

Heat shrinkable moulded shapes —

Part 2: Methods of test

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National foreword

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Foreword

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Endorsement notice

The text of the International Standard IEC 62329-2:2006 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

This International Standard is one of a series which deals with heat-shrinkable moulded shapes. The series consists of the following parts:

- Part 1: Definitions and general requirements (IEC 62329-1)
- Part 2: Methods of test (IEC 62329-2)
- Part 3: Specification requirements for shape dimensions, material requirements and compatibility performance (IEC 62329-3) (in consideration)

HEAT-SHRINKABLE MOULDED SHAPES –

Part 2: Methods of test

1 Scope

This part of IEC 62329 gives methods of test for heat-shrinkable 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 do not completely establish the suitability of moulded shapes for impregnation or encapsulation processes or other specialized applications. Where necessary, the test methods in this Part will need to be supplemented by appropriate impregnation or compatibility tests to suit the individual circumstances.

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.

IEC 60093:1980, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

IEC 60212:1971, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

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 60243-1:1998, *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 60587:1984, *Test methods for evaluating resistance to tracking and erosion of electrical insulating materials used under severe ambient conditions*

IEC 60695-6-30:1996, *Fire hazard testing – Part 6: Guidance and test methods on the assessment of obscuration hazards of vision caused by smoke opacity from electrotechnical products involved in fires – Section 30: Small scale static method. Determination of smoke opacity. Description of the apparatus*

IEC 60695-11-10:1999, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60754-1:1994, *Test on gases evolved during combustion of materials from cables – Part 1: Determination of the amount of halogen acid gas*

IEC 60754-2:1991, *Test on gases evolved during combustion of materials from cables – Part 2: Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity*

IEC 62329-1:2005, *Heat shrinkable moulded shapes – Part 1: Definitions and general requirements*

ISO 62:1999, *Plastics – Determination of water absorption*

ISO 105-A02:1993, *Textiles – Tests for colour fastness – Part A02: Grey scale for assessing changes in colour*

ISO 105-B01:1994, *Textiles – Tests for colour fastness – Part B01: Colour fastness to light: Daylight*

ISO 846:1997, *Plastics – Evaluation of the action of micro-organisms*

ISO 3261:1975, *Fire tests – Vocabulary*¹

ISO 4589-2:1996, *Plastics – Determination of burning behaviour by oxygen index – Part 2: Ambient-temperature test*

ISO 4589-3:1996, *Plastics – Determination of burning behaviour by oxygen index – Part 3: Elevated-temperature test*

3 Test conditions

Unless otherwise specified, all tests shall be made under standard ambient conditions according to IEC 60212; i.e. 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.

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.

Where a test at low temperature is specified, the specification sheets of IEC 62329-3 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.

¹ This standard has been withdrawn.

4 Standard test specimens

4.1 Moulded shape material specimens

Moulded shape material specimens shall be prepared from $(2 \pm 0,15)$ mm thick sheets, unless otherwise specified, and shall be prepared from the same heat-shrinkable material 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 x 150 mm.

4.2 Moulded shape compatibility specimens

See IEC 62329-1, Subclause 4.2, and Clause 31 of this standard.

5 Dimensions

5.1 Number of test specimens

Three specimens of each size and style shall be tested.

5.2 Procedure

Measure the moulded shapes in the as supplied condition and after unrestricted shrinkage as specified in IEC 62329-3. Carry out unrestricted shrinkage by conditioning in an oven for the time and temperature specified in IEC 62329-3. Remove the shapes from the oven and allow to cool naturally to the ambient temperature specified in Clause 3. 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 $\pm 0,25$ mm. In the case of dispute an optical method shall be used.

5.3 Result

Report all measured values as the result.

6 Density

6.1 Number of test specimens

At least three specimens shall be tested, cut from a test sheet in accordance with 4.1.

6.2 Procedure

Any method for the determination of the density may be used which can ensure an accuracy of $\pm 0,01$ g/cm³.

6.3 Report

Record the method selected for the determination and report all measured values for density

6.4 Result

The result is the mean, unless specified otherwise in the specification sheets of IEC 62329-3.

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 4.1.

7.3 Procedure

The specimens shall be suspended vertically in an oven for $4\text{ h} \pm 10\text{ min}$ at the temperature specified in IEC 62329-3.

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 62329-3 the specimens shall be tested for tensile strength and elongation at break.

7.4 Report

Report all results from the visual examination. Report all calculated values.

7.5 Result

The results for each property is the central value unless otherwise specified in the specification sheets of IEC 62329-3.

8 Bending at low temperature

8.1 Number and form of test specimens

Cut three specimens from a test sheet in accordance with 4.1 approximately $150\text{ mm} \times 6\text{ mm}$.

8.2 Procedure

The specimens shall be suspended for $4\text{ h} \pm 10\text{ min}$ in a chamber maintained at the temperature specified in IEC 62329-3. 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 62329-3. 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.

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 Clause 3 for (336 ± 2) h at a temperature of $40\text{ °C} \pm 3\text{ K}$ unless otherwise specified in the relevant sheet of IEC 62329-3. 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 5.

Following this measurement, the shapes shall be allowed to fully recover, using the time and temperature specified in IEC 62329-3 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: expanded dimensions before and after storage at elevated temperature, and 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 4.1 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.

10.2 Conditioning

Unless otherwise specified in IEC 62329-3, 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 62329-3 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 shall be calculated from the maximum load and the original area of cross-section and the result expressed in megapascals (MPa):

$$\text{tensile strength} = \frac{F_{\max}}{A} \text{ (MPa)}$$

where

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

A is the original cross-sectional area (mm²).

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

$$\text{elongation at break (\%)} = \frac{(L - L_0)}{L_0} \times 100$$

where

L is the measured distance between the two marks on the stretched specimen at break;

L_0 is the original distance between the marks.

10.6

Report all calculated values.

10.7 Result

The results for each property is the central value unless otherwise specified in the specification sheets of IEC 62329-3.

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 4.1. The width of the strips shall be approximately 20 mm.

11.2 Procedure

- 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 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 secant modulus of the specimen shall be calculated as follows:

$$2 \% \text{ secant modulus} = \frac{F_1 - F}{0,02A} \text{ (MPa)}$$

where

A is the initial average cross-sectional area of the specimen (mm²) (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 secant modulus at 2 % elongation.

11.5 Result

The result is the central value unless specified otherwise in the specification sheets of IEC 62329-3.

12 Electric strength

12.1 Number and form of test specimens

Three specimens shall be tested using standard test sheets in accordance with 4.1.

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 atmosphere of (50 ± 5) % relative humidity at a temperature of 23 °C ± 2 K.

12.3 Electrodes

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

12.4 Procedure

The electrodes shall be placed in the centre of the test sheet as described in IEC 60243-1 and the assembly placed in transformer oil.

The voltage used shall be in accordance with IEC 60243-1 applied between the two electrodes at a uniform rate from zero, such that breakdown occurs between 10 s and 20 s.

Calculate the electric strength by dividing the voltage at which breakdown occurs by the thickness of the test sheet. Express the result in MV/m.

12.5 Result

Report all values.