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Plastics — Amorphous thermoplastic moulding materials — Determination of maximum reversion

Plastiques — Matières à mouler thermoplastiques amorphes — Détermination du retrait maximal

Reference number
ISO 8328 : 1989 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8328 was prepared by Technical Committee ISO/TC 61, *Plastics.*

Annex A of this International Standard is for information only.

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Introduction

The mechanical properties of test specimens of amorphous thermoplastic materials are influenced mainly by their molecular orientation. Reproducible test results can only be obtained by using test specimens that are in the same state of orientation. Procedures for the preparation of test specimens with a specified maximum reversion are described in ISO 2557-1 and ISO 2557-2.

The amount of molecular orientation can be assessed by measuring the maximum reversion of the specimens at an elevated temperature under specified conditions. For industrial purposes, it can be assumed that, when the measured maximum reversions of test specimens, after a specified heat treatment, are equal, then their state of molecular orientation is similar.

Plastics — Amorphous thermoplastic moulding materials — Determination of maximum reversion

1 Scope

This International Standard specifies a method of assessing molecular orientation in test specimens of amorphous thermoplastic materials by determination of the maximum longitudinal reversion after a specified heat treatment. The method is suitable only for specimens exhibiting predominantly uniaxial orientation, such as bars and dumb-bells in which the orientation occurs along the length of the specimen, or plates in which the orientation is parallel to one of the sides.

The method is not suitable for fibre reinforced thermoplastics or cellular plastics.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 306 : 1987, *Plastics — Thermoplastic materials — Determination of the Vicat softening temperature.*

ISO 2818 : 1980, *Plastics — Preparation of test specimens by machining.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 reversion, R: The percentage change in length of a defined portion of a moulded specimen when this specimen is subjected to a specified heat treatment (see clause 6). It is given by the equation

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

where

L_0 is the length before heat treatment (initial length);

L_1 is the length after heat treatment (final length).

3.2 maximum reversion, R_m: The reversion measured when the specimen is subjected to a heat treatment at a temperature above the glass transition temperature of the material, high enough to make the degree of reversion independent of small changes in heating time or temperature.

4 Apparatus

Ordinary laboratory apparatus and

4.1 Heating cabinet, temperature-controlled, having a high thermal capacity so that the temperature is kept constant at the specified value to within ± 2 °C and the specified temperature is regained within less than 1 min after test specimens are placed in the cabinet.

To achieve the required rapid heating of the specimen by simple means, it is recommended that the thermal capacity of the cabinet be increased by a specimen holder with high thermal capacity and small working volume. An example of such a specimen holder is shown in figures 1 and 2. It consists of two metal blocks separated by two spacers — for example, 13 mm wide spacers for specimens with a thickness up to 6,5 mm and 25 mm wide spacers for specimens with a thickness up to 13 mm — and a metal back plate about 5 mm thick.

The whole assembly, i.e. the specimen holder plus specimen support (4.2), is placed in a suitable oven. A heat-resistant sheet is placed in front of the assembly to avoid a fall in temperature when the oven door is opened. The heat-resistant sheet has a slot to allow the specimen support (4.2) to be inserted or withdrawn from the specimen holder (see figure 2).

4.2 Specimen support, consisting of a thin metal sheet, for example aluminium sheet, coated with a suitable slip agent, for example a mixture of 20 parts by mass of talc and 80 parts by mass of silicone oil *).

4.3 Measuring device: A dial gauge or other device capable of measuring the length of a specimen to an accuracy of 0,1 mm.

*) Silicone oil 200 MPa, heat stabilized.

5 Test specimens

5.1 Preparation

Unless otherwise specified, each test specimen shall be the central part, 30 mm in length, of a moulding having predominantly uniaxial molecular orientation (for example a dumb-bell, bar moulding or bar cut from a plate) and shall be fabricated by machining in accordance with ISO 2818, method 3.

The specimens shall be prepared from the parallel-sided section of the dumb-bell or bar by reducing the length to 30 mm by trimming a similar portion from both ends. The surface of the ends of the trimmed test specimen shall be parallel and smooth.

NOTE — In evaluating the results for specimens longer than 30 mm, it should be borne in mind that the reversion may be less than that measured on the 30 mm test portion.

5.2 Number of specimens

Five specimens shall be used for each determination.

6 Procedure

For each test specimen, measure the length of the centreline of each of the two opposite sides at 23 °C ± 2 °C to the nearest 0,1 mm and record the mean of the two measurements as the initial length L_0.

Preheat the heating cabinet (4.1), with the specimen holder (if used), to the temperature specified in the relevant material standard. If no temperature is specified, the temperature shall be 170 °C for materials with a glass transition temperature T_g below 120 °C. For materials with a T_g above 120 °C, the temperature shall be the Vicat softening temperature (determined in accordance with ISO 306) + 50 °C.

Place the test specimens on the specimen support (4.2), coated with the slip agent (see 4.2), place the specimen support plus specimens in the specimen holder (if used), and put the whole assembly (specimen holder plus specimen support) in the heating cabinet. Unless otherwise specified in the relevant material standard, heat the specimens for 30 min.

After the specified time, remove the test specimens, while still on their support, from the heating cabinet and let them cool in still air, the support resting on a heat-insulating surface. After they have reached 23 °C ± 2 °C, measure the lengths of the centrelines of the two opposite sides of each test specimen to the nearest 0,1 mm and record the mean for each test specimen as the final length L_1 (see figure 3).

Since reversion decreases from the surface of the specimen to the centre, the specimen shrinks less in the centre; thus a protruding nose is formed, as shown in figure 3. This nose shall be neglected in determining L_1.

7 Expression of results

Calculate the maximum reversion for each specimen. Report the maximum reversion of the mouldings under test as the arithmetic mean of the five results, to the nearest whole number.

8 Test report

The test report shall include the following particulars:

a) a reference to this International Standard;

b) a complete identification of the moulding material (type, designation, etc.);

c) details of the preparation of the mouldings and the test specimens;

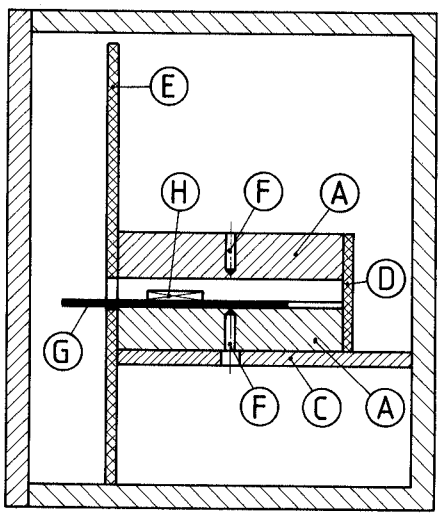
d) details of the reversion test:

1) test temperature,

2) heating time,

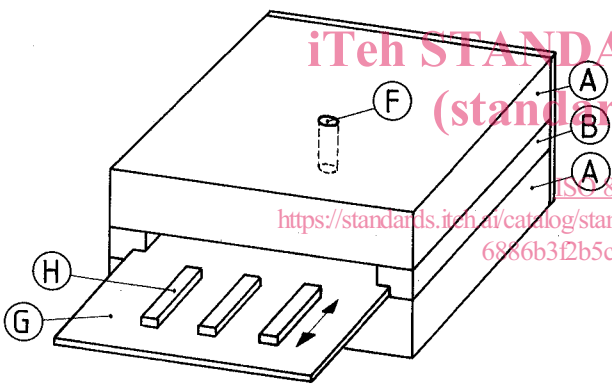
3) initial and final lengths of the test specimens;

e) the individual values of the maximum reversion and their arithmetic mean.



(A) Metal block (250 mm × 250 mm × 50 mm)
(B) Spacer (20 mm × 250 mm × 13 mm or 25 mm)
(C) Support for specimen holder
(D) Metal back plate (100 mm × 250 mm × 5 mm)
(E) Heat-resistant sheet (approx. 10 mm thick)
(F) Hole drilled for thermocouple
(G) Thin metal sheet
(H) Test specimen

Figure 1 — Example of specimen holder in heating cabinet



See figure 1 for key to letters

Figure 2 — Specimen holder

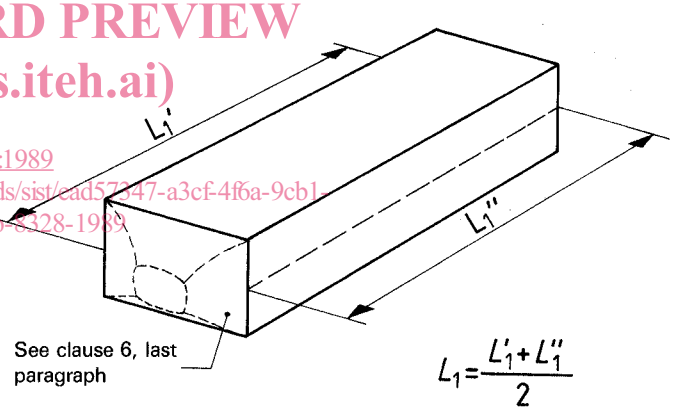


Figure 3 — Measurement of mean length after reversion

Annex A
(informative)

Bibliography

[1] ISO 2557-1 : 1989, *Plastics — Amorphous thermoplastics — Preparation of test specimens with a specified maximum reversion — Part 1: Bars.*

[2] ISO 2557-2 : 1986, *Plastics — Amorphous thermoplastics — Preparation of test specimens with a specified reversion — Part 2: Plates.*

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