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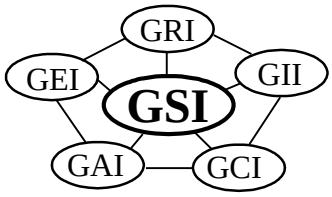

Original: May 25, 2016

GRI GM30*

Standard Specification for

"Test Methods, Test Properties and Testing Frequency for Coated Tape Polyethylene (cPE) Barriers"

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 It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part.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 (GSI), 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 coated tape polyethylene barriers in three thickness categories. These thicknesses reflect both varying vapor transmission and mechanical property strength values.

Note 1: The base fabric for this type of barrier is a woven tape product (also called slit film or split film) polyethylene textile which is then polyethylene coated on one or both sides for the final product.

Note 2: The three thickness categories of this type of barrier can also be categorized on the basis of their mass per unit area.

1.2 This specification sets forth a set of minimum, maximum, or range of physical, mechanical and endurance properties that must be met, or exceeded by the barrier being manufactured.

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

*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.

Note 3: This specification is intended to set forth physical, mechanical and vapor properties focused on appropriate manufacturing quality control (MQC) practices for general applications. Manufacturing quality assurance (MQA) can utilize any or all of the stated test methods so as to verify product conformance and/or acceptance.

1.4 This standard specification is intended to ensure good uniform quality cPE barriers for use in general applications.

Note 4: Additional tests, or more restrictive values for the tests indicated, may be necessary under conditions of a particular application. In this situation, interactions between the purchaser/specifier and the manufacturer are required.

Note 5: For information on installation techniques, users of this standard are referred to the geosynthetics literature, which is abundant on the subject. Manufacturer's literature may also indicate product-specific considerations.

2. Referenced Documents

2.1 ASTM Standards

D 751 Standard Test Methods for Coated Fabrics
D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
D 4833 Test Method for Index Puncture Resistance of Geomembranes and Related Products
D 5884 Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes
D 6241 Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
D 7003 Test Method for Strip Tensile Properties of Reinforced Geomembranes
D 7238 Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus
E96 Test Methods for Water Vapor Transmission of Materials

2.2 GRI Standards

GM16 Observation of Surface Cracking of Geomembranes

2.3 Other

Guglielmetti, J. I., Sprague, C. J. and Coyle, M. J. (1977), "Geomembrane Installation and Construction Survivability," Proc. Geosynthetics '97, IFAI, St. Paul, MN, pp. 236-252.

3. Definitions

Coated Tape Polyethylene Barriers (cPE) - In plastics, these materials represent polymeric sheets that consist of a woven slit film geotextile spread coated with polyethylene to achieve a lower permeability product.

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.

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.

Soft Conversion of Units - Action involving the changing a measurement from imperial units to equivalent metric units (or vice versa) within "acceptable measurement tolerances". This is done to convert the measurements without physically changing the item, and it is typically used to specify a requirement. For example, a 60 mil material would be converted to 1.5 mm using an approximate (or "soft") conversion.

4. Material Classification and Formulation

4.1 The textile for this type of barrier is of the woven tape product (also called slit or split) film type. The base resin is polyethylene having a formulation consistent with typical practice for geosynthetic engineering applications.

4.2 The polyethylene resin with which the textile is coated will generally be in the density range of 0.90 to 0.94 g/cc. This refers to the natural, i.e., nonformulated, resin.

4.3 The resin shall be virgin material with no more than 25% rework. If rework is used, it must be of the same formulation (or other approved formulation) as the parent material.

4.4 The polyethylene coating shall be of a formulation such that the endurance criterion in the specification is met or exceeded.

4.5 No post consumer resin (PCR) of any type shall be added to the formulation.

5. Physical, Mechanical and Endurance Property Requirements

5.1 The barrier shall conform to the test property requirements prescribed in Tables 1 and 2. Table 1 is for cPE barriers in American Units and Table 2 is for cPE barriers in SI units. The conversion from American to SI units is "soft", see definition section. It is also to be understood that the tables refer to the latest revision of the referenced test methods and practices.

Note 6: It should be clearly stated that this specification is for verifying performance of barrier materials and not geomembranes. The existence of GRI-GM13 and GM17 and experience gained in over 40 years with such materials should be recognized that those two specifications contain durability and survivability criteria that are largely absent from this specification.

Note 7: There are several tests which are included in this standard that are not customarily required in other barrier specifications because they are relevant and important in the context of current manufacturing processes. The following endurance tests have been purposely added:

- Ultraviolet Light Resistance
- Surface Cracking
- Chalking Observation

5.2 The values listed in the tables of this specification are to be interpreted according to the designated test method. The physical and mechanical properties are all "min. ave." values.

Note 8: In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

5.3 In an effort to try to quantify the difference between Category 1-Severe, Category 2-Moderate and Category 3-Light we present Table 3 to suggest targeted performance of these barrier materials. This table is simply a guide and the site specific installation survivability conditions may take precedence.

5.4 The various properties of the cPE barrier shall be tested at the minimum frequencies shown in Tables 1 and 2. If the specific manufacturer's quality control guide is more stringent, it must be followed in like manner.

Note 9: This specification is focused on manufacturing quality control (MQC). Conformance and/or acceptance testing and manufacturing quality assurance (MQA) testing are at the discretion of the purchaser and/or quality assurance engineer,

respectively. Communication and interaction with the manufacturer is strongly suggested.

5.5 It should be stated that cPE barriers can develop pinholes through the coating when elongated greater than 20%. This has the effect of greatly increasing the ASTM E96 water vapor transmission values.

5.6 It should also be stated that cPE barriers are difficult to repair after some years of service. This is in contrast to HDPE and LLDPE geomembranes which can be repaired via extrusion seaming/welding.

6. Workmanship and Appearance

6.1 cPE barriers shall generally have a uniform undulating appearance. They shall be essentially free from irregular filaments, filaments that are bunched together, crossing over one another, and such defects that mechanically affect the specified properties of the barrier. Strictly cosmetic flaws that do not affect the specified properties are generally acceptable.

6.2 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 Tables 1 and 2. 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 shall be in accordance with the appropriate test methods listed in Tables 1 and 2.

7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are 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 manual.

9. Packaging and Marketing

9.1 The barrier shall be rolled onto a substantial core or core segments and held firm by dedicated straps/slings, or other suitable means. The rolls must be adequately

protected for safe transportation to the point of delivery, unless otherwise specified in the contract or order.

9.2 Marking of the barrier rolls shall be done in accordance with the manufacturers accepted procedure as set forth in their quality manual.

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.

REVISION SCHEDULE

GRI-GM30

"Test Methods, Test Properties and Testing Frequency for Coated Tape Polyethylene (cPE) Barriers"

Adopted: May 25, 2016

American Units

Table 1 – Specification Values for Coated Tape Polyethylene Barriers

Property and Units[1]	ASTM or GRI Test Methods	Category 1 – Severe[2] (40 mil – nominal)	Category 2 – Moderate[2] (30 mil – nominal)	Category 3 – Light[2] (24 mil – nominal)	Testing Frequency
Thickness (mils) (min. ave.)	ASTM D751	36	27	22	per roll
Weight, (oz/yd^2) (min. ave.)	ASTM D751	18	15	10	20,000 lb
Strip Tensile Strength[3] (lb) (min. ave.)	ASTM D7003	250	225	200	20,000 lb
Strip Tensile Elongation[3] (%) (min. ave.)	ASTM D7003	20	20	20	20,000 lb
Tongue Tear[3] (lb) (min. ave.)	ASTM D5884	50	50	50	20,000 lb
CBR Puncture (lb) (min. ave.)	ASTM D6241	1000	700	400	
Index Pin Puncture-Resistance (lb) (min. ave.)	ASTM D4833	220	180	160	45,000 lb
Hydrostatic Resistance (psi) (min. ave.)	ASTM D751	700	500	300	45,000 lb
Dimensional Stability (% change) (Max)	ASTM D1204	3	3	3	
Water Vapor Transmission (WVT) (g/m^2-day)[4] (max. ave.)	ASTM E96	0.3	0.4	0.5	per each formulation
UV Resistance (fluorescent light method)	ASTM D7238				
(a) Strength and Elongation retained after 10,000 light hours	ASTM D7003	> 50% retained	> 50% retained	> 50% retained	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 dimensionally stability and WVT which are maximum values.

(2) The categories refer to the type of subgrade, manner of installation, anchorage/tie downs, and site-specific conditions, see Table 3.

(3) If the tape 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.

(4) Performed at 23° ± 0.5°C temperature and 50% ± 5% relative humidity.

SI Units

Table 2 – Specification Values for Coated Tape Polyethylene Barriers

Property and Units[1]	ASTM or GRI Test Methods	Category 1 – Severe[2] (1 mm – nominal)	Category 2 – Moderate[2] (0.75 mm – nominal)	Category 3 – Light[2] (0.61 mm – nominal)	Testing Frequency
Thickness (mm) (min. ave.)	ASTM D751	0.91	0.69	0.56	per roll
Weight, (g/m^2) (min. ave.)	ASTM D751	610	520	340	9,000 kg
Strip Tensile Strength[3] (N) (min. ave.)	ASTM D7003	1100	1000	900	9,000 kg
Strip Tensile Elongation[3] (%) (min. ave.)	ASTM D7003	20	20	20	9,000 kg
Tongue Tear[3] (N) (min. ave.)	ASTM D5884	220	220	220	9,000 kg
CBR Puncture (N) (min. ave.)	ASTM D6241	4400	3100	1800	
Index Pin Puncture-Resistance (N) (min. ave.)	ASTM D4833	980	800	700	20,000 kg
Hydrostatic Resistance (kPa) (min. ave.)	ASTM D751	4800	3400	2000	20,000 kg
Dimensional Stability (% change) (Max)	ASTM D1204	3	3	3	
Water Vapor Transmission (WVT) (g/m^2-day)[4] (max. ave.)	ASTM E96	0.3	0.4	0.5	per each formulation
UV Resistance (fluorescent light method)	ASTM D7238				
(a) Strength and Elongation retained after 10,000 light hours	ASTM D7003	> 50% retained	> 50% retained	> 50% retained	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 dimensionally stability and WVT which are maximum values.

(2) The categories refer to the type of subgrade, manner of installation, anchorage/tie downs, and site-specific conditions.

(3) If the tape 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.

(4) Performed at 23° ± 0.5°C temperature and 50% ± 5% relative humidity.

Table 3 - Required Degree of Survivability as a Function of Site Conditions*

Subgrade Conditions	Low ground-pressure equipment (≤ 7 kPa) (1 psi)	Medium ground-pressure equipment (> 7 kPa and ≤ 20 kPa)	Heavy ground-pressure equipment (> 20 kPa) (3 psi)
Subgrade has been cleared of all obstacles. Surface is smooth and level so that any shallow depressions and humps do not exceed 10 mm in depth or height. All larger depressions are filled.	Light	Moderate	Severe
Subgrade has been cleared of obstacles larger than 20 mm in size. Depressions and humps should not exceed 20 mm in depth or height. Larger depressions should be filled.	Moderate	Severe	Not Recommended
Subgrade has been cleared of obstacles larger than 30 mm in size. Depressions and humps should not exceed 30 mm in depth or height. Larger depressions should be filled.	Severe	Not Recommended	Not Recommended

Category 3 (Light)

Category 2 (Moderate)

Category 1 (Severe)

EPA/600/R-93 - Section 3.3.4.1 suggests "…using small pneumatic tire lifting units with maximum tire inflation pressure of 40 kPa (6 lb/sq. in.) is acceptable directly on the geosynthetic during the deployment of the material. This in turn has resulted in allowing contractors to use ATV's or specially adapted construction equipment with low ground contact pressure during the installation process. The following provisions are also recommended in this regard; no sudden stops/starts, no tire spinning, only smooth and clean tires, 90° entrance and exits with protection apron, no excessive turning, no driving over wrinkles, one person per vehicle and no vehicles on slopes.

Barrier materials must be covered before being able to receive repeated vehicular traffic. A minimum cover soil thickness of 300 mm is recommended by the US EPA where the US Corps of Engineers requires 450 mm. This cover soil must be free of stones greater than 15 mm in size. Placement of the cover soil over the barrier should progress up gradient. It is highly recommended that the barrier is protected against puncture from above or below by a geotextile or a GCL.