

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Combined flexible materials for electrical insulation –
Part 3: Specifications for individual materials

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Matériaux combinés souples destinés à l'isolement électrique –
Partie 3: Spécifications pour matériaux particuliers

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Matériaux combinés souples destinés à l'isolement électrique –
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**COMBINED FLEXIBLE MATERIALS
FOR ELECTRICAL INSULATION –**
Part 3: Specifications for individual materials

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International Standard IEC 60626-3 has been prepared by IEC technical committee 15: Solid electrical insulating materials.

This third edition cancels and replaces the second edition published in 1996 and its amendment 1 (1999), and constitutes a technical revision. The main changes from the previous edition are as follows:

- consolidation of amendment 1 published in 1999 which was mainly describing the sheets from 340 to 459;
- revision and reordering of previous tables of 1996 edition.

The text of this standard is based on the following documents:

FDIS	Report on voting
15/442/FDIS	15/465/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 60626 series, under the general title *Combined flexible materials for electrical insulation*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

This standard contains 31 sheets of Part 3, as follows:

100, 101, 102, 110, 111, 112, 113, 114, 115, 302, 303, 312, 313, 315, 320, 330, 340, 350, 351, 360, 400, 401, 402, 403, 410, 411, 420, 421, 502, 503, 505.

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COMBINED FLEXIBLE MATERIALS FOR ELECTRICAL INSULATION –

Part 3: Specifications for individual materials

1 Scope

This part of IEC 60626 specifies dimensional and performance requirements for individual combined flexible materials for electrical insulation. This part is in the form of groups of sheets. Sheets are numbered in accordance with Table 1, which provides a complete list of all the specification sheets belonging to this standard.

Materials which conform to this specification meet established levels of performance. However, the selection of material by a user for a specific application should be 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 referenced documents are indispensable for the application 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.

The list of normative references is extensive because, in order to obtain a combination of two or more materials for electrical insulation, it is necessary that those base materials (paper, film, etc.) shall conform to the requirements set forth, in the appropriate specification of the base material alone, for that purpose. This rule shall be applied also in the development of new possible combinations; to this end, specifications of materials not actually used, but referenced, may be eligible for future developments.

IEC 60554-1:1977, *Specification for cellulosic papers for electrical purposes – Part 1: Definitions and general requirements*

IEC 60554-3 (all parts), *Specification for cellulosic papers for electrical purposes – Part 3: Specifications for individual materials*

IEC 60626-1:1995, *Combined flexible materials for electrical insulation – Part 1: Definitions and general requirements*

IEC 60626-2:1995, *Combined flexible materials for electrical insulation – Part 2: Methods of test*

IEC 60641-1:2008, *Pressboard and presspaper for electrical purposes – Part 1: Definitions and general requirements*

IEC 60641-3-2:2008, *Pressboard and presspaper for electrical purposes – Part 3: Specifications for individual materials – Sheet 2: Requirements for presspaper types P.2.1, P.4.1, P.4.2, P.4.3 and P.6.1*

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

IEC 60674-3-2:1992, *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 60674-3-4:1993, *Specification for plastic films for electrical purposes – Part 3: Specifications for individual materials – Sheet 4: Requirements for polyimide films used for electrical insulation*

IEC 60819-1:1995, *Non-cellulosic papers for electrical purposes – Part 1: Definitions and general requirements*
Amendment 1 (1996)

IEC 60819-3-1:2001, *Non-cellulosic papers for electrical purposes – Part 3: Specifications for individual materials – Sheet 1: Filled glass paper*

IEC 60819-3-2:2001, *Non-cellulosic papers for electrical purposes – Part 3: Specifications for individual materials – Sheet 2: Hybrid inorganic- organic paper*

IEC 60819-3-3:2006, *Non-cellulosic papers for electrical purposes – Part 3: Specifications for individual materials – Sheet 3: Unfilled aramid (aromatic polyamide) papers*

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3 Requirements

In addition to complying with the general requirements of IEC 60626-1, each flexible combined laminate shall conform to the requirements set forth in the appropriate sheet corresponding to its type, as shown in the sheets of this standard.

4 Designation

Table 1 lists material designations and constructions appropriate to each sheet. Material conforming to this specification shall be identified by a designation containing the IEC standard number, the material designation from IEC 60626-1 and the nominal thickness. For example:

IEC 60626-3, Sheet 112, P-C/F-PET/P-C, 0,15 mm

5 Thermal classification

Performance experience provides information about the thermal capability of combined flexible materials in electrical insulation systems. This information is given in each individual sheet. Thermal classification information on these sheets is not to be considered as a requirement.

6 Specification sheets

The presently 31 sheets listed in the Introduction are organised according to the composition of the laminates as described in the following master listing Table 1, including sections that could be offered by the market in the future; therefore classification numbering is already provided for future growth.

Table 1 – Master listing for IEC 60626-3 sheet identification

Sheet No.	Flexible laminate composition
100 to 149	Paper or presspaper containing sulphate wood pulp fibres
100 to 109	Duplex with PET film
110 to 119	Triplex with PET film
120 to 149	Others ^a
150 to 199	Paper or presspaper containing cotton fibres ^a
150 to 159	Duplex with PET film ^a
160 to 169	Triplex with PET film ^a
170 to 199	Others ^a
200 to 249	Paper or presspaper containing both cotton and wood pulp fibres ^a
200 to 209	Duplex with PET film ^a
210 to 219	Triplex with PET film ^a
220 to 249	Others ^a
250 to 299	Paper or presspaper containing other cellulosic fibres or mixtures of cellulosic and non-cellulosic fibers ^a
300 to 399	Wet-laid paper containing organic non-cellulosic fibres
300 to 309	Duplex calendered aramid with PET film
310 to 319	Triplex calendered aramid with PET film
320 to 329	Triplex uncalendered aramid with PET film
330 to 339	Triplex calendered aramid with PI film
340 to 349	Duplex hybrid organic-inorganic with PET film
350 to 359	Triplex hybrid organic-inorganic with PET film
360 to 369	Triplex hybrid organic-inorganic with filled glass paper
370 to 399	Others ^a
400 to 499	Wet-laid paper containing inorganic fibres
400 to 459	Glass
460 to 499	Others ^a
500 to 599	Dry-laid non-woven containing organic fibres
500 to 519	100 % PET-based fibres
520 to 539	100 % aramid-based fibres ^a
540 to 599	Others ^a
600 to 999	Other constructions
^a Sections provided for future development of new specification sheets at present are void.	
The specification sheets developed for the time being are: 100, 101, 102, 110, 111, 112, 113, 114, 115, 302, 303, 312, 313, 315, 320, 330, 340, 350, 351, 360, 400, 401, 402, 403, 410, 411, 420, 421, 502, 503, 505, and are given below.	

Sheet 100

**Requirements for combined flexible duplex materials of two layers –
F-PET/P-C (23 µm PET film with presspaper or paper)****1 Description**

This sheet gives the requirements for duplex materials consisting of paper or presspaper containing sulphate wood pulp fibres (P-C) laminated on a polyethylene terephthalate film (F-PET) having a nominal thickness of 23 µm.

2 Thermal classification

Experience has shown that the combined flexible materials listed in this sheet may be suitable for use in electrical apparatus with ratings up to and including the range of 120 °C to 130 °C.

3 Single-layer requirements

Use paper which meets the requirements for classes 1.1, 1.2, 1.3 or 1.4 of IEC 60554-1 and IEC 60554-3. Alternatively, use presspaper which meets the requirements for P2, P4 or P6 of IEC 60641-1 and IEC 60641-3-2. Each of these presspapers or papers can have a different density, which will affect the nominal grammage of the laminate.

Use a PET film, which has a nominal thickness of 23 µm and meets the requirements of IEC 60674-1 and IEC 60674-3-2.

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4 Breakdown voltage requirements

For all laminates listed in Clause 5, the minimum electric breakdown voltage using 6 mm diameter electrodes is

- for unfolded specimens: 6 kV;
- for folded specimens: 5 kV.

However, in accordance with IEC 60626-2, a minimum electric breakdown voltage on folded specimens is not required for laminates of nominal thickness greater than 0,5 mm.

5 Additional requirements

Additional requirements are given in the table below:

Property	Clause in IEC 60626-2	Units Tolerance	
Laminate nominal thickness	2	mm	0,10 0,13 0,15 0,18 0,20 0,30 0,35 0,40 0,45 0,50 0,60
Laminate thickness tolerance	2	± %	15 15 15 15 15 15 10 10 10 10 10
Laminate nominal grammage	3	g/m ² ±12 %	115 155 190 215 250 300 370 430 490 610 730
Tensile strength unfolded	4	N/10 mm min. MD CMD	90 100 135 150 180 220 270 300 360 450 540 60 70 90 100 120 140 180 200 240 300 360
Tensile strength folded, film inside	4	N/10 mm min. MD CMD	70 80 100 110 140 170 210 240 280 350 420 40 50 60 70 80 100 120 140 160 200 240
Elongation, unfolded	4	% min. MD CMD	3 3 3 3 5 5 5 5 5 5 5 10 10 10 10 13 13 13 13 13 13 13
NOTES MD = machine direction CMD = cross machine direction min. = minimum			

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Sheet 101

**Requirements for combined flexible duplex materials of two layers –
F-PET/P-C (36 µm PET film with presspaper or paper)****1 Description**

This sheet gives the requirements for duplex materials consisting of paper or presspaper containing sulphate wood pulp fibres (P-C) laminated on a polyethylene terephthalate film (F-PET) having a nominal thickness of 36 µm.

2 Thermal classification

Experience has shown that the combined flexible materials listed in this sheet may be suitable for use in electrical apparatus with ratings up to and including the range of 120 °C to 130 °C.

3 Single-layer requirements

Use paper which meets the requirements for classes 1.1, 1.2, 1.3, or 1.4 of IEC 60554-1 and IEC 60554-3. Alternatively, use presspaper which meets the requirements for P2, P4 or P6 of IEC 60641-1 and IEC 60641-3-2. Each of these presspapers or papers can have a different density, which will affect the nominal grammage of the laminate.

Use a PET film which has a nominal thickness of 36 µm and meets the requirements of IEC 60674-1 and IEC 60674-3-2.

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4 Breakdown voltage requirements

For all laminates listed in Clause 5, the minimum electric breakdown voltage using 6 mm diameter electrodes is

- for unfolded specimens: 7 kV;
- for folded specimens: 6 kV.

However, in accordance with IEC 60626-2, a minimum electric breakdown voltage on folded specimens is not required for laminates of nominal thickness greater than 0,5 mm.

5 Additional requirements

Additional requirements are given in the table below.

Property	Clause in IEC 60626-2	Units Tolerance										
Laminate nominal thickness	2	mm	0,10	0,15	0,20	0,25	0,30	0,35	0,40	0,45	0,50	0,60
Laminate thickness tolerance	2	± %	15	15	15	15	10	10	10	10	10	10
Laminate nominal grammage	3	g/m ² ±12 %	120	190	250	280	370	395	490	510	610	730
Tensile strength unfolded	4	N/10 mm min. MD CMD	90 60	135 90	180 120	190 130	270 180	280 190	360 240	380 250	450 300	540 360
Tensile strength folded, film inside	4	N/10 mm min. MD CMD	70 40	100 60	130 80	150 90	200 120	230 130	270 160	300 170	340 200	410 240
Elongation, unfolded	4	% min. MD CMD	3 10	3 10	5 13	5 13	5 13	5 13	5 13	5 13	5 13	5 13
NOTES MD = machine direction CMD = cross machine direction min. = minimum												

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