INTERNATIONAL STANDARD

ISO 75-1

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Plastics — Determination of temperature of deflection under load —

Part 1: General test method

Plastiques — Détermination de la température de fléchissement sous charge —

Partie 1: Méthode d'essai générale

Reference number
ISO 75-1:2013(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 75-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical properties*.

This third edition cancels and replaces the second edition (ISO 75-1:2004), which has been technically revised.

ISO 75 consists of the following parts, under the general title *Plastics — Determination of temperature of deflection under load*:

— *Part 1: General test method*

— *Part 2: Plastics and ebonite*

— *Part 3: High-strength thermosetting laminates and long-fibre-reinforced plastics*

Introduction

The first editions of this part of ISO 75 and ISO 75-2 described three methods (A, B and C) using different test loads and two specimen positions, edgewise and flatwise. For testing in the flatwise position, test specimens with dimensions 80 mm × 10 mm × 4 mm were required. These can be moulded directly or machined from the central section of the multipurpose test specimen (see ISO 20753).

The previous (i.e. second) editions of this part of ISO 75 and ISO 75-2 specified the flatwise test position as preferred, while still allowing testing in the edgewise position with the test conditions given in Annex A until the next revision of this part of ISO 75 and ISO 75-2, as agreed in ISO/TC 61/SC 2/WG 5. Therefore, with this revision, the edgewise test position will be removed.

At the time of publication, technical development of testing instruments made instruments based on a fluidized bed or air ovens available. These are especially advantageous for use at temperatures at which the common silicone oil-based heat transfer fluids reach their limit of thermal stability. The fluidized bed and air oven methods of heat transfer are introduced in this part of ISO 75.

An additional precision statement covering the new heating methods is introduced in ISO 75-2.

Plastics — Determination of temperature of deflection under load —

Part 1:
General test method

1 Scope

This part of ISO 75 gives a general test method for the determination of the temperature of deflection under load (flexural stress under three-point loading) of plastics. Different types of test specimen and different constant loads are defined to suit different types of material.

ISO 75-2 gives specific requirements for plastics (including filled plastics and fibre-reinforced plastics in which the fibre length, prior to processing, is up to 7,5 mm) and ebonite, while ISO 75-3 gives specific requirements for high-strength thermosetting laminates and long-fibre-reinforced plastics in which the fibre length is greater than 7,5 mm.

The methods specified are suitable for assessing the relative behaviour of different types of material at elevated temperature under load at a specified rate of temperature increase. The results obtained do not necessarily represent maximum applicable temperatures because in practice essential factors, such as time, loading conditions and nominal surface stress, can differ from the test conditions. True comparability of data can only be achieved for materials having the same room-temperature flexural modulus.

The methods specify preferred dimensions for the test specimens.

Data obtained using the test methods described are not intended to be used to predict actual end-use performance. The data are not intended for design analysis or prediction of the endurance of materials at elevated temperatures.

This method is commonly known as the HDT test (heat deflection test or heat distortion test), although there is no official document using this designation.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 75-2, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 75-3, *Plastics — Determination of temperature of deflection under load — Part 3: High-strength thermosetting laminates and long-fibre-reinforced plastics*

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

ISO 20753, *Plastics — Test specimens*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
flexural strain
ε_f
nominal fractional change in length of an element of the outer surface of the test specimen at midspan

Note 1 to entry: It is expressed as a dimensionless ratio or a percentage (%).

3.2
flexural strain increase
$\Delta\varepsilon_f$
specified increase in flexural strain that takes place during heating

Note 1 to entry: It is expressed as a percentage (%).

Note 2 to entry: This quantity is introduced to highlight the fact that the initial deflection caused by application of the test load is not measured and that therefore the criterion for the end of the test does not constitute an absolute strain value. Only the deflection increase is monitored (see 3.4). This new quantity does not change the test or evaluation procedure compared to previous editions of this part of ISO 75, but serves only to clarify what is really measured.

3.3
deflection
s
distance over which the top or bottom surface of the test specimen at midspan deviates during flexure from its original position

Note 1 to entry: It is expressed in millimetres (mm).

3.4
standard deflection
Δs
increase in deflection corresponding to the flexural strain increase, $\Delta\varepsilon_f$, at the surface of the test specimen, and which is specified in ISO 75-2 or ISO 75-3

Note 1 to entry: It is expressed in millimetres (mm) [see 8.3, Formula (4)].

3.5
flexural stress
σ_f
nominal stress at the outer surface of the test specimen at midspan

Note 1 to entry: It is expressed in megapascals (MPa).

3.6
load
F
force, applied to the test specimen at midspan, which results in a defined flexural stress

Note 1 to entry: It is expressed in newtons (N) [see 8.1, Formulae (1) to (3)].

3.7
temperature of deflection under load
T_f
temperature at which the deflection of the test specimen reaches the standard deflection as the temperature is increased

Note 1 to entry: It is expressed in degrees Celsius (°C).

4 Principle

A standard test specimen is subjected to three-point bending under a constant load in the flatwise position to produce one of the flexural stresses given in the relevant part of ISO 75 (all parts). The temperature is raised at a uniform rate, and the temperature at which the standard deflection, corresponding to the specified increase in flexural strain, occurs is measured.

5 Apparatus

5.1 Means of producing a flexural stress

The apparatus shall be constructed essentially as shown in Figure 1. It consists of a rigid metal frame in which a rod can move freely in the vertical direction. The rod is fitted with a weight-carrying plate and a loading edge. The base of the frame is fitted with test-specimen supports; these and the vertical members of the frame are made of a material having the same coefficient of linear expansion as the rod.

The test-specimen supports consist of metal pieces that are cylindrical in the contact area and with their lines of contact with the specimen in a horizontal plane. The size of the span, i.e. of the distance between the contact lines, is given in ISO 75-2 or ISO 75-3. The supports are fitted to the base of the frame in such a way that the vertical force applied to the test specimen by the loading edge is midway (±1 mm) between them. The contact edges of the supports are parallel to the loading edge and at right angles to the length direction of the test specimen placed symmetrically across them. The contact edges of the supports and loading edge have a radius of (3,0 ± 0,2) mm and shall be longer than the width of the test specimen.

Unless vertical parts of the apparatus have the same coefficient of linear thermal expansion, the difference in change of length of these parts introduces an error in the reading of the apparent deflection of the test specimen. A blank test shall be made on each apparatus using a test specimen made of rigid material having a low coefficient of expansion and a thickness comparable to that of the specimen under test. The blank test shall cover the temperature ranges to be used in the actual determination, and a correction term shall be determined for each temperature. If the correction term is 0,01 mm or greater, its value and algebraic sign shall be recorded and the term applied to each test result by adding it algebraically to the reading of the apparent deflection of the test specimen.

NOTE Invar and borosilicate glass have been found suitable as materials for the test specimen in the blank test.

5.2 Heating equipment

The heating equipment shall be a heating bath containing a suitable liquid, a fluidized bed or an air oven. For heat transfer media other than gas (air) the test specimen shall be immersed to a depth of at least 50 mm. An efficient stirrer or means to fluidize the solid heat transfer medium shall be provided. If liquids are used for heat transfer, it shall be established that the liquid chosen is stable over the temperature range used and does not affect the material under test, for example causing it to swell or crack.

The method using a liquid heat transfer medium shall be considered a reference method in case of doubts or conflicts, if possible in the temperature range under consideration.

The heating equipment shall be provided with a control unit so that the temperature can be raised at a uniform rate of (120 ± 10) °C/h.