Designation: D7465/D7465M – 15$^{\varepsilon 1}$

Standard Specification for Ethylene Propylene Diene Terpolymer (EPDM) Sheet Used In Geomembrane Applications[1]

This standard is issued under the fixed designation D7465/D7465M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Section 9 was editorially corrected in July 2015.

1. Scope

1.1 This specification covers flexible sheet made from ethylene propylene diene terpolymer (EPDM) geomembrane intended for use in geotechnical and geoenvironmental applications. The tests and property limits used to characterize the sheet are values to ensure minimum quality for the intended use. The vulcanized rubber sheet may be non-reinforced, fabric or scrim reinforced.

1.2 In place geomembrane design criteria, such as field seaming strength, and material compatibility, among others, are factors that must be considered but are beyond the scope of this specification.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D471 Test Method for Rubber Property—Effect of Liquids

D518 Test Method for Rubber Deterioration—Surface Cracking (Withdrawn 2007)[3]

D573 Test Method for Rubber—Deterioration in an Air Oven

D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

D751 Test Methods for Coated Fabrics

D1149 Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment

D1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature

D1418 Practice for Rubber and Rubber Latices—Nomenclature

D2137 Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics

D4439 Terminology for Geosynthetics

D4833/D4833M Test Method for Index Puncture Resistance of Geomembranes and Related Products

D5884 Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes

D7004/D7004M Test Method for Grab Tensile Properties of Reinforced Geomembranes

D7635/D7635M Test Method for Measurement of Thickness of Coatings Over Fabric Reinforcement

G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of other geosynthetic terms used in this guide, refer to Terminology D4439.

3.1.2 *composite, n*—factory laminated non-woven geotextile and EPDM.

3.1.3 *EPDM, n*—terpolymer of ethylene, propylene, and diene with the residual unsaturated portion of the diene in the side chain. **D1418**

[1] This specification is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.10 on Geomembranes.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

4. Classification

4.1 Types describe the sheet construction:

4.1.1 *Type I*—Non-reinforced.

4.1.2 *Type II*—Scrim (or fabric) internally reinforced.

5. Materials and Manufacture

5.1 The sheet shall be formulated from EPDM polymers and other compounding ingredients. EPDM shall be the principal polymer used in the sheet and shall be greater than 95 % of the total polymer content.

5.2 To make seams and repairs, the sheet shall be capable of being bonded watertight to itself and the supplier or fabricator shall recommend suitable methods.

6. Physical Properties and Requirements

6.1 The sheet shall conform to the physical requirements prescribed in Table 1.

6.2 The tolerance for time conditions (aging, weathering, and so forth) is ±15 min or ±1 % of the period; whichever is greater, unless otherwise specified.

6.3 Tolerances for temperature shall be ±2°C [±4°F].

7. Dimensions

7.1 The width and length of the sheet shall be agreed upon between the purchaser and the supplier.

7.1.1 The width and length tolerance shall be +3 %, -0 %.

TABLE 1 Physical Requirements for EPDM Sheet

Property	ASTM	Nominal Sheet Thickness	Type I	Type II
Thickness, min, mm [in.]:				
Sheet-overall	D412		1.14 [0.045]	
			1.52 [0.060]	
	D751			1.14 [0.045]
				1.52 [0.060]
Coating over scrim or fabric	D7635/D7635M	1.14 [0.045]	...	0.38 [0.015]
		1.52 [0.060]		0.59 [0.022]
Breaking Strength, min, N [lbf]	D7004/D7004M Grab Method	1.14 [0.045]	...	400 [90]
		1.52 [0.060]		400 [90]
Tensile strength, min, MPa [psi]	D412 Die C	1.14 [0.045]	9.0 [1305]	...
		1.52 [0.060]	9.0 [1305]	
Puncture Resistance N [lbs] Min.	D4833/D4833M	1.14 [0.045]	133 [30]	270 [60]
		1.52 [0.060]	178 [40]	350 [80]
Elongation, ultimate, min %	D412 Die C	1.14 [0.045]	300	250[A]
		1.52 [0.060]	300	250[A]
Elongation @ fabric break, ultimate, min, %				
Machine direction	D7004/D7004M, Grab Method,	1.14 [0.045]		15
	50 mm [2 in.] per minute	1.52 [0.060]		15
Cross direction	jaw separation rate	1.14 [0.045]		15
		1.52 [0.060]		15
Tensile set, max	D412 Method A, Die C	1.14 [0.045]	10	...
		1.52 [0.060]	10	
Tear resistance, min, kN/m [lbf/in.]	D624 Die C	1.14 [0.045]	26.27 [150]	...
		1.52 [0.060]	40.28 [230]	
Tearing strength, min, N [lbf]	D5884	1.14 [0.045]	...	580 [130]
		1.52 [0.060]		750 [170]
Brittleness point, max °C [°F]	D2137	1.14 [0.045]	–45 [–49]	–45 [–49]
		1.52 [0.060]	–45 [–49]	–45 [–49]
Ozone resistance, no cracks	D1149	1.14 [0.045]	pass	pass
		1.52 [0.060]	pass	pass
Heat Aging:	D573			
Breaking strength, min, N [lbf]	D7004/D7004M	1.14 [0.045]		356 [80]
		1.52 [0.060]		888 [200]
Tensile strength, min, MPa [psi]	D412 Method A, Die C	1.14 [0.045]	8.3 [1205]	...
		1.52 [0.060]	8.3 [1205]	
Elongation, ultimate, min, %	D412 Die C	1.14 [0.045]	200	200[A]
		1.52 [0.060]	200	200[A]
Tear resistance, min, kN/m [lbf/in.]	D624 Die C	1.14 {0.045]	21.9 [125]	...
		1.52 [0.060]	37.3 [213]	
Linear dimensional change, max, %	D1204	1.14 [0.045]	±1	±1
		1.52 [0.060]	±1	±1
Water absorption, max, mass, %	D471	1.14 [0.045]	±8, –2	±8, –2[A]
		1.52 [0.060]	±8, –2	±8, –2[A]
Laboratory Accelerated Weathering:	G151 and G155			
Visual Inspection	D518	1.14 [0.045]	No cracks	No cracks
		1.52 [0.060]	No cracks	No cracks
PRFSE, min, %		1.14 [0.045]	30	...
		1.52 [0.060]	30	
Elongation, ultimate, min, %		1.14 [0.045]	200	...
		1.52 [0.060]	200	

[A] Specimens to be prepared from coating rubber compound, vulcanized in a similar method to the reinforced products.

7.2 The thickness tolerance shall be +15 %, -10 % of the thickness agreed upon between the purchaser and supplier, but in no case shall the thickness be less than the minimum listed in Table 1.

8. Workmanship, Finish, and Appearance

8.1 The sheet, including the full width of factory seams if present, shall be fully adhered, watertight, and visibly free of pinholes, particles of foreign matter, undispersed raw material or other manufacturing defects that might affect serviceability. If the number of irregularities in the form of pockmarks (see Note 1) appear excessive on the sheet (or portion thereof), then its rejection shall be negotiated between involved parties.

NOTE 1—Pockmarks are oblong depressions, cavities or craters on the surface of the sheet that have an approximate surface dimension of 3.2 by 1.6 mm [1/8 by 1/16 in.], and have a maximum depth approaching one half of the sheet thickness.

8.2 Edges of the sheets shall be straight and flat so that they may be seamed to one another without fishmouthing.

9. Test Methods

9.1 *Dimensions*—Test Methods D751, after permitting the sheet to relax at 23 ± 2°C [73.4 ± 4°F] for 1 h ± 15 min.

9.2 *Thickness, Sheet Overall*—From across the full width of the unbuffed sheet, take three samples, 300 by 300 mm [1 by 1 ft]. Measure the thickness of each corner. Refer to Test Methods D412 for Type I sheet and Test Methods D751 for Type II sheet.

9.3 *Thickness of Coating Over Scrim (Reinforcing Fabric)—Optical Method*—see Annex A1.

9.4 *Breaking Strength*—Test Methods D751, Grab Method.

9.5 *Tensile Strength*—Test Methods D412, Die C.

9.6 *Puncture Resistance*—Test Method D4833/D4833M.

9.7 *Elongation, Ultimate*—Test Methods D412, Die C.

9.8 *Elongation at Fabric Break, Ultimate*—Test Methods D751, Grab Method, 50 mm [2 in.] per minute jaw separation rate.

9.9 *Tensile Set*—Test Methods D412, Method A, Die C, 50 % elongation.

9.10 *Tear Resistance*—Test Method D624, Die C.

9.11 *Tearing Strength*—Test Methods D751, B-Tongue Tear.

9.12 *Brittleness Point*—Test Methods D2137.

9.13 *Ozone Resistance*—Test Methods D1149, Terminology D4439. Inspect at 7× magnification on specimens exposed to 100 mPa [1×10^{-5} psi] ozone in air at 40 ± 2°C [104 ± 4°F]. Elongate Type I specimens 50 % for 166 ± 1.66 h exposure. And Type II specimens must be wrapped around a 75 mm [3 in.] diameter mandrel for 166 ± 1.66 h exposure. The required specimen width is 25 mm [1 in.].

9.14 *Heat Aging*—Test Method D573. Age sheet at 116 ± 2°C [240 ± 4°F] for 670 ± 6.7 h. Specimens are then cut from the aged sheet for testing of breaking strength, tensile strength, elongation and tear resistance.

9.15 *Linear Dimensional Change*—Test Method D1204.

9.16 *Water Absorption*—Test Method D471, at 70 ± 2°C [158 ± 4°F] for 166 ± 1.66 h.

9.17 *Laboratory Accelerated Weathering*—Accelerated weathering tests shall be performed in accordance with Practices G151 and G155. These tests are performed on the intact sheet with the weathering side facing the lamps. Mount specimens for exposure under no strain. After exposure the specimens shall be removed and inspected immediately for cracks and crazing at 10 % strain in the bent loop configuration in accordance with Test Method D518 under 7 × magnifications. A specimen is rated "pass" if no cracks or crazing are observed. In addition, for Type I sheet, determine tensile strength and ultimate elongation after exposure to laboratory accelerated weathering. Calculate the specimen percent retained fractional strain energy (PRFSE):

$$PRFSE = \frac{(Tensile\ Strength \times Elongation)\ aged}{(Tensile\ Strength \times Elongation)\ original} \times 100$$

9.18 Tbe Xenon-Arc exposure devices shall be operated in accordance with Practices G151 and G155 and the following condtions:

Filter type:	Daylight Filter
Irradiance:	0.35 to 0.70 W/(m^2. nm) at 340 nm: ±0.02 W/(m^2. nm) maximum allowed fluctuation (42 to 84 W/m^{2}at 300 to 400 nm: ±2 W/m^2 maximum allowed fluctuation)
Cycle:	690 min ± 15 min light, 30 min light plus water spray
Uninsulated black panel temp:	80 ± 2.5°C maximum allowed fluctuation [176 ± 4°F maximum allowed fluctuation]
Chamber air temperature (if controlled)	50 ± 2°C maximum allowed fluctuation
Relative humidity:	50 %; ±10 % maximum allowed fluctuation
Spray water:	Deionized: refer to Practice G155, Section 6.6.1 for temperature of the water
Specimen repositioning (if required):	Every 315 kJ (m^2.nm) at 340 nm (37.8 MJ/m^2 at 300 to 400 nm)
Exposure duration:	5040 kJ (m^2.nm) at 340 nm (604.8 MJ/m^2 at 300 to 400 nm).

10. Inspection and Special Testing

10.1 The manufacturer shall inspect and test production to ensure compliance of the product with this specification.

11. Rejection and Resubmittal

11.1 Failure to conform to any one of the requirements prescribed in this specification shall constitute grounds for rejection. Rejection shall be reported to the producer or supplier promptly and in writing. The seller shall have the right to reinspect the rejected shipment and resubmit the lot after removal of those packages not conforming to the specified requirements.

12. Product Marking

12.1 The sheet shall be identified on the side intended to be exposed to the weather with this ASTM designation number and ASTM type, the name of the manufacturer or supplier, or the generic sheet type. The type and size of the identification is at the manufacturer's option. The identification shall be applied in such a manner as to be legible at least five years from installation. Identification shall not be required when so specified by the purchaser.

13. Packaging and Package Marking

13.1 The material shall be rolled on a substantial core and packaged in a standard commercial manner, unless otherwise specified in the contract or order.

13.2 Shipping containers shall be marked with the name of the material, the stock and lot numbers, the ASTM designation number and type, the size and quantity as defined by the contract or order under which shipment is made and the name of the manufacturer or supplier.

14. Keywords

14.1 EPDM; geomembrane; rubber sheet; vulcanized rubber

ANNEX

(Mandatory Information)

A1. OPTICAL METHOD FOR MEASUREMENT OF THICKNESS OF COATING OVER SCRIM (REINFORCING FABRIC) FOR TYPE II SHEET

A1.1 *Scope*—This is a method for measuring the thickness of the coating over the reinforcing fabric.

A1.2 *Measurement Method Principle*—The thickness of coating material over reinforcing fabric can be observed with a standard reflectance microscope. Measurement is made with a calibrated eyepiece.

A1.3 *Apparatus*:

A1.3.1 *Microscope,* 60× with reticle.

A1.3.2 *Light Source*—If light source on the microscope is not adequate, a small tensor lamp can also be used.

A1.3.3 *Stage Micrometer,* 0.0254-mm [0.001-in.] divisions.

A1.4 *Procedure*:

A1.4.1 *Calibration:*

A1.4.1.1 Place a standard reflectance stage micrometer in place of the specimen.

A1.4.1.2 Turn on microscope light source.

A1.4.1.3 Position the reticle eyepiece and the micrometer such that the scales are superimposed. Focus the reticle by turning the eyepiece. Focus the specimen and reticle by turning the vertical adjustment knob.

A1.4.1.4 Locate a point at which both scales line up. Count the number of micrometer divisions away. Measure to the nearest 0.0125 mm [0.5 mil]. The calibration may be optimized in increasing the number of divisions measured.

A1.4.1.5 Repeat the calibration three times and average the results.

A1.4.2 *Specimen Analysis:*

A1.4.2.1 Carefully center a sharp single edge razor or equivalent over the fiber intersections along the x – x line.

A1.4.2.2 Make a clean bias cut completely through the liner.

A1.4.2.3 Remove the razor cut section and mount in common putty with the cut surface facing upward.

A1.4.2.4 Observe the cut surface with the eyepiece reticle. Measure the thickness of the coating on either side of the thread intersection by counting the number of reticle divisions (to the nearest one-half division).

A1.4.2.5 Sample two or three areas of the coatings and average the results.

A1.5 *Calculation*:

A1.5.1 *Calibration:*

A1.5.1.1 A calibration example follows:

In this example, 4.5 micrometer divisions (MD) are equal to 4 reticle divisions (RD).

$$4\ RD = 4.5\ MD \tag{A1.1}$$

$$1\ RD = 4.5/4\ MD \tag{A1.2}$$

$$1\ RD = 1.125\ MD \tag{A1.3}$$

One micrometer division is equal to 0.0254 mm [1 mil], therefore:

$$1\ RD = 0.0286\ mm\ 1.125\ mils \tag{A1.4}$$

This calculated value (0.0286 mm [1.125 mils] in the sample) is the calibration factor.

A1.5.1.2 *Specimens*—Multiply the number of reticle divisions by the calibration factor. Report results to the nearest 0.0127 mm [0.5 mil].

A1.6 *Precision*—Measurements are accurate to ±0.0127 mm [±0.5 mil] when the thickness is about 0.5 mm [20 mils].