IEC 60674-2

Edition 2.0 2016-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Specification for plastic films for electrical purposes –
Part 2: Methods of test

Spécification pour les films en matière plastique à usages électriques –
Partie 2: Méthodes d'essai

IEC 60674-2:2016-11(en-fr)

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Specification for plastic films for electrical purposes – Part 2: Methods of test

Spécification pour les films en matière plastique à usages électriques – Partie 2: Méthodes d'essai

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SPECIFICATION FOR PLASTIC FILMS FOR ELECTRICAL PURPOSES –

Part 2: Methods of test

FOREWORD

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International Standard IEC 60674-2 has been prepared by IEC technical committee 15: Solid electrical insulating materials.

This bilingual version (2019-01) corresponds to the monolingual English version, published in 2016-11.

This second edition cancels and replaces the first edition published in 1988 and Amendment 1 (2001). This edition constitutes a technical revision.

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

a) this document was completely revised editorially and technically and included in the IEC 60674 series of standards;
b) the test methods are updated to reflect today's state of the art;

c) a method to obtain DC electric strength is now specified according to IEC 60243-2.

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

CDV	Report on voting
15/742/CDV	15/760/RVC

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

The French version of this standard has not been voted upon.

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

A list of all parts in the IEC 60674 series, published under the general title *Specification for 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The contents of the corrigendum of December 2017 have been included in this copy.

INTRODUCTION

This document is one of a series which deals with plastic films for electrical purposes. The series consists 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 (IEC 60674-3 (all parts))

SPECIFICATION FOR PLASTIC FILMS FOR ELECTRICAL PURPOSES –

Part 2: Methods of test

1 Scope

This part of IEC 60674 is applicable to plastic films used for electrical purposes. This part of IEC 60674 gives methods of test.

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

IEC 60216 (all parts), *Electrical insulating materials – Thermal endurance properties*

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

IEC 60243-2, *Electric strength of insulating materials – Test methods – Part 2: Additional requirements for tests using direct voltage*

IEC 60250:1969, *Recommended methods for the determination of the permittivity and dielectric dissipation factor of electrical insulating materials at power, audio and radio frequencies including metre wavelengths*

IEC 60343, *Recommended test methods for determining the relative resistance of insulating materials to breakdown by surface discharges*

IEC 60394-2:1972, *Varnished fabrics for electrical purposes – Part 2: Methods of test*

IEC 60426, *Electrical insulating materials – Determination of electrolytic corrosion caused by insulating materials – Test methods*

IEC 60454-2:2007, *Pressure-sensitive adhesive tapes for electrical purposes – Part 2: Methods of test*

IEC 60589, *Methods of test for the determination of ionic impurities in electrical insulating materials by extraction with liquids*

IEC TR 60648, *Method of test for coefficients of friction of plastic film and sheeting for use as electrical insulation*

IEC 60674-3 (all parts), *Specification for plastic films for electrical purposes – Part 3: Specifications for individual materials*

IEC 62631-3-1, *Dielectric and resistive properties of solid insulating materials – Part 3-1: Determination of resistive properties (DC methods) – Volume resistance and volume resistivity – General method*

IEC 62631-3-2, *Dielectric and resistive properties of solid insulating materials – Part 3-2: Determination of resistive properties (DC methods) – Surface resistance and surface resistivity*

ISO 527-3:1995, *Plastics – Determination of tensile properties – Part 3: Test conditions for films and sheets*

ISO 534, *Paper and board – Determination of thickness, density and specific volume*

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

ISO 4591:1992, *Plastics – Film and sheeting – Determination of average thickness of a sample, and average thickness and yield of a roll, by gravimetric techniques (gravimetric thickness)*

ISO 4592, *Plastics – Film and sheeting – Determination of length and width*

ISO 4593, *Plastics – Film and sheeting – Determination of thickness by mechanical scanning*

ISO 6383-1, *Plastics – Film and sheeting – Determination of tear resistance – Part 1: Trouser tear method*

ISO 6383-2, *Plastics – Film and sheeting – Determination of tear resistance – Part 2: Elmendorf method*

ISO 11357-3:2011, *Plastics – Differential scanning calorimetry (DSC) – Part 3: Determination of temperature and enthalpy of melting and crystallization*

3 General notes on tests

3.1 Discard at least the first three layers of film from the roll to be tested before removing test specimens.

3.2 Sample rolls shall be exposed for at least 24 h to the standard atmosphere 23 °C ± 2 K and 50 % ± 5 % RH before test specimens are removed for test. Unless otherwise specified, all individual test specimens shall be conditioned for 1 h and tested in the same standard atmosphere.

4 Thickness

4.1 General

Thickness shall be measured by any one or more of the methods given below as required by IEC 60674-3 (all parts).

4.2 Determination of thickness by mechanical scanning

4.2.1 General

Two methods, the first using a single sheet and the second using a stack of sheets, are given individually as follows.

4.2.2 Measurement by a single sheet

4.2.2.1 Principle

The method is based on ISO 4593 using a precision micrometre to measure the thickness of a single sheet test specimen.

4.2.2.2 Test specimens and measuring points

Cut three strips about 100 mm wide across the width of the sample. The test strips shall not contain creases or other defects.

Determine the thickness of the test strips in accordance with the requirements of ISO 4593 using a micrometre having plane or radiused measuring surfaces.

Measurements shall be made at nine points at approximately equally spaced intervals along the length of the test strips. In the case of samples less than 300 mm wide make the measurements every 50 mm along the length of the test strips. In the case of untrimmed rolls, readings shall not be taken within 50 mm of the edges.

4.2.2.3 Result

The thickness is the central value of all the measurements, the highest and lowest values on each strip being reported.

4.2.3 Measurement by a multi-layer of sheets

Bulking (micrometric) thickness shall be measured according to ISO 534, except that the method for obtaining sample pieces is different. Before taking samples, some outer layers of the roll should be removed to obtain undamaged film surface. The four test pieces are initially made up of 12 film layers, the layers being cut together using a suitable template (preferably 250 mm × 200 mm, the 200 mm dimension being in the machine direction) from a stack of film pieces. Discard the first and last layer of each pack or test piece just prior to placing the pack between the pressure faces of the micrometre.

4.3 Determination of thickness by gravimetric method

4.3.1 Measurement by a sample

Principle: calculation of the thickness of a sample from measurements of mass, area and density in accordance with Clause 3 of ISO 4591:1992.

4.3.2 Measurement by a roll

Principle: calculation of the average thickness from measurements of the length, average width and net mass of the roll and the density of the film in accordance with Clause 4 of ISO 4591:1992.

4.4 Crosswise thickness profile and lengthwise variation in thickness

The non-contacting measurement methods, for example using radiation or laser light, are commonly used. The apparatus may be installed in the production line by the manufacturer if the profile and the variation in a roll are required. The minimum resolution for the measurement, its accuracy and testing surface area (width and length) are the subjects specified in IEC 60674-3 (all parts).

5 Density

Density shall be determined in accordance with ISO 1183. The particular method is specified in IEC 60674-3 (all parts).

6 Width

The width is to be determined in accordance with ISO 4592, except that a 5 m sample length is used. Determine the width five times along the length at equal intervals after the film has relaxed for 1 h.

Record each width measured and report the central value as the width of the roll.

7 Windability (bias/camber and sag)

7.1 Principle

An assessment is made of the distortion of the film as supplied in the roll.

Two forms of distortion may be apparent in the film which can impair its subsequent winding characteristics. These distortions are:

1) the film may exhibit bias or camber and therefore its edges may not be straight (see Figure 1);
2) the film may sag below its general level in areas where it has been stretched (see Figures 2 and 3).

7.2 General

Two methods are given. Method A is appropriate for narrow (i.e. less than 150 mm) films where distortion is apparent mainly as bias/camber and also for the measurement of sag for very thick films where the tension required for extension by Method B is excessive.

Method B is appropriate for wider (i.e. greater than 150 mm) films where distortion is apparent, mainly as sag.

7.3 Method A

7.3.1 Principle

To assess bias/camber, a length of film is unwound and laid on a flat surface and the deviation of each of its edges from a straight line is measured (see Figure 1).

To assess sag, a length of film is unwound and laid orthogonally over two parallel bars under defined conditions and the deviation from a uniform catenary is measured (see Figure 2). It may sometimes be convenient to make this measurement using the rollers of a winding machine, but in cases of dispute the dimensions and distances shall be as given below.

7.3.2 Measurement of bias/camber

7.3.2.1 Apparatus

A flat, horizontal table of any suitable material having a satin finish (not polished) of sufficient width to accommodate the maximum width of film to be tested and of length 1 500 mm ± 15 mm with ends parallel to within 0,1° (or 1,8 mm per 1 metre of table width). Alternatively, the table may be longer than the above length but shall then have two reference lines clearly marked on its surface 1 500 mm ± 15 mm apart and parallel to the same accuracy.

- A soft brush suitable for smoothing the film specimen on the table surface.
- A long (in excess of 1 525 mm) steel straight-edge.
- A 150 mm steel rule with 1 mm graduations.

7.3.2.2 Test specimens

The first three layers of film from the roll are discarded. For each specimen a fresh length of approximately 2 m is taken, being drawn from the roll with the lightest tension necessary to unwind it slowly (at about 300 mm/s).

7.3.2.3 Procedure

The specimen length of film is placed lengthwise over the table as shown in Figure 1. Starting from one end, the soft brush is used to lightly press the film into intimate contact with the table surface, expelling any trapped air as far as possible.

The steel straight-edge is then placed along one edge of the film so that any deviation of the film edge from a straight line can be readily observed. The straight-edge is adjusted to coincide with the film edge at the two table ends (or at the reference marks if these are used) and the distance between these points shall be 1 500 mm ± 15 mm. The distance between the straight edge and the film edge is measured to the nearest 1 mm at approximately mid-span by means of the steel rule.

The deviation of the second film edge is then measured using the same procedure.

The sum of the distances in millimetres of the two edges of the film from the steel straight-edge at the mid-span is the bias/camber value for that test specimen.

The above procedure is repeated for two further test specimens.

7.3.2.4 Results

The bias/camber is the central value of the three determinations, the other two values being reported.

7.3.3 Measurement of sag

7.3.3.1 Apparatus

A rigid framework supporting two parallel, freely rotatable metal rollers, each roller 100 mm ± 10 mm in diameter and of sufficient length to accommodate the maximum width of film are to be tested. The axes of the rollers shall be in the same horizontal plane and set mutually parallel to within 0,1° (i.e. within 1,8 mm per 1 m length of roller) with a separation of 1 500 mm ± 15 mm. The roller surfaces shall be accurately cylindrical to within 0,1 mm with any suitable satin finish (not polished) (see Figure 2). The framework shall be fitted with a device for mounting the roll of film being tested immediately below one of the rollers. The mounting shall be such that the axis of the film roll is parallel to the superior roller to within 1° and the film may be drawn off the roll against an adjustable unwind tension. At the opposite end of the framework a weighted or sprung clamp is fixed to the film web hanging freely from the second roller. The weight or spring loading and its position on the film may be adjusted so as to give a substantially uniform tension across the web as specified in IEC 60674-3 (all parts).

A device for measuring along a line midway between the rollers the distance of the film below the plane of those rollers is set up (see Figure 3). The device may comprise simply a long (in excess of 1,525 mm) steel straight-edge and a 150 mm steel rule with 1 mm graduations, or more complex devices may be employed whereby the film position is noted automatically or semi- automatically.