinforced geomembranes. As such, the polyethylene plys must be on both sides of the fabric scrim so as to completely encapsulate it and provide enough ply adhesion to resist delamination under field conditions.
 - 4.5 The fabric scrim consists of polymer yarns in an open woven pattern sufficient to achieve the minimum specification strength and elongation values. The type of yarns often consist of polyester filaments but other polymers have been successfully used in the past, e.g., nylon. The actual identification can be requested by the purchaser/owner, if desired.
 - 4.6 The specification addresses three serviceability categories; severe, moderate, and gentle. The serviceability categories are qualitative and if unknown for a particular application one should use the more robust and stronger material.
 - 4.7 Post-consumer plastics which has seen previous use cannot be used for either the geomembrane plys or the fabric scrim.
5. Physical, Mechanical and Durability Property Requirements
 - 5.1 The finished geomembranes shall conform to the test property requirements in either Table 1(a) or 1(b). Table 1(a) is in US (English) units and Table 1(b) is in SI (Metric) units. The conversion of units from US-to-SI units is “soft”.
 - Note 4: There are many ASTM test methods which have been revised from their original and this specification requires the most recent version.
 - Note 5: There is one GRI test currently included in this standard. This is necessary since the topic is not covered by current ASTM or ISO standards. It is GRI GM16, “Observation of Surface Cracking”.
 - 5.2 The properties of the geomembrane shall be tested at the minimum frequencies shown in Table 1. If the specific manufacturer’s quality control guide is more stringent and is certified accordingly, it must be followed in like manner.
 - Note 6: 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, respectively; see definitions.
 6. Workmanship and Appearance

- 6.1 The finished geomembranes shall have consistently good appearance. It shall be free from defects including cracking and crazing that would affect the specified properties of the geomembrane.
 - 6.2 The scrim reinforced geomembranes shall generally have a uniformly undulating surface appearance. It shall be free from defects including delamination and blisters that would affect the specified properties of the geomembrane.
 - 6.3 General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.
7. MQC Sampling
 - 7.1 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 roll width.
 - 7.2 The number of tests conducted shall be in accordance with the appropriate test methods listed in Table 1.
 - 7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum (or maximum) value listed in these tables, hence the values listed are generally the minimum average values and are designated as "min. ave."
8. MQC Retest and Rejection
 - 8.1 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 control guide and/or documents.
9. Packaging and Storage
 - 9.1 The finished geomembrane shall be rolled in the machine direction onto a stable core for handling storage and shipment. The roll is to be protected by an outer wrapping or plastic bag. The manufacturer's identification label should be clearly visible on the core and in a manner consistent with established policy of the manufacturer.
 - 9.2 Handling of the rolls of geomembrane shall be by forklift stinger, or by dedicated slings consistent with the weight of the rolls. Handling shall be performed in a manner that does not result in physical damage to the geomembrane or core.
 - 9.3 The rolls of geomembrane shall be stored at the manufacturer's facility in a neat and orderly fashion until shipment to the field site.

10. Certification

10.1 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.

11. Warranty

11.1 Upon request of the purchaser, a manufacturer's warranty covering the quality of the material shall be furnished at the completion of the terms of the contract.

Note 7: If a warranty is required for the installation of the geomembrane, it is to be developed between the installation contractor and the party requesting such a document.

Table 1(a) – Specification Values for Exposed Scrim Reinforced Polyethylene Geomembranes

Property and Units ⁽¹⁾	ASTM or GRI Test Methods	Category 1 – Severe ⁽²⁾ (20 mil – nominal)	Category 2 – Moderate ⁽²⁾ (12 mil – nominal)	Category 3 – Gentle ⁽²⁾ (8 mil – nominal)	Testing Frequency
Thickness ⁽³⁾ (mils)	ASTM D751	17	10	6	per roll
Weight, (lb/1000 ft ²)	ASTM D751	94	53	34	20,000 lb
Grab Tensile Strength ⁽⁴⁾ (lb)	ASTM D7004	114	76	59	20,000 lb
Grab Tensile Elongation ⁽⁴⁾ (%)	ASTM D7004	15	15	15	20,000 lb
Strip Tensile Strength ⁽⁴⁾ (lb)	ASTM D7003	77	51	45	20,000 lb
Strip Tensile Elongation ⁽⁴⁾ (%)	ASTM D7003	15	15	15	20,000 lb
Tongue Tear (lb)	ASTM D5884	53	40	15	20,000 lb
CBR Puncture (lb)	ASTM D6241	320	220	150	45,000 lb
Hydrostatic Resistance ⁽⁵⁾ (lb/in. ²)	ASTM D751	130	85	60	45,000 lb
Water Vapor Transmission (WVT) (g/m ² -day) ⁽⁷⁾	ASTM E96	0.4	0.7	1.2	200,000 lb
Oxidative Induction Time (OIT)					
(a) Standard OIT (min.)	ASTM D3895	(6)	(6)	(6)	per each formulation
(b) High Pressure OIT (min.)	ASTM D5885	1000	1000	1000	
UV Resistance (fluorescent light method)	ASTM D7238				
(a) Str. & Elong. retained after 10,000 hrs	ASTM D7004	50%	50%	50%	per each formulation
(b) Response to bending	GRI GM16	no cracking	no cracking	no cracking	

Notes

- (1) All values are minimum, or minimum average, except WVT which is a maximum value.
- (2) The categories refer to the type of subgrade, manner of installation, anchorage/tie downs, and site-specific conditions.
- (3) The thickness value is measured in the valleys created by the scrim reinforcement, i.e., ply to ply thickness between scrim should be measured.
- (4) If the reinforcement is aligned in any direction other than the machine and transverse directions, specimen shall be cut such that reinforcing yarns are oriented parallel to the central axis of the tension testing machine.
- (5) The center of the circular test specimen should be equidistant between sets of parallel yarns.
- (6) Not recommended since the high temperatures of the STD-OIT test produces an unrealistic result for some of the antioxidants used in these materials.
- (7) Performed at 23° ± 0.5°C temperature and 50% ± 5% relative humidity.

SI (Metric) Units

Table 1(b) – Specification Values for Exposed Scrim Reinforced Polyethylene Geomembranes

Property and Units ⁽¹⁾	ASTM or GRI Test Methods	Category 1 – Severe ⁽²⁾ (0.50 mm – nominal)	Category 2 – Moderate ⁽²⁾ (0.30 mm – nominal)	Category 3 – Gentle ⁽²⁾ (0.20 mm – nominal)	Testing Frequency
Thickness ⁽³⁾ (mm)	ASTM D751	0.43	0.25	0.15	per roll
Weight, (kg/1000 m ²)	ASTM D751	0.50	0.28	0.18	9,000 kg
Grab Tensile Strength ⁽⁴⁾ (N)	ASTM D7004	510	340	260	9,000 kg
Grab Tensile Elongation ⁽⁴⁾ (%)	ASTM D7004	15	15	15	9,000 kg
Strip Tensile Strength ⁽⁴⁾ (N)	ASTM D7003	340	225	200	9,000 kg
Strip Tensile Elongation ⁽⁴⁾ (%)	ASTM D7003	15	15	15	9,000 kg
Tongue Tear (N)	ASTM D5884	235	180	65	9,000 kg
CBR Puncture (N)	ASTM D6241	1420	980	670	20,000 kg
Hydrostatic Resistance ⁽⁵⁾ (kPa)	ASTM D751	900	590	410	20,000 kg
Water Vapor Transmission (WVT) (g/m ² -day) ⁽⁷⁾	ASTM E96	0.4	0.7	1.2	200,000 kg
Oxidative Induction Time (OIT)					
(a) Standard OIT (min.)	ASTM D3895	(6)	(6)	(6)	per each
(b) High Pressure OIT (min.)	ASTM D5885	1000	1000	1000	formulation
UV Resistance (fluorescent light method)	ASTM D7238				
(a) Str. & Elong. retained after 10,000 hrs	ASTM D7004	50%	50%	50%	per each
(b) Response to bending	GRI GM16	no cracking	no cracking	no cracking	formulation

Notes

- (1) All values are minimum, or minimum average, except WVT which is a maximum value.
- (2) The categories refer to the type of subgrade, manner of installation, anchorage/tie downs, and site-specific conditions.
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