

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Plastic films for electrical purposes –
Part 3: Specifications for individual materials – Sheet 4: Polyimide films used for
electrical insulation**

**Films plastiques à usages électriques –
Partie 3: Spécifications pour matériaux particuliers – Feuille 4: Films de
polyimide utilisés dans l'isolation électrique**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PLASTIC FILMS FOR ELECTRICAL PURPOSES –**Part 3: Specifications for individual materials –
Sheet 4: Polyimide films used for electrical insulation****FOREWORD**

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IEC 60674-3-4 has been prepared by IEC technical committee 15: Solid electrical insulating materials. It is an International Standard.

This second edition cancels and replaces the first edition published in 1993. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) this document has been completely revised editorially and technically and included in the IEC 60674 series of standards;
- b) new types have been included;
- c) the ranges of thickness have been expanded;
- d) changes have been made to the requirements of some existing types.

The text of this International Standard is based on the following documents:

Draft	Report on voting
15/956/CDV	15/971/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60674 series, published under the general title *Plastic films for electrical purposes*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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INTRODUCTION

This document is one of a series which deals with plastic films for electrical purposes. The series will consist of three parts:

Part 1: Definitions and general requirements (IEC 60674-1);

Part 2: Methods of test (IEC 60674-2);

Part 3: Specifications for individual materials.

This document contains one of the sheets comprising Part 3, as follows:

Sheet 4: Polyimide films used for electrical insulation

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PLASTIC FILMS FOR ELECTRICAL PURPOSES –

Part 3: Specifications for individual materials – Sheet 4: Polyimide films used for electrical insulation

1 Scope

This sheet of IEC 60674-3 gives the requirements for polyimide films used for electrical purposes.

Materials which conform to this specification meet established levels of performance. However, the selection of a material by a user for a specific application is based on the actual requirements necessary for adequate performance in that application and not based on this specification alone.

Safety warning: it is the responsibility of the user of the methods contained or referred to in this document to ensure that they are used in a safe manner.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60674-1:1980, *Specification for plastic films for electrical purposes – Part 1: Definitions and general requirements*

IEC 60674-2:2016, *Specification for plastic films for electrical purposes – Part 2: Methods of test*

IEC 60757, *Code for designation of colours*

ISO 9773, *Plastics – Determination of burning behaviour of thin flexible vertical specimens in contact with a small-flame ignition source*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 Classification

This document contains three of the groups comprising Part 3 as follows:

- a) Group A: Polyimide films based on poly(N,N'-p,p'-oxidiphenylene pyromellitimide) used for electrical insulation.

For this Group A, the following types shall be applied:

- Type 1: General purpose
- Type 2a: One side FEP coated (heat sealable)
- Type 2b: Two side FEP coated (heat sealable)
- Type 3a: Dimensionally stabilized (low shrinkage)
- Type 3b: Dimensionally stabilized (low CTE (Coefficient of Thermal Expansion))
- Type 4: Heat shrinkable (withdrawn; formally used in IEC 60674-3-4:1993)
- Type 5: Corona resistant (under consideration)

- b) Group B: Polyimide films based on poly(N,N'-p,phenylenebiphenyl tetracarboxyl imide) used for electrical insulation.

No assigned by type for this Group B

- c) Group C: Polyimide films based on poly(N,N'-p,p-oxidiphenylene biphenyl-tetracarboxylimide) used for electrical insulation.

No assigned by type for this Group C.

5 Designation

The plastic film shall be identified by the following designation:

Designation of the film – IEC 60674-3-4 – PI Group– type – thickness in micrometres – width in millimetres – length in metres – colour.

EXAMPLE:

Polyimide film – IEC 60674-3-4 – PI Group A– type 1 – 100 – 20 – 200 – nc

(nc = natural colour; other colours according to IEC 60757).

6 General requirements

The material shall be made from polyimide polymer and shall conform to the requirements laid down in IEC 60674-1.

- Group A – Type 1 material shall be a flexible, self-supporting film made from polyimide polymer.
- Group A – Type 2a and Type 2b shall have a heat sealable coating of fluoroethylene-propylene (FEP) resin on one or both sides of type 1 material.
- Group A – Type 3a and Type 3b shall be identical to Group A – type 1 except for dimensional stability with improved low shrinkage and improved low CTE, respectively.
- Group A – type 5 shall be a flexible, self-supporting film made from polyimide polymer using fillers for an upgraded lifetime under presence of corona discharges.

7 Dimensions

7.1 Thickness

The film thickness shall be measured by a roll in accordance with the requirements of 4.3.2 of IEC 60674-2:2016. The mechanical scanning method (4.2.2 of IEC 60674-2:2016) could be used when required.

There are no requirements for thickness in this document, but preferred thicknesses in μm are as follows:

5; 7,5; 10; 12,5; 20; 25; 37,5; 50; 75; 100; 125; 150; 175.

The thickness tolerance shall comply with the requirements in 4.1 of IEC 60674-1:1980 unless otherwise specified in the purchase contract.

7.2 Width

The film width shall be measured in accordance with the requirements of Clause 6 of IEC 60674-2:2016.

Preferred widths cannot be given on account of the great variety of applications.

The tolerance on the width shall comply with the requirements on Table 1.

Table 1 – Tolerance on the width

Width mm	Tolerance mm
≤ 50	$\pm 0,5$
$> 50, \leq 300$	$\pm 1,0$
$> 300, \leq 450$	$\pm 2,0$
$> 450, \leq 1\,500$	$\pm 4,0$
$> 1\,500$	^a
^a Specified in the purchase contract	

8 Properties

8.1 Properties not dependent on thickness

Properties which are not dependent on thickness shall comply with the requirements on Table 2.

Table 2 – Properties not dependent on thickness

Property	Requirements				Units	IEC 60674-2:2016 Test method Clause (conditions)
	Group A	Type ^c	Group B ^d	Group C ^d		
Density	1 435 ± 20	all types	1 480 ± 10	1 390 ± 10	kg/m ³	ISO 1183-2:2019
Melting point	Does not melt	all types	Does not melt	Does not melt		ISO 11357-3
Relative Permittivity	3,6 ± 0,4 3,6 ± 0,4	all types	3,4 ± 0,4 3,4 ± 0,4	3,4 ± 0,4 3,4 ± 0,4	–	18.2 ^a (23 °C, 1 kHz) (23 °C, 1 MHz)
Dissipation factor	≤ 7 × 10 ⁻³ ≤ 7 × 10 ⁻³	all types	≤ 7 × 10 ⁻³ ≤ 7 × 10 ⁻³	≤ 7 × 10 ⁻³ ≤ 7 × 10 ⁻³	–	18.2 ^a (23 °C, 1 kHz) (23 °C, 1 MHz)
Volume resistivity	≥ 10 ¹⁴	all types	≥ 10 ¹⁴	≥ 10 ¹⁴	Ω·m	17.1
Surface resistivity	≥ 10 ¹⁴	all types	≥ 10 ¹⁴	≥ 10 ¹⁴	Ω	16
Dimensional change (shrinkage in MD and TD) ^b	≤ 0,35 ≤ 0,15	1, 2a, 2b, 3a, 3b	≤ 0,15	≤ 0,15	%	25 (200 °C, 15 min)
CLTE (Coefficient of Linear Thermal Expansion)	≤ 40 ≤ 25	1, 2a, 2b, 3a, 3b	≤ 25	–	ppm/ °C	ISO 11359-2 (100 °C – 200 °C)
Water absorption	≤ 3,0	all types	≤ 2,0	≤ 2,0	%	32.3.2, (6 h) ^e
^a Use non-contacting electrodes or evaporated metal electrodes. ^b MD: machine direction, TD: transverse direction. ^c The films in Group A is assigned by type. ^d The films in Group B and Group C are not assigned by type. ^e The film is dried at 110 °C, and placed in an atmosphere of 93 % ± 2 % r.h. for 6 h						

8.2 Properties dependent on thickness

Properties which are dependent on thickness shall comply with the requirements on Table 3.

Table 3 – Properties dependent on thickness

Property	Nominal thickness									Units	IEC6067 4- 2:2016 Test method Clause	Applica- bility
	µm											
	5	7,5	12,5	25	50	75	125	150	175			
Tensile strength (either direction) Minimum value	–	–	140	160	160	160	160	110	110	MPa	12 ^a	Group A
	–	–										Type 1
			140	160	160	160	160					Type 2a
			140	160	160	160	160					Type 2b
	100	120	140	160	160	160	160					Type 3a
	–	294	294	294	294	294	294	–				Type 3b
	–	196	196	196	196	196	196					Group B
												Group C
Elongation at break (either direction) Minimum value	–	–	60	60	60	60	60	60	60	%	12 ^a	Group A
	–	–										Type 1
			30	30	30	30	30					Type 2a
	20	30	30	30	30	30	30					Type 2b
			40	40	40	40	40					Type 3a
			40	40	40	40	40					Type 3b
	–	25	25	25	25	25	25					Group B
	–	80	80	80	80	80	80					Group C
Electric strength (AC test) 48 Hz to 62 Hz Minimum value	–	–	235	235	195	175	120	110	110	V/µm	20.1	Group A
	–	–										Type 1
			235	235	195	175	120					Type 2a
			235	235	195	175	120					Type 2b
	235	235	235	235	195	175	120					Type 3a
	–	200	200	200	180	130	100					Type 3b
	–	200	200	200	195	135	110					Group B
												Group C

The dash – indicates that these sizes are not generally available.

^a Rate of extension is 50 mm/min, reference lines are 100 mm apart.

9 Other properties

9.1 Thermal endurance

The temperature indexes for thermal endurance shall comply with the values on Table 4.