
Specification for plastic films for electrical purposes - Part 3: Specifications for individual materials - Sheet 2: Requirements for balanced biaxially oriented polyethylene terephthalate (PET) films used for electrical insulation (IEC 60674-3-2:1992)

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Bestimmung für Isolierfolien für elektrotechnische Zwecke -- Teil 3: Anforderungen für einzelne Werkstoffe -- Blatt 2: Anforderungen an isotrop biaxial orientierte polyethylenterephthalat-(PET)-Folien zur elektrischen Isolierung

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Spécification pour les films en matière plastique à usages électriques -- Partie 3: Spécifications pour matériaux particuliers -- Feuille 2: Prescriptions pour les films de polyéthylène-téréphtalate (PET), à orientation biaxe équilibrée, utilisés dans l'isolation électrique

Ta slovenski standard je istoveten z: EN 60674-3-2:1998

ICS:

29.035.20 Ú|æ cã} æ Å { ^} æ [|ææ \ ã Plastics and rubber insulating materials

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Descriptors: Electrical insulating materials, solid electrical insulating materials, insulating films, plastic films, polyethylene terephthalate, specifications

English version

Specification for plastic films for electrical purposes
 Part 3: Specifications for individual materials
 Sheet 2: Requirements for balanced biaxially oriented
 polyethylene terephthalate (PET) films used for electrical
 insulation

(IEC 60674-3-2:1992)

Spécification pour les films en matière
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(CEI 60674-3-2:1992)

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CENELEC

European Committee for Electrotechnical Standardization
 Comité Européen de Normalisation Electrotechnique
 Europäisches Komitee für Elektrotechnische Normung

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Ref. No. EN 60674-3-2:1998 E

Foreword

The text of the International Standard IEC 60674-3-2:1992, prepared by SC 15C, Specifications, of IEC TC 15, Insulating materials, was submitted to the formal vote and was approved by CENELEC as EN 60674-3-2 on 1998-04-01 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1998-12-01

Annexes designated “normative” are part of the body of the standard. In this standard, Annex ZA is normative. Annex ZA has been added by CENELEC.

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1 General

1.1 Scope

This International Standard gives the requirements for balanced biaxially oriented polyethylene terephthalate (PET) film for use as electrical insulation.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. IEC 674-1:1980, *Specification for plastic films for electrical purposes — Part 1: Definitions and general requirements.*

IEC 674-2:1988, *Specification for plastic films for electrical purposes — Part 2: Methods of test.*

IEC 757:1983, *Code for designation of colour.*

1.3 Classification

The PET film shall be of the following types:

Type 1: General purpose

Type 2: For use as the dielectric of capacitors.

2 Designation

The plastic film shall be identified by the following designation:

Designation of the film — IEC 674-3-2 — PET — type — thickness in micrometres — width in millimetres — length in metres — colour.

Example:

Polyethylene terephthalate — IEC 674-3-2 — PET — type 1 — 100 — 20 — 200 — nc (nc = natural colour; other colours according to IEC 757).

3 General requirements

The material shall be made from polyethylene terephthalate; it shall be biaxially oriented with an approximately balanced orientation and shall conform to the requirements laid down in part 1 of IEC 674.

For certain applications additives to the base material may be present (e.g. pigments, dyes). Where such additives are included, they shall not affect the requirements for any of the properties listed for that type unless otherwise specified.

4 Dimensions

4.1 Thickness

The film thickness shall be measured by a gravimetric method in accordance with the requirements of 3.3 of IEC 674-2.

NOTE There are no requirements for thickness in this standard but preferred thicknesses are as follows:

2, 3, 3, 5, 5, 6, 8, 10, 12, 15, 19, 23, 36, 50, 75, 100, 125, 190, 250, 300, 350 μm .

The thickness tolerance shall comply with the requirements in 4.1 of IEC 674-1 unless otherwise specified in the purchase contract.

4.2 Width

The film width shall be measured in accordance with the requirements of clause 5 of IEC 674-2.

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

The tolerance on the width shall comply with the requirements of 4.2 of IEC 674-1 except for slot closure applications where on a width of less than 25 mm, a tolerance of $\begin{matrix} 0 \\ -0,3 \end{matrix}$ mm is specified as an alternative.

5 Properties

5.1 Properties not dependent on thickness

Table 1 — Property requirements for all types

Property	Requirements	Units	IEC 674-2 Test method Subclause	Type
Density — normal	$1\,390 \pm 10$	kg/m ³	4, Method D ^a	1 and 2
Density — for opaque pigmented film	$1\,400 \pm 10$			
Melting-point	Under consideration	—		
Permittivity	$3,3 \pm 0,2$	—	16.1 (23 °C, 1 kHz) ^b	1 and 2
Dissipation factor	$< 3 \times 10^{-3}$	—	16.1 (23 °C, 48 Hz – 62 Hz) ^b	1 and 2
	$< 6 \times 10^{-3}$	—	16.1 (23 °C, 1 kHz) ^b	1
	Under consideration	—	16.2	2
Volume resistivity	$> 10^{14}$	$\Omega \times m$	15 ^c	1
	$> 10^{15}$			2
Surface resistivity	$> 10^{13}$	Ω	14 ^c	1
	$> 10^{14}$			2
Electrolytic corrosion	A1	—	21 Visual test	1 and 2
	2	%	21 Tensile wire test	
Dimensional stability with rising temperature	≥ 200	°C	24	1
	≥ 200		25	1

^a This method is only suitable for film thicknesses above 12 µm. The recommended mixture is tetrachloromethane/n-heptane. For film < 12 µm see IEC 250 (being revised).

^b Use non-contacting electrodes or evaporated metal electrodes.

^c Measurement conditions to be 23 °C and 50 % r.h. after 24 h exposure. The test voltages are 100 V ± 10 V for thicknesses > 10 µm and 10 V for thicknesses < 10 µm.

5.2 Properties dependent on thickness

Table 2 — Properties dependent on thickness

Property	Requirements				Units	IEC 674-2 Test method Subclause	Type
	< 15 µm	> 15 – < 100 µm	> 100 – < 250 µm	> 250 µm			
Tensile strength (either direction) Minimum value	170 ^a	150	140	110	MPa	10 ^b	1 and 2
Elongation at break (either direction) Minimum value	50 ^a	80	80	80	%	10 ^b	1 and 2
Dimensional change (shrinkage either direction)	3,5	3,0	3,0	2,0	%	23 (150 °C, 15 min)	1 and 2
Electric strength	See Table 3 and Table 4					18.1 a.c. ^c 18.2 d.c. ^c	1 and 2 2
Electrical weak spots	See Table 5					19.3	2

^a No requirement for film thicknesses below 5 µm.
^b Rate of extension 100 mm/min, reference lines 100 mm apart.
^c Method to use 6 mm diameter electrodes. For materials of thicknesses 100 µm or less, tests shall be made in air using a rate of rise of voltage of 500 V/s. For materials thicker than 100 µm, tests shall be made in transformer oil.

Table 3 — Electric strength (a.c. test) for all types

Nominal thickness µm	Minimum electric strength kV/µm	IEC 674-2 Test method Subclause
6	—	18.1 Using 6 mm diameter electrodes in air
8	—	
10	210	
12	208	
15	200	
19	190	
23	174	
36	150	
50	130	
75	105	
100	90	
125	80	18.1 Using 6 mm diameter electrodes in transformer oil
190	65	
250	60	
350	50	

Table 4 — Electric strength (d.c. test) type 2 only

Nominal thickness µm	Minimum breakdown voltage Central value V	Not more than two of the 21 results shall be below V	Not more than one of the 21 results shall be below V
6	1 500	600	400
8	2 000	1 100	550
10	2 400	1 500	800
12	2 800	1 800	1 000
15	3 200	2 000	1 600
19	3 400	2 200	1 900
23	4 000	2 500	2 200

Electrical weak spots (type 2 only)

When measured according to 19.3 of IEC 674-2 with a test voltage of 200 V/µm based on the nominal thickness of the film, the number of faults counted shall not exceed the numbers given in Table 5.

Table 5 — Number of faults counted

Nominal thickness µm	Fault count/m ²
3	6
3,5	4
5	2
6	1
8	0,8
10	0,4
12 and above	0,2

5.3 Other properties

5.3.1 Thermal endurance

Thermal endurance shall be measured according to clause 28 of IEC 674-2.

For type 1 film only.

Tl \geq 130:	end point criterion:	10 % retention of tensile strength;
Tl \geq 115:	end point criterion:	50 % retention of tensile strength.

Compliance with either one of these two end point criteria shall constitute compliance with this specification sheet.

The water content of the air in the ageing oven during the ageing process shall be in the range of 9,5 to 12,5 g/m³.

Ageing temperatures of 140 °C, 160 °C and 180 °C are recommended.

5.3.2 Burning characteristics

No requirement.

6 Roll characteristics for all types

6.1 Roll diameter/film length

There are no requirements in this standard for roll diameters or film lengths on a roll. These should be subject to contract.

6.2 Windability/sag

According to clause 6 of IEC 674-2

6.2.1 For films of width less than 150 mm, method A shall be used.

Table 6 — Windability

Property	Type 1	Type 2
Bias/camber	< 10 mm	< 10 mm
Sag (tension 5 MN/m ²)	< 5 mm	< 2 mm

6.2.2 For films of width 150 mm and above, method B shall be used.

The extension required to achieve bias/camber and sag limit shall be not more than 0,1 %. This requirement does not apply to thicknesses greater than 36 μ m for which there are no requirements.

6.3 Joins

Where joins (splices) are permitted, their construction shall conform to the requirements given in 3.3 of IEC 674-1. Breaks (unjoined pieces) shall also be indicated so as to be clearly visible when viewed from the end face of the roll.

The number of joins (splices) or breaks in each roll shall not exceed the values given in Table 7.

Table 7 — Maximum permissible number of joins or breaks per roll

Film thickness μ m	Width \leq 50 mm Outer diameter < 250 mm	Width > 50 mm Outer diameter < 250 mm	Width > 50 mm Outer diameter 250 mm – 450 mm
2; 3; 3,5	6	4	6
5; 6	5	4	5
8	4	3	4
10	4	3	4
\geq 12	4	3	3

6.4 Roll width

The maximum difference between the film width measured according to clause 5 of IEC 674-2 and the roll width excluding the core (expressed in millimetres) shall be according to Table 8.

Table 8 — Film width

Nominal film width mm	Requirement Maximum difference mm
< 150	0,5
150 to 300	1,0
\geq 300	2,0

6.5 Cores

The preferred core inner diameters are 76 mm and 152 mm.