

Geosynthetic Institute

475 Kedron Avenue
Folsom, PA 19033-1208 USA
TEL (610) 522-8440
FAX (610) 522-8441



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GRI – GS33 Standard Specification*

Standard Specification for

“Test Methods, Test Properties and Testing Frequency for
Polyolefin (Film) 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 It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part.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, 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 polyolefin film barriers (PFB) with a thickness range of 0.15 – 0.30 mm (6-15 mil). The PFBs are generally smooth but can have a satin or matte finish.
- 1.2 This specification sets forth a set of minimum, physical, mechanical and chemical properties that must be met, or exceeded by the film being manufactured. In a few cases a range is specified.
- 1.3 In the context of quality systems and management, this specification represents manufacturing quality control (MQC).
- 1.4 This standard specification is intended to ensure good quality and performance of films in general applications, but is possibly not adequate for use as a complete specification when applied to specific situations. Additional tests, or more restrictive values for test indicated, may be necessary under conditions of a particular application.

2. Referenced Documents

*This GRI standard specification 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 it is kept current on the Institute’s Website <<geosynthetic-institute.org>>.

2.1 ASTM Standards

D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
D 1004 Test Method for Initial Tear Resistance of Plastics Film and Sheeting D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
D 1603 Test Method for Carbon Black in Olefin Plastics
D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
D 5397 Procedure to Perform a Single Point Notched Constant Tensile Load – (SP-NCTL) Test: Appendix
D 5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
D 5885 Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
D 5994 Test Method for Measuring the Core Thickness of Textured Geomembranes
D 6370 Standard Test Method for Rubber-Compositional Analysis by Thermogravimetry (TGA)
D 6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
D 7238 Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus
D 7466 Test Method for Measuring the Asperity Height of Textured Geomembranes D 8117 Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by Differential Scanning Calorimetry

2.2 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

Formulation - The mixture of a unique combination of ingredients identified by type, properties and quantity.

Nominal - Representative value of a measurable property determined under a set of conditions, by which a product may be described. Abbreviated as nom. in Tables 1 and 2.

5. Physical, Mechanical and Chemical Property Requirements

5.1 The PFBs shall conform to the test property requirements prescribed in Tables 1 and 2. Each of the tables are given in English and SI (metric) units. The conversion from English to SI (metric) is soft.

5.2 The values listed in the tables of this specification are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV)

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

6. Workmanship and Appearance

6.1 Polyolefin Film Barriers (PFBs) shall have good appearance qualities. It shall be free from such defects that would affect the specified properties of the material. It should not have surface agglomerates or tears in any of the materials.

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 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.

- 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 PFBs 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 adequate for safe transportation to the point of delivery, unless otherwise specified in the contract or order.
- 9.2 The PFBs may be "C" or "S" folded onto a core. They may also be accordion folded onto a pallet to expedite shipping and handling.
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.

Table 1 – Test method, properties and frequencies for Polyolefin Film Barriers (PFBs) **ENGLISH IMPERIAL**

Property	Test Method	Units	Class “A”	Class “B”	Class “C”	Frequency (Minimum)
Thickness (min. ave.)	D 5199	mil	15	10	6	Per roll
Density (min. ave.)	D 1505/D792	g/cc	0.93	0.93	0.93	500,000 lbs
Ash Content (range)	D 1603 (1)	%	2-4	2-4	2-4	500,000 lbs
Tensile Properties (min. ave.)						
• break stress	D 882	lb/in.	70	45	15	250,000 lbs
• break elongation	D 882	%	1000	800	400	250,000 lbs
Elmendorf Tear Resistance (min. ave.)	D 1922	lbf	6.7	4.5	0.7	250,000 lbs
Puncture Resistance (min. ave.)	D 4833	lbf	30	20	10	250,000 lbs
Impact	D 1709	lbf	7.05	5.07	2.20	250,000 lbs
Oxidative Induction Time (OIT) (min. ave.) (2)						
(a) Standard OIT	D 8117	min.	100	100	100	Per formulation
— or —						
(b) High Pressure OIT	D 5885	min.	200	200	200	Per formulation
Water Vapor Permeance	E96	perms	0.01	0.02	0.04	Per formulation

- (1) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.
- (2) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

Table 2 – Test method, properties and frequencies for Polyolefin Film Barriers (PFBs) **METRIC**

Property	Test Method	Units	Class “A”	Class “B”	Class “C”	Frequency (Minimum)
Thickness (min. ave.)	D 5199	mm	0.38	0.25	0.15	Per roll
Density (min. ave.)	D 1505/D792	g/cc	0.93	0.93	0.93	226,796 kg
Ash Content (range)	D 1603 (1)	%	2-4	2-4	2-4	226,796 kg
Tensile Properties (min. ave.)						
• break stress	D 882	kN/m	12.3	9.5	2.6	113,398 kg
• break elongation	D 882	%	1000	800	400	113,398 kg
Elmendorf Tear Resistance (min. ave.)	D 1922	mN	30,000	20,000	3000	113,398 kg
Puncture Resistance (min. ave.)	D 4833	N	133	89	44	113,398 kg
Impact	D 1709	gm	3200	2300	1000	113,398 kg
Oxidative Induction Time (OIT) (min. ave.) (2)						
(a) Standard OIT	D 8117	min.	100	100	100	Per formulation
— or —						
(b) High Pressure OIT	D 5885	min.	200	200	200	Per formulation
Water Vapor Permeance	E96	perms	0.01	0.02	0.04	Per formulation

- (1) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.
- (2) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

**Adoption and Revision Schedule
for
Standard Specification per GRI-GS33**

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