

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

Heat shrinkable low and medium voltage moulded shapes –  
Part 2: Methods of test

[standards.iteh.ai](https://standards.iteh.ai)

Profils thermorétractables basse et moyenne tensions –  
Partie 2: Méthodes d'essai

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IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

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Heat shrinkable low and medium voltage moulded shapes –  
Part 2: Methods of test (standards.iteh.ai)

Profils thermorétractables basse et moyenne tensions –  
Partie 2: Méthodes d'essai

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## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references .....	8
3 Terms and definitions .....	9
4 Test conditions .....	9
5 Standard test specimens .....	9
6 Dimensions.....	9
6.1 Number of test specimens.....	9
6.2 Procedure .....	9
6.3 Result .....	10
7 Heat shock .....	10
7.1 Number of test specimens.....	10
7.2 Form of test specimens.....	10
7.3 Procedure .....	10
7.4 Report.....	10
7.5 Result .....	10
8 Bending at low temperature.....	10
8.1 Number and form of test specimens.....	10
8.2 Procedure .....	10
8.3 Result .....	10
9 Dimensional stability on storage.....	10
9.1 Number of test specimens.....	10
9.2 Procedure .....	11
9.3 Result .....	11
10 Tensile strength and elongation at break .....	11
10.1 Number and form of test specimens.....	11
10.2 Conditioning.....	12
10.3 Test temperature .....	12
10.4 Procedure .....	12
10.5 Calculations .....	12
10.6 Report.....	12
10.7 Result .....	12
11 Secant modulus at 2 % elongation.....	13
11.1 Number and form of test specimens.....	13
11.2 Procedure .....	13
11.3 Calculation.....	13
11.4 Report.....	13
11.5 Result .....	13
12 Electric strength .....	13
12.1 Number and form of test specimens.....	13
12.2 Conditioning.....	13
12.3 Electrodes .....	13
12.4 Procedure .....	14
12.5 Report.....	14

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[IEC 62677-2:2017](https://standards.iteh.ai/catalog/standards/sist/2944f129-00ed-441c-a829-9d73d057d/iec-62677-2-2017)

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12.6	Result .....	14
13	Volume resistivity .....	14
13.1	Number and form of test specimens .....	14
13.2	Electrodes .....	14
13.3	Procedure .....	14
13.4	Report.....	14
13.5	Result .....	14
14	Permittivity and dissipation factor .....	14
14.1	Number and form of test specimens .....	14
14.2	Electrodes .....	14
14.3	Procedure .....	14
14.4	Calculation.....	14
14.5	Result .....	15
15	Resistance to tracking .....	15
15.1	Procedure .....	15
15.2	Report.....	15
15.3	Result .....	15
16	Flammability .....	15
16.1	Method A .....	15
16.1.1	Number and form of test specimens .....	15
16.1.2	Procedure .....	15
16.1.3	Result.....	15
16.2	Method B .....	15
16.2.1	Number and form of test specimens .....	15
16.2.2	Apparatus .....	15
16.2.3	Procedure .....	15
16.2.4	Result.....	16
17	Carbon black content.....	16
17.1	Number and form of test specimens .....	16
17.2	Procedure .....	16
17.3	Report.....	16
17.4	Result .....	17
18	Resistance to selected fluids .....	17
18.1	Principle .....	17
18.2	Choice of fluid.....	17
18.3	Methods of assessment .....	17
18.4	Number and form of test specimens .....	17
18.5	Procedure .....	17
18.6	Result .....	18
19	Long term heat ageing (3 000 h).....	18
19.1	Number and form of test specimens .....	18
19.2	Procedure .....	18
19.3	Report.....	18
19.4	Result .....	18
20	Heat ageing .....	18
20.1	Number and form of test specimens .....	18
20.2	Procedure .....	18
21	Water absorption .....	18

21.1	Procedure .....	18
21.2	Report.....	18
21.3	Result .....	18
22	Resistance to mould growth.....	19
22.1	Test in accordance with ISO 846.....	19
22.2	Report.....	19
22.3	Result .....	19
23	Peel adhesion.....	19
23.1	Principle .....	19
23.2	Apparatus .....	19
23.3	Form and number of test specimens .....	19
23.4	Procedure .....	19
23.5	Calculation.....	20
23.6	Report.....	20
23.7	Result .....	20
24	Copper corrosion (presence of corrosive volatiles) .....	20
24.1	Principle .....	20
24.2	Apparatus .....	20
24.3	Number and form of test specimens .....	21
24.4	Procedure .....	21
24.5	Report.....	21
24.6	Result .....	21
25	Halogen content .....	21
25.1	Method for the determination of low levels of chlorine and/or bromine and/or iodine.....	21
25.1.1	Principle .....	21
25.1.2	Apparatus .....	22
25.1.3	Procedure.....	22
25.2	Determination of low levels of fluorine .....	22
25.2.1	Principle .....	22
25.2.2	Apparatus .....	22
25.2.3	Reagents .....	23
25.2.4	Procedure.....	23
25.3	Result .....	23
26	Adhesive temperature resistance.....	23
26.1	Number and form of test specimens .....	23
26.2	Procedure .....	23
26.3	Report.....	23
26.4	Result .....	24
27	Resistance to weathering .....	24
27.1	Number and form of test specimens .....	24
27.2	Procedure .....	24
27.3	Report.....	24
	Bibliography.....	25
	Figure 1 – Dumb-bell specimen for tensile strength test.....	11
	Figure 2 – Test arrangement for flammability to Clause 16 method B.....	16
	Figure 3 – Test arrangement for heat shrink moulded shape on metal tube or cable .....	20

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

FDIS	Report on voting
15/807/FDIS	15/811/RVD

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.

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

A list of all parts in the IEC 62677 series, published under the general title *Heat shrinkable low and medium voltage moulded shapes*, 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

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## INTRODUCTION

This part of IEC 62677 is one of a series which deals with heat shrinkable low and medium voltage moulded shapes. The series consists of three parts:

Part 1: General requirements (IEC 62677-1<sup>1</sup>)

Part 2: Methods of test (IEC 62677-2)

Part 3: Material requirements (IEC 62677-3-101<sup>2</sup>, IEC 62677-3-102<sup>3</sup> and IEC 62677-3-103<sup>4</sup>)

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<sup>1</sup> Under preparation. Stage at the time of publication: IEC RFDIS IEC 62677-1:2017.

<sup>2</sup> Under preparation. Stage at the time of publication: IEC AFDIS IEC 62677-3-101:2017.

<sup>3</sup> Under preparation. Stage at the time of publication: IEC AFDIS IEC 62677-3-102:2017.

<sup>4</sup> Under preparation. Stage at the time of publication: IEC ACDV IEC 62677-3-103:2017.

# HEAT SHRINKABLE LOW AND MEDIUM VOLTAGE MOULDED SHAPES –

## Part 2: Methods of test

### 1 Scope

This part of IEC 62677 gives methods of test for heat shrinkable low and medium voltage moulded shapes in a range of configurations and materials suitable for insulation, environmental sealing, mechanical protection and strain relief for connector/cable terminations and multi-way transitions.

The tests specified are designed to control the quality of the moulded shapes but it is recognized that they are designed to be used in low and medium voltage cable accessories and as such electrical performance will be proven as part of the assembly. Examples of this are described in EN 50393, HD 629.1 and IEC 60502-4.

### 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 62677-2:2017](#)

IEC 60216-4-1:2006, *Electrical insulating materials – Thermal endurance properties – Part 4-1: Ageing ovens – Single-chamber ovens*

IEC 60216-4-2:2000, *Electrical insulating materials – Thermal endurance properties – Part 4-2: Ageing ovens – Precision ovens for use up to 300 °C*

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

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

IEC 62631-3-1:2016, *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 60695-11-2:2013, *Fire hazard testing – Part 11-2: Test flames – 1 kW pre-mixed flame – Apparatus, confirmatory test arrangement and guidance*

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

IEC 62677-3 (all parts), *Heat shrinkable low and medium voltage moulded shapes*

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

ISO 846:1997, *Plastics – Evaluation of the action of microorganisms*

ISO 4892-3:2016, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

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

ISO 11358-1:2014, *Plastics – Thermogravimetry (TG) of polymers - Part1: General principles*

ISO 11358-2:2014, *Plastics – Thermogravimetry (TG) of polymers - Part 2: Determination of activation energy*

### 3 Terms and definitions

No terms and definitions are listed in this document.

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

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

### 4 Test conditions

**4.1** Unless otherwise specified, all tests shall be made under standard ambient conditions according to IEC 60212, that is at a temperature between 15 °C and 35 °C and at ambient relative humidity.

In cases of dispute, the tests shall be carried out at a temperature of 23 °C ± 2 K and at (50 ± 5) % relative humidity.

**4.2** When heating at elevated temperature is specified for a test procedure, the specimen shall be maintained for the prescribed period in a uniformly heated oven complying with either IEC 60216-4-1 or IEC 60216-4-2.

**4.3** Where a test at low temperature is specified, the specification sheets of IEC 62677-3 (all parts) may require it to be carried out at  $t$  °C or lower, where  $t$  is the requested temperature. In such cases, the operator may carry out the test at the specified temperature or any lower temperature which is convenient. If, however, at a temperature below that specified, the specimen fails to meet the requirements, the test shall be repeated at the specified temperature, subject to a tolerance of ±3 K as specified in IEC 60212. If the specimen then passes, it shall be considered to have met the requirements.

### 5 Standard test specimens

Moulded shape material specimens shall be prepared from (2 ± 0,15) mm thick sheets, unless otherwise specified, and shall be prepared from the same heat shrinkable material and conditions (including cross-linking) that is to be used to manufacture the heat shrinkable moulded shapes. The dimensions of the sheet shall be sufficient to enable any of the relevant tests to be performed.

NOTE A suitable size has been found to be 150 mm × 150 mm.

### 6 Dimensions

#### 6.1 Number of test specimens

Three specimens of each size and style shall be tested.

#### 6.2 Procedure

Measure the moulded shapes in the as supplied condition and after unrestricted shrinkage as specified in IEC 62677-3 (all parts). Carry out unrestricted shrinkage by conditioning in an oven for the time and temperature specified in IEC 62677-3 (all parts). Remove the shapes from the oven and allow to cool naturally to the ambient temperature specified in Clause 4.

The method of measurement can be mechanical or optical. Wall thickness shall be measured to an accuracy of  $\pm 0,05$  mm and internal diameter to an accuracy of  $\pm 0,1$  mm. In the case of dispute an optical method shall be used.

### 6.3 Result

Report all measured values as the result.

## 7 Heat shock

### 7.1 Number of test specimens

Three specimens shall be tested.

### 7.2 Form of test specimens

Cut three specimens in accordance with Clause 10, from a test sheet in accordance with Clause 5.

### 7.3 Procedure

The specimens shall be suspended vertically in an oven for  $4\text{ h} \pm 10$  min at the temperature specified in IEC 62677-3 (all parts).

The specimens shall be removed and allowed to cool to room temperature. They shall then be visually examined for any signs of dripping, cracking or flowing. In addition, when so specified in IEC 62677-3 (all parts) the specimens shall be tested for tensile strength and elongation at break.

### 7.4 Report

Report all results from the visual examination. Report all values from the tensile strength and elongation test.

### 7.5 Result

The result for each property is the central value unless otherwise specified in the specification sheets of IEC 62677-3 (all parts).

## 8 Bending at low temperature

### 8.1 Number and form of test specimens

Cut three specimens from a test sheet in accordance with Clause 5 approximately  $150\text{ mm} \times 6\text{ mm}$ .

### 8.2 Procedure

The specimens shall be suspended for  $4\text{ h} \pm 10$  min in a chamber maintained at the temperature specified in IEC 62677-3 (all parts). While still at that temperature, they shall be wound without jerking for one complete turn in a close helix round a mandrel also at the same temperature and having a diameter specified in IEC 62677-3 (all parts). The time to achieve one complete turn shall not be greater than 5 s. The specimens shall then be allowed to return to room temperature.

The specimens shall then be visually examined without magnification while still on the mandrel for signs of cracking.

### 8.3 Result

Report whether there is any cracking.

## 9 Dimensional stability on storage

### 9.1 Number of test specimens

Three shapes shall be tested.

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## 9.2 Procedure

The internal diameter of each outlet shall be measured in the expanded state as delivered. The shapes shall then be stored in a ventilated oven as detailed in 4.2 for  $(336 \pm 2)$  h at a temperature of  $40 \text{ °C} \pm 3 \text{ K}$  unless otherwise specified in the relevant sheet of IEC 62677-3 (all parts). They shall then be removed from the oven, allowed to cool to ambient temperature and the same dimensions re-measured. The accuracy of measurement shall be in accordance with Clause 6.

Following this measurement, the shapes shall be allowed to fully recover, using the time and temperature specified in IEC 62677-3 (all parts) for the shapes being evaluated. The shapes shall then be cooled to ambient temperature and the recovered dimensions measured.

## 9.3 Result

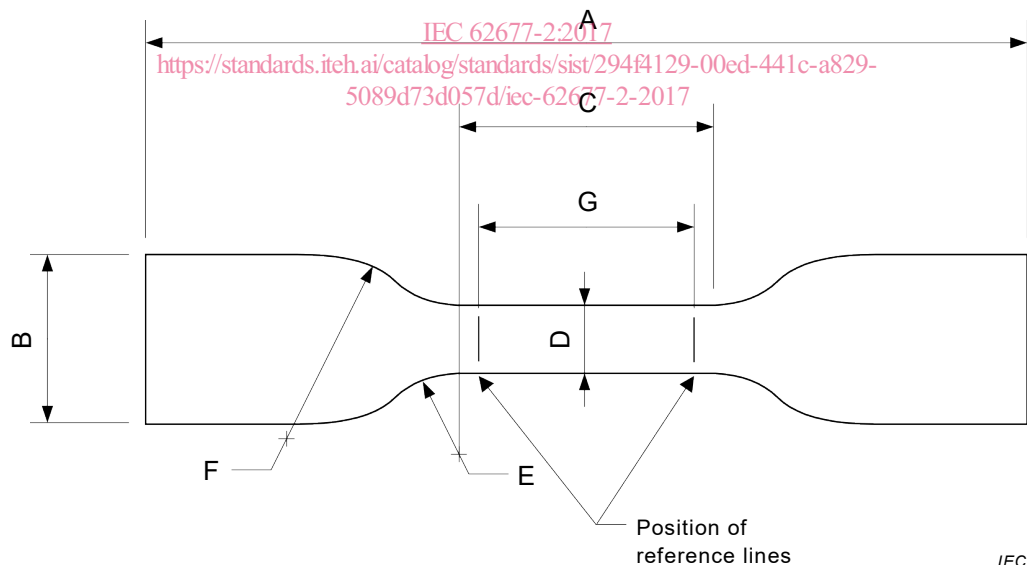
Report, as the result, all measured values for each of the three sets of measurements: the expanded dimensions before and after storage at elevated temperature, and the fully recovered dimensions after storage at elevated temperature.

## 10 Tensile strength and elongation at break

### 10.1 Number and form of test specimens

Cut five dumb-bell specimens from a test sheet in accordance with Clause 5 to the dimensions and tolerances given in Figure 1. The specimens shall be stamped from the sheet using a single stroke of a press and a knife edge punch of appropriate form and dimensions.

NOTE The profile given in Figure 1 is that of type 2 of ISO 37.



A = overall length, minimum	75 mm
B = width at ends	$(12,5 \pm 1,0)$ mm
C = length of narrow parallel portions	$(25 \pm 1)$ mm
D = width of narrow parallel portion	$(4,0 \pm 0,1)$ mm
E = small radius	$(8,0 \pm 0,5)$ mm
F = large radius	$(12,5 \pm 1,0)$ mm
G = distance between reference lines	20 mm maximum

In any one specimen, the thickness of the narrow portion shall nowhere deviate by more than 2% from the mean.

**Figure 1 – Dumb-bell specimen for tensile strength test**

## 10.2 Conditioning

Unless otherwise specified in IEC 62677-3 (all parts), the test specimens shall be kept at an ambient temperature of  $23\text{ °C} \pm 2\text{ K}$  for at least 1 h before testing, or for a longer time to enable the specimens to reach a temperature of  $23\text{ °C} \pm 2\text{ K}$ .

## 10.3 Test temperature

The test shall be made at a temperature of  $23\text{ °C} \pm 2\text{ K}$ .

## 10.4 Procedure

The width and thickness of the central parallel portion of the specimen shall be measured between the gauge marks to the nearest 0,01 mm at a minimum of three points. The average cross-sectional area is then determined.

The specimen shall be mounted in the tensile test machine in axial alignment with the direction of pull. The jaws shall be separated at the uniform rate specified in IEC 62677-3 (all parts) for a particular material. The range of the testing machine shall be such that the maximum load is between 15 % and 85 % of the maximum scale reading.

The distance between the reference lines at break may conveniently be measured by means of a rule, callipers or an extensometer.

The maximum load shall be measured to an accuracy of 2 %. The distance between the reference lines at break shall be measured to within 2 mm.

If the test specimen breaks outside the reference lines the result shall be discarded and a further test made using another specimen.

## 10.5 Calculations

The tensile strength  $S$  shall be calculated from the maximum load and the original area of cross-section, and the result expressed in megapascals (MPa):

$$S = \frac{F_{\max.}}{A} \text{ (MPa)}$$

where

$F_{\max.}$  is the maximum load (N);

$A$  is the original cross-sectional area ( $\text{mm}^2$ ).

The elongation at break  $E$  shall be expressed as a percentage of the original distance between the reference lines, i.e.:

$$E = \frac{L - L_0}{L_0} \times 100 \text{ (%)}$$

where

$L$  is the measured distance between the two reference lines on the stretched specimen at break;

$L_0$  is the original distance between the two reference lines.

## 10.6 Report

Report all calculated values.

## 10.7 Result

The result for each property is the central value unless otherwise specified in the specification sheets of IEC 62677-3 (all parts).

## 11 Secant modulus at 2 % elongation

### 11.1 Number and form of test specimens

Perform three tests on strips cut from a test sheet in accordance with Clause 5. The width of the strips shall be approximately 20 mm.

### 11.2 Procedure

The procedure is as follows.

- The secant modulus shall be calculated from the determination of the tensile stress necessary to produce in the specimen an extension of 2 % of the length between jaws or between reference lines.
- Depending on the method of measurement chosen, the length of the specimen between the jaws or reference lines shall be not less than 100 mm.
- The extension may be measured by means of an extensometer or by jaw separation; the extension shall be measured to an accuracy of 2 %.
- The strain rate shall be  $(0,1 \pm 0,03)$  mm/min for each millimetre length between jaws (e.g. 12 mm/min for a 120 mm length between jaws).
- An initial tensile force ( $F$ ) may need to be applied to the specimen for the purpose of straightening it. This force shall not exceed 3 % of the final value.
- The force shall be increased until the extension between the jaws or reference lines reaches 2 %. The force ( $F_1$ ) required to produce this extension shall be recorded.

### 11.3 Calculation

The 2 % secant modulus of the specimen ( $M$ ) shall be calculated as follows:

$$M = \frac{F_1 - F}{0,02A} \text{ (MPa)}$$

<https://standards.iteh.ai/catalog/standards/sist/2944129-00ed-441c-a829-5089d73d057d/iec-62677-2-2017>

where

$A$  is the initial average cross-sectional area of the specimen ( $\text{mm}^2$ ) (determined as specified in 10.4);

$F_1$  is the force required to produce a 2 % extension (N);

$F$  is the force applied to produce the initial (straightening) stress (N).

### 11.4 Report

Report all measured values for the secant modulus at 2 % elongation.

### 11.5 Result

The result is the central value unless specified otherwise in the specification sheets of IEC 62677-3 (all parts).

## 12 Electric strength

### 12.1 Number and form of test specimens

Three specimens shall be tested using standard test sheets in accordance with Clause 5.

### 12.2 Conditioning

In case of doubt or dispute, these tests shall be made on specimens which have been conditioned by exposure for not less than 24 h to an ambient atmosphere of temperature  $23 \text{ }^\circ\text{C} \pm 2 \text{ K}$  and  $(50 \pm 5) \%$  relative humidity.

### 12.3 Electrodes

The electrodes shall be in accordance with IEC 60243-1, that is, unequal diameter electrodes for sheet materials.