
INTERNATIONAL STANDARD



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Plastics — Thermosetting moulding materials — Determination of shrinkage of compression moulded test specimens in the form of bars

Matières plastiques — Matières à mouler thermodurcissables — Détermination du retrait des éprouvettes moulées par compression sous forme de barreaux

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2577 was drawn up by Technical Committee ISO/TC 61, *Plastics*, and circulated to the Member Bodies in January 1972.

It has been approved by the Member Bodies of the following countries :

Australia	Hungary	South Africa, Rep. of
Austria	India	Spain
Belgium	Ireland	Sweden
Canada	Israel	Switzerland
Chile	Italy	Turkey
Czechoslovakia	Japan	United Kingdom
Egypt, Arab Rep. of	Netherlands	U.S.A.
Finland	New Zealand	U.S.S.R.
France	Portugal	
Germany	Romania	

No Member Body expressed disapproval of the document.

Plastics — Thermosetting moulding materials — Determination of shrinkage of compression moulded test specimens in the form of bars

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method of determining the moulding shrinkage and the shrinkage after heat treatment of thermosetting moulding materials.

These characteristics are useful for the production control of thermosetting materials and for checking uniformity of manufacture. Furthermore, knowledge of the initial shrinkage of thermosetting materials is important for the construction of compression moulds, and that of post-shrinkage for establishing the suitability of the moulding material for the manufacture of moulded pieces with accurate dimensions.

2 REFERENCES

ISO/R 291, *Plastics — Standard atmospheres for conditioning and testing.*

ISO/R 295, *Plastics — Compression moulding test specimens of thermosetting materials.*

3 DEFINITIONS

For the purpose of this International Standard the following definitions apply :

3.1 moulding shrinkage : The relative difference in dimensions between a moulding from a given material and the mould cavity in which it was moulded, both the mould and the moulding after cooling being at defined conditions when measured.

3.2 post-shrinkage : The relative difference between the dimensions of a moulded piece after cooling and the dimensions of the same piece after having been treated in an oven at a given temperature for a defined period and again cooled.

4 SAMPLING

A representative sample shall be taken from the moulding material to be tested and be kept at room temperature in airtight containers until moulded without any conditioning.

5 TEST SPECIMENS

5.1 For determining the moulding shrinkage the test specimens to be used shall be bars with a length of not less than 80 mm, a width between 10 and 15 mm and a thickness between 4 and 10 mm.

5.2 The test specimens shall be prepared in a positive or a semipositive compression mould with single or multiple cavities.

5.3 In special cases it may be suitable to engrave marks on the upper part of the mould near both ends of the specimen in order to allow an accurate measurement.

6 PROCEDURE

6.1 If not already known, measurements of the lengths of the cavities or the distance between the engraved marks of the mould shall be made to the nearest 0,01 mm, at a temperature of $23 \pm 2^\circ\text{C}$ (in accordance with ISO/R 291).

The gaugings of these moulds (as well as the measurements of the test specimens) shall always be made between the same marked measuring points. These numerical values are recorded as gauges of the moulds and employed as a constant for each calculation of shrinkage.

NOTE — From time to time moulds shall be checked for wear, etc. Apart from measuring directly the lengths of the cold moulds, the gauge for the moulds may be obtained very precisely by cold moulding specimens from lead and measuring the lengths of these pieces.

6.2 At least three test specimens from the sample to be tested shall be moulded under such conditions of pressure, temperature, time, etc. as agreed upon by the interested parties as suitable for the material. In the absence of such agreements, moulding shall be carried out in accordance with the recommendations given in the Annexes to ISO/R 295.

After removal from the mould, the test specimens shall be allowed to cool to room temperature by placing them on a material with low thermal conductivity and under an appropriate load to avoid warping. Store them at a temperature of $23 \pm 2^\circ\text{C}$ and a relative humidity of $50 \pm 5\%$ until making measurements.

6.3 The period of storage of the test specimens for determining the moulding shrinkage shall be between 16 and 72 h.

6.4 For the determination of the moulding shrinkage, the lengths of the bars from end face to end face, or the distances between the marks on the bars, shall be measured at a temperature of $23 \pm 2^\circ\text{C}$ to the nearest 0,02 mm with micrometers, screw gauges or similar devices having the same accuracy. At least three specimens are to be measured.

NOTE — Before measuring the lengths of the test specimens, they shall be put on completely plane sheets of glass or metal in order to determine any warps or distortions. Test specimens with such defects must be rejected.

6.5 For the determination of the post-shrinkage, the test specimens, measured as described in 6.4, shall be supported to avoid deformation, separated from each other and put in an oven.

The heating temperatures are :

$80 \pm 2^\circ\text{C}$ for urea-formaldehyde moulding materials;

$110 \pm 3^\circ\text{C}$ for all other thermosetting moulding materials.

The times of exposure are :

48 ± 1 h for rapid determination;

168 ± 2 h for normal determination.

NOTE — The post-shrinkage depends strongly on the time of exposure. Therefore the exposure time is to be noted (see 7.2 and section 8), and to be fixed in the specification of the material.

At the end of the heating period, the test specimens shall be removed from the oven and allowed to cool in a standard atmosphere of $23 \pm 2^\circ\text{C}$ and a relative humidity of $50 \pm 5\%$ for at least 3 h.

After the cooling period the test specimens shall be measured again at a temperature of $23 \pm 2^\circ\text{C}$ to an accuracy of 0,02 mm as described in 6.4.

7 EXPRESSION OF RESULTS

7.1 The moulding shrinkage (MS) is given, as a percentage, by the formula

$$MS = \frac{L_0 - L_1}{L_0} \times 100$$

where

L_0 is the length, in millimetres, of the dimension of the mould, determined as in 6.1;

L_1 is the length, in millimetres, of the corresponding dimension measured on the test specimen according to 6.4

7.2 The post-shrinkage (PS) is given, as a percentage, by the formula :

$$PS_{48h} \text{ or } PS_{168h} = \frac{L_1 - L_2}{L_1} \times 100$$

where

L_1 is the same as in 7.1;

L_2 is the length, in millimetres, of the same dimension of the test specimen, measured after heat treatment for 48 or 168 h, according to 6.5.

8 TEST REPORT

The test report shall include the following particulars :

- a) the grade and designation of the moulding material;
- b) the type of test specimen used;
- c) the date of preparation of the test specimens;
- d) the moulding conditions by reference to the appropriate International Standard or otherwise;
- e) the moulding shrinkage (MS) as a percentage, including
 - the individual values,
 - the mean value;
- f) the post-shrinkage (PS_{48h} and/or PS_{16h}) as a percentage, including
 - the individual values,
 - the mean value;
- g) the total number of test specimens;
- h) the number of rejected test specimens;
- i) the cause for rejection, if possible with details (for example, 2 mm warp in a length of 120 mm);
- j) the conditions of heat treatment, if different from those specified in this International Standard;
- k) the date of the tests.