



Standard Specification for Polymeric Resin Film for Electrical Insulation and Dielectric Applications¹

This standard is issued under the fixed designation D5213; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification covers requirements for the material, dimensions and tolerances, and property values of film, in sheet or strip form, with or without heat-sealable coatings.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

NOTE 1—This document is similar to IEC 60674, Part 3, Sheets 2, 4, 5, 6, and 7.

2. Referenced Documents

2.1 ASTM Standards:²

[D149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies](#)

[D883 Terminology Relating to Plastics](#)

[D1711 Terminology Relating to Electrical Insulation](#)

[D2305 Test Methods for Polymeric Films Used for Electrical Insulation](#)

[D3636 Practice for Sampling and Judging Quality of Solid Electrical Insulating Materials](#)

[D4088 Practice for Preparation for Shipment of Solid Electrical Insulating Materials \(Withdrawn 2003\)³](#)

2.2 IEC Standards:

[Publication 60674-3 Specification for Electrical Films for Electrical Purposes⁴](#)

¹ This specification is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.07 on Flexible and Rigid Insulating Materials.

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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 Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminologies [D1711](#) and [D883](#) unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *sheet, n*—material greater than 75 mm in width.

3.2.2 *strip, n*—material 75 mm or less in width.

4. Classification

4.1 This specification covers the following:

4.1.1 *Type I*—General purpose,

4.1.2 *Type II*—Heat sealable,

4.1.2.1 *Grade 1*—One side coated, and

4.1.2.2 *Grade 2*—Two sides coated.

4.2 *Materials:*

4.2.1 *Item A*—Poly(N,N'-p,p'-oxydiphenylene pyromellitimide),

4.2.2 *Item B*—Poly(N,N'-p,p'-oxydiphenylene biphenyltetracarboxylimide),

4.2.3 *Item C*—Poly(N,N'-p-phenylene biphenyltetracarboxylimide),

4.2.4 *Item D*—FEP-fluorocarbon, and

4.2.5 *Item E*—Polyethylene terephthalate.

4.2.6 *Item F*—Polyethylene naphthalate.

4.2.7 *Item G*—Polyetherimide.

5. Ordering Information

5.1 Order the film covered by this specification stating the type, grade, class, thickness, width, and roll dimensions.

6. Materials

6.1 Type I material is flexible, unsupported film.

6.2 Type II material is film meeting all of the requirements of Type I, and having a heat-sealable coating on one or both sides.

7. Requirements

7.1 The film covered by this specification shall meet the property requirements given in [Tables 1-7](#) and [Table 8](#) when tested by the methods given in Test Methods [D2305](#).

*A Summary of Changes section appears at the end of this standard

TABLE 1 Property Values for Type I, Class A Film poly(N,N'-p-p'-oxydiphenylene pyromellitimide)

	Average Property Value							
	Nominal Thickness, μm (mils)							
	7.5 (0.3)	13 (0.5)	20 (0.8)	25 (1.0)	50 (2.0)	75 (3.0)	100 (4.0)	130 (5.0)
Tensile strength, min MPa (psi), machine direction and transverse direction	69 (10 000)	97 (14 000)	138 (20 000)	138 (20 000)	138 (20 000)	138 (20 000)	138 (20 000)	138 (20 000)
Elongation, min percent, machine and transverse direction	10	20	35	35	40	45	45	45
Shrinkage, max percent, after exposure to 200 °C (392 F), machine and transverse direction	...	...	0.30	0.30	0.35	0.35	0.35	0.35
Moisture absorption, max percent, 100 % RH	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dielectric strength, min kV/mm (V/mil), 60 Hz ^{A,B}	120 (3000)	120 (3000)	180 (4500)	180 (4500)	150 (3800)	140 (3600)	100 (2500)	100 (2500)
Volume resistivity, min $\Omega\text{-cm}$, ^{B,C}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}
Permittivity, max at 1 kHz ^B	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dissipation factor, max at 1 kHz ^B	0.007	0.005	0.005	0.004	0.004	0.004	0.004	0.004

^AUse Type 3 electrodes in air of Table 1 of Test Method D149 (opposing 6.4-mm diameter rods).

^BAt 23 °C (73.4 °F), 50 % RH.

^CThe median value of 5 measurements shall be used for compliance.

TABLE 2 Property Values for Type I, Class B Film poly(N,N'-p-p'-oxydiphenylene biphenyltetracarboxylimide)

	Average Property Value								
	Nominal Thickness, μm (mils)								
	7.5 (0.3)	13 (0.5)	20 (0.8)	25 (1.0)	40 (1.6)	50 (2.0)	75 (3.0)	100 (4.0)	130 (5.0)
Tensile strength, min MPa (psi), machine direction and transverse direction	110 (15 000)	138 (20 000)	196 (28 000)	196 (28 000)	196 (28 000)	196 (28 000)	196 (28 000)	196 (28 000)	196 (28 000)
Elongation, min percent, machine and transverse direction	24	40	80	80	80	80	80	80	80
Shrinkage, max percent, after exposure to 200 °C (392 °F), machine and transverse direction	...	...	0.30	0.30	0.35	0.35	0.35	0.35	0.35
Moisture absorption, max percent, 100 % RH	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Dielectric strength, min kV/mm (V/mil), 60 Hz ^{A,B}	120 (3000)	120 (3000)	180 (4500)	180 (4500)	150 (3800)	140 (3500)	130 (3300)	100 (2500)	95 (2400)
Volume resistivity, min $\Omega\text{-cm}$, ^{B,C}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}
Permittivity, max at 1 kHz ^B	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dissipation factor, max at 1 kHz ^B	0.007	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

^A Use Type 3 electrodes in air of Table 1 of Test Method D149 (opposing 6.4-mm diameter rods).

^BAt 23 °C (73.4 °F), 50 % RH.

^CThe median value of 5 measurements shall be used for compliance.

TABLE 3 Property Values for Type I, Class C Film poly(N,N'-p-phenylene biphenyltetracarboxylimide)

	Average Property Value								
	Nominal Thickness, μm (mils)								
	7.5 (0.3)	13 (0.5)	20 (0.8)	25 (1.0)	40 (1.6)	50 (2.0)	75 (3.0)	100 (4.0)	130 (5.0)
Tensile strength, min MPa (psi), machine direction and transverse direction	133 (19 000)	176 (25 000)	241 (34 000)	241 (34 000)	241 (34 000)	241 (34 000)	241 (34 000)	241 (34 000)	241 (34 000)
Elongation, min percent, machine and transverse direction	25	25	25	25	25	25	25	25	25
Shrinkage, max percent, after exposure to 200 °C (392 °F), machine and transverse direction	...	...	0.15	0.15	0.15	0.20	0.20	0.20	0.20
Moisture absorption, max percent, 100 % RH	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Dielectric strength, min kV/mm (V/mil), 60 Hz ^{A,B}	120 (3000)	120 (3000)	180 (4500)	180 (4500)	150 (3800)	140 (3500)	120 (3000)	100 (2500)	95 (2400)
Volume resistivity, min $\Omega\text{-cm}$, ^{B,C}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}	10^{15}
Permittivity, max at 1 kHz ^B	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dissipation factor, max at 1 kHz ^B	0.007	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

^A Use Type 3 electrodes in air of Table 1 of Test Method D149 (opposing 6.4-mm diameter rods).

^BAt 23 °C (73.4 °F), 50 % RH.

^CThe median value of 5 measurements shall be used for compliance.