IEC 60893-2

Edition 3.0 2023-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes –
Part 2: Methods of test

Matériaux isolants – Stratifiés industriels rigides en planches à base de résines thermodurcissables à usages électriques –
Partie 2: Méthodes d'essai

IEC 60893-2:2023-11 (en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

INSULATING MATERIALS – INDUSTRIAL RIGID LAMINATED SHEETS BASED ON THERMOSETTING RESINS FOR ELECTRICAL PURPOSES –

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FOREWORD

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IEC 60893-2 has been prepared by IEC technical committee 15: Solid electrical insulating materials. It is an International Standard.

This third edition cancels and replaces the second edition published in 2003. This edition constitutes a technical revision.

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

a) removal of reference to withdrawn specification IEC 60167:1964;

b) inclusion of reference to IEC 62631-3-3:2015, which supersedes IEC 60167:1964. Details in 6.3 have been updated accordingly. The actual performance of the test has not changed;

c) normative references have been updated.

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

Draft	Report on voting
15/1017/FDIS	15/1023/RVD

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 60893 series, published under the general title *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins 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

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

This document is one of a series which deals with industrial rigid laminated sheets based on thermosetting resins for electrical purposes.

This series consists of four parts:

- Part 1: Definitions, designations and general requirements (IEC 60893-1);
- Part 2: Methods of test (IEC 60893-2);
- Part 3: Specifications for individual materials (IEC 60893-3);
- Part 4: Typical values (IEC TR 60893-4).

INSULATING MATERIALS – INDUSTRIAL RIGID LAMINATED SHEETS BASED ON THERMOSETTING RESINS FOR ELECTRICAL PURPOSES –

Part 2: Methods of test

1 Scope

This part of IEC 60893 describes methods of test for the materials defined in IEC 60893-1 (referred to also as Part 1).

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 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60212:2010, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

IEC 60216-1:2013, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*

IEC 60243-1:2013*, Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60296:2012[1], *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

IEC 60587:2007[2], *Electrical insulating materials used under severe ambient conditions – Test methods for evaluating resistance to tracking and erosion*

IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60893-1, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 1: Definitions, designations and general requirements*

IEC 60893-3 (all parts), *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 3: Specifications for individual materials*

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[1] A fifth edition of this standard has been published in 2020.

[2] A fourth edition of this standard has been published in 2022.

IEC TR 60893-4, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 4: Typical values*

IEC 62631-3-3:2015, *Dielectric and resistive properties of solid insulating materials – Part 3-3: Determination of resistive properties (DC methods) – Insulation resistance*

ISO 62:2008, *Plastics – Determination of water absorption*

ISO 178:2010[3], *Plastics – Determination of flexural properties*

ISO 179-1:2000[4], *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 179-2:1997[5], *Plastics – Determination of Charpy impact properties – Part 2: Instrumented impact test*

ISO 180:2000[6], *Plastics – Determination of Izod impact strength*

ISO 527-1:2012[7], *Plastics – Determination of tensile properties – Part 1: General principles*

ISO 527-4:1997[8], *Plastics – Determination of tensile properties – Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

ISO 604:2002, *Plastics – Determination of compressive properties*

ISO 1183-1:2012[9], *Plastics – Methods for determining the density of non-cellular plastics – Part 1: Immersion method, liquid pyknometer method and titration method*

ISO 3611:2010[10], *Geometrical product specifications (GPS) – Dimensional measuring equipment: Micrometers for external measurements – Design and metrological characteristics*

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

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3 A sixth edition of this standard has been published in 2019.

4 A third edition of this standard has been published in 2023.

5 A second edition of this standard has been published in 2020.

6 A fifth edition of this standard has been published in 2023.

7 A third edition of this standard has been published in 2019.

8 A third edition of this standard has been published in 2023.

9 A third edition of this standard has been published in 2019.

10 A third edition of this standard has been published in 2023.

4 Conditioning of test specimens

Unless otherwise specified, test specimens shall be conditioned for at least 24 h in standard atmosphere B according to IEC 60212:2010 (temperature 23 ± 2 °C, relative humidity (50 ± 5) %).

Unless otherwise specified, each specimen shall be tested in the conditioning atmosphere and at the conditioning temperature, or the tests shall commence within 3 min of removal of each test specimen from the conditioning atmosphere.

Where testing at an elevated temperature is required in one of the specification sheets of IEC 60893-3, test specimens shall be conditioned for 1 h at that elevated temperature immediately before testing.

5 Dimensions

5.1 Thickness

5.1.1 General

Any method which enables the thickness of the laminated sheet to be measured at an appropriate number of points may be used, provided that the equipment used and the method of measurement are capable of a precision of 0,01 mm or better.

The following reference method has been shown to be suitable and shall be used in cases of dispute.

5.1.2 Test apparatus for reference method

In case of dispute, an external screw type micrometer in accordance with ISO 3611 having faces with diameters between 6 mm and 8 mm shall be used.

5.1.3 Procedure for reference method

Measure the thickness of the rigid laminated sheet as delivered to the nearest 0,01 mm at eight points, two along each edge but not less than 20 mm from the edge.

5.1.4 Results

Report the maximum and minimum measured values and the arithmetic mean of all measured values in mm.

5.2 Flatness

5.2.1 General

This test is applicable to all sheets having a thickness of 3 mm or greater.

5.2.2 Test specimens

The test specimen shall be the whole sheet or panel under test in the ‘as received’ condition.

5.2.3 Test method

When any sheet of nominal thickness 3,0 mm or more is placed without restraint, concave side up, on a flat surface, the departure at any point of the upper surface of the sheet from a light straight edge 1 000 mm or 500 mm in length, laid in any direction upon it, shall not exceed the value given in the relevant sheet of IEC 60893-3 appropriate to the material, its thickness and length of straight edge. The mass of the 1 000 mm straight edge shall not exceed 800 g, and the mass of the 500 mm straight edge shall not exceed 400 g.

5.2.4 Results

Report the maximum measured deviation from flatness in mm.

In cases where the sheet deviates from flatness in two directions, is saddle-shaped, measure both deviations and report the highest.

6 Mechanical tests

6.1 Flexural strength

6.1.1 General

The flexural strength is defined as the flexural stress at rupture. It shall be determined by the method specified in ISO 178. Method A shall be used.

6.1.2 Test specimens

Cut the test specimens from the sheet to be tested with their major axes parallel to the sides of the sheet. Test five test specimens in each direction, except for types with fibres aligned mainly in the same direction. In such cases, cut five specimens only, with their long axis parallel to the direction of the fibres.

If the nominal thickness of the sheet to be tested is more than 10 mm (20 mm in the case of types PF WV), reduce the thickness of the test specimens to 10 mm (20 mm in the case of PF WV).

When it is necessary to reduce the thickness of a test specimen, machine it, leaving one face of the sheet intact. In such cases, test specimens shall be tested with the original surface of the sheet in contact with the two supports.

6.1.3 Test method

The test shall be carried out with the load applied perpendicular to the plane of the laminations. The test speed shall be 5 mm/min with a tolerance of ±20 %.

6.1.4 Results

Report the arithmetic mean of the results for each direction in MPa. Take the lower of the two mean values as the minimum flexural strength of the sheet under test, except in cases where the reinforcing fibres run mainly in one direction. In such cases, take the mean value obtained in this direction.

6.2 Modulus of elasticity in flexure

6.2.1 General

The following test method shall be used in order to determine the modulus of elasticity in flexure.

6.2.2 Test specimens

The specimens shall be in the same form as described for the flexural strength test described in 6.1.2 above.

6.2.3 Test method

Modulus of elasticity shall be determined by the method specified in ISO 178.

6.2.4 Results

Results shall be expressed in MPa.

6.3 Compressive strength

6.3.1 General

The following test method shall be used in order to determine the compressive strength.

6.3.2 Test specimens

Specimens shall be cut from the sheet under test as described in ISO 604.

6.3.3 Test method

Compressive strength shall be determined by the method specified in ISO 604 with the load applied perpendicular to the plane of the laminations.

6.3.4 Results

Results shall be expressed in MPa.

6.4 Impact strength

6.4.1 General

This test is only applicable to sheets of nominal thickness equal to or greater than 5 mm.

6.4.2 Charpy Impact strength

6.4.2.1 Test specimens

Test specimens shall be cut from the sheet under test in accordance with Figure 1 a). Five specimens, with a thickness between 5 mm and 10 mm, shall be tested in each direction, except for types with fibres aligned mainly in the same direction. In such cases, cut five specimens only, with their longitudinal axis parallel to the direction of the fibres.

If the nominal thickness of the sheet to be tested is greater than 10 mm, reduce the thickness of the test specimen to 10 mm by machining equal amounts from both faces of the sheet.

6.4.2.2 Test method

The Charpy impact strength shall be determined in the edgewise direction as described by the method given in ISO 179-1 and ISO 179-2 except that the specimens shall be as described above, and the span shall be 70 mm. The material shall be tested with the major axes in each direction parallel to the sides of the sheet, except in the case of materials whose fibres lie mainly in the same direction. For these materials only specimens with their longitudinal axis parallel to the direction of the fibres shall be tested.