SLOVENSKI STANDARD
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Plastomerne cevi in fitingi - Zmehļ iģļ e po Vicatu (VST) - 1. del: Sploġna preskusna metoda

Thermoplastics pipes and fittings -- Vicat softening temperature -- Part 1: General test method

Tubes et raccords en matières thermoplastiques -- Température de ramollissement Vicat -- Partie 1: Méthode générale d'essai

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INTERNATIONAL STANDARD

ISO 2507-1

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Thermoplastics pipes and fittings — Vicat softening temperature —

Part 1: General test method

Tubes et raccords en matières thermoplastiques — Température de ramollissement Vicat —

Partie 1: Méthode générale d'essai

Reference number
ISO 2507-1:1995(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 voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 2507-1 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 5, *General properties of pipes, fittings and valves of plastic materials and their accessories — Test methods and basic specifications*.

This first edition of ISO 2507-1, and ISO 2507-2, cancels and replaces the second edition of ISO 2507 (ISO 2507:1982), of which it constitutes a technical revision.

ISO 2507 consists of the following parts, under the general title *Thermoplastics pipes and fittings — Vicat softening temperature*:

— *Part 1: General test method*

— *Part 2: Test conditions for unplasticized poly(vinyl chloride) (PVC-U) or chlorinated poly(vinyl chloride) (PVC-C) pipes and fittings and for high impact resistance poly(vinyl chloride) (PVC-HI) pipes*

— *Part 3: Test conditions for acrylonitrile/butadiene/styrene (ABS) and acrylonitrile/styrene/acrylic ester (ASA) pipes and fittings*

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Introduction

This International Standard is based on ISO 306.

For convenience of use, it has been considered preferable to draw up a complete document for use in determining the Vicat softening temperature of thermoplastics pipes and fittings. For further details, reference to ISO 306 is recommended.

Please note, however, that ISO 306 is applicable to materials in the form of sheets, whereas this International Standard is applicable to materials in the form of pipes and fittings.

ISO 2507 comprises three parts: the first gives the general conditions under which the Vicat softening temperature of a pipe or fitting is determined, the other two parts provide the particular requirements for conducting tests on pipes and fittings of different materials (see the Foreword).

The basic specifications for various materials are given in the informative annexes of the appropriate parts.

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Thermoplastics pipes and fittings — Vicat softening temperature —

Part 1:
General test method

1 Scope

This part of ISO 2507 specifies a general method for determining the Vicat softening temperature of thermoplastics pipes and fittings. It includes the adaptation of method B of ISO 306:1994, using a force of 50 N.

This method is applicable only to thermoplastics materials for which it is possible to measure the temperature at which their rate of softening becomes rapid.

It is not applicable to crystalline or semi-crystalline polymers.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 2507. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 2507 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 291:1977, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 306:1994, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST).*

3 Principle

Determination of the temperature at which a standard indenter, under a force of 50 N ± 1 N, penetrates 1 mm into the surface of a test piece cut from the wall of a pipe or fitting while the temperature is raised at a constant rate.

The temperature at which the penetration is 1 mm is called the Vicat softening temperature (VST), in degrees Celsius.

4 Apparatus

4.1 Rod, provided with a **load-carrying plate** (4.4), held in a **rigid metal frame** so that it can move freely in the vertical direction, the base of the frame serving to support the test piece under the indenting tip at the end of the rod (see figure 1).

If the rod and the components of the frame do not have the same coefficient of linear thermal expansion, their differential change in length introduces an error into the readings. A blank test shall be carried out for each apparatus using a test piece of rigid material with a low coefficient of expansion. This test shall cover the whole range of service temperatures and a correction term shall be determined for each temperature. If the correction term is greater than or equal to 0,02 mm, its algebraic sign shall be noted and the correction shall be applied to each test by adding it to the value observed for apparent penetration. It is recommended that the apparatus be constructed using an alloy with a low coefficient of thermal expansion.

4.2 Indenting tip, preferably of hardened steel, 3 mm long and having a circular cross-section with an area of 1 $mm^2 \pm 0{,}015\ mm^2$, fixed at the bottom of the rod (4.1). The lower surface of the indenting tip shall be plane and perpendicular to the axis of the rod, and free from burrs.

4.3 Micrometer dial gauge (or any other measuring instrument), for measuring the penetration of the indenting tip into the test piece to within 0,01 mm. The thrust of the dial gauge, which contributes to that applied to the test piece, shall be known (see 4.4).

4.4 Load-carrying plate, fixed to the rod (see 4.1), and **weights** located centrally so that the total thrust applied to the test piece can be adjusted to 50 N ± 1 N. The downward thrust due to combined effects of the rod, indenting tip, load-carrying plate and the thrust of the dial gauge spring shall not exceed 1 N.

4.5 Heating bath, containing, if possible, a suitable liquid (see notes 1 and 2) in which the apparatus is immersed so that the test piece is at least 35 mm below the surface of the liquid. An efficient stirrer shall be provided. The heating bath shall be equipped with a means of control such that the temperature can be raised at a uniform rate of 50 °C/h ± 5 °C/h.

The rate of temperature rise shall be considered to be satisfactory if the difference in temperature measured for each interval of 6 min during the test does not exceed 5 °C ± 0,5 °C.

NOTES

1 Paraffin oil, transformer oil, glycerol and silicone oils may be suitable for heat-transfer fluids, but other liquids may be used. In all cases, it should be established that the liquid chosen is stable at the test temperatures used and does not affect the product under test, for example by softening, swelling or cracking.

If no liquid is suitable as a heat-transfer fluid, the oven with air circulation should be used (4.7).

2 The test results can be dependent on the thermal conductivity of the heat transfer medium.

3 The uniform rate of temperature rise can be obtained by controlling the heat either manually or automatically, although the latter is strongly recommended. One method found to give satisfactory results is to use an immersion heater adjusted to give the desired rate of temperature rise from the initial test temperature and then to increase the heating power (either by means of the immersion heater itself, or by means of a subsidiary heater) by adjustment of a rheostat or a variable transformer.

4 It is advisable to have a cooling coil in the liquid of the heating bath, in order to reduce the time required to lower the temperature between two consecutive tests. This coil should be removed or drained before starting a new test, since boiling liquid which has been used as coolant can affect the rate of temperature rise.

4.6 Mercury-in-glass thermometer, partial immersion type (or any other suitable temperature-measuring device), having appropriate graduations and accurate to 0,5 °C. Each mercury-in-glass thermometer shall be calibrated for the depth of immersion specified in 7.3.

4.7 Oven with air circulation, in which the temperature can be maintained at the value specified in that part of ISO 2507 relevant to the applicable material.

5 Test pieces

5.1 Sampling

5.1.1 Pipes

The test pieces shall consist of segments of rings, removed from the pipes, limited by cross-sections and having the following dimensions:

— length: approximately 50 mm;

— width: between 10 mm and 20 mm.

5.1.2 Fittings

The test pieces shall consist of segments of rings taken from the sockets, spigots or other cylindrical parts of the fitting, limited by cross-sections and with the length equal to:

— the length of the socket, for fittings of diameter less than or equal to 90 mm;

— 50 mm, for fittings of a diameter greater than 90 mm.

Their width shall be between 10 mm and 20 mm.

Cut the test pieces from a zone which does not include a weld line or injection point.

5.2 Preparation

5.2.1 If the wall thickness of the pipe or fittings is greater than 6 mm, reduce it to 4 mm by machining the outer surface only of the pipe or fitting, by a suitable technique.

If the socket of the fitting is threaded, machine the treaded part until a smooth surface is obtained.

5.2.2 Test pieces of thickness between 2,4 mm and 6 mm inclusive shall be tested as they are.

5.2.3 If the wall thickness of the pipe or fitting is less than 2,4 mm, each test piece shall comprise two ring segments superimposed so as to obtain an overall thickness of at least 2,4 mm. The lower segment, which will serve as a base, shall be flattened. To do this heat it to 140 °C for 15 min, while resting a thin metal plate on it. The upper segment shall be left as such.

5.3 Number of test pieces

Use two test pieces for each test, but provide additional test pieces, in case the difference between the results is too great (7.7).

6 Conditioning

Condition the test pieces for 5 min at a temperature at least 50 °C lower than the expected Vicat softening temperature (VST).

7 Procedure

7.1 Bring the heating bath (4.5) to a temperature about 50 °C lower than that anticipated for the VST of the product under test (see 4.5, note 4).

Maintain this bath temperature constant.

7.2 Mount the test piece horizontally under the indenting tip (see 4.2) of the unloaded rod (see 4.1), which shall rest on the concave surface of the test piece. The surface of the test piece which is in contact with the base of the apparatus shall be flat.

In the case of pipes and fittings with a wall thickness of less than 2,4 mm, the indenting tip shall rest on the concave surface of the non-flattened segment, the latter being placed on the flattened segment.

The indenting tip shall at no point be less than 3 mm from the edge of the test piece.

7.3 Immerse the apparatus in the heating bath. The bulb of the thermometer or the sensing portion of the temperature-measuring instrument (4.6) shall be at the same level as and as close as possible to the test piece.

7.4 Position the indenting tip and, after 5 min, add to the load-carrying plate the weight required so that the total thrust on the test piece is 50 N ± 1 N. Record the reading on the micrometer dial gauge (or other indentation-measuring instrument) (see figure 1) or set the instrument to zero.

7.5 Raise the temperature of the bath at a uniform rate of 50 °C/h ± 5 °C/h. Stir the liquid well during the test.

7.6 Record the temperature of the bath at which the indenting tip has penetrated into the test piece by 1 mm ± 0,01 mm relative to its starting position defined (7.4), and record it as the VST of the test piece.

7.7 Record as the VST of the pipe or fitting under test the arithmetic mean of the Vicat softening temperatures of the two test pieces.

Express the result in degrees Celsius.

If the individual results differ by more than 2 °C, report them in the test report (see clause 8, item h) and repeat the test using a new set of at least two test pieces (see 5.1).

8 Test report

The test report shall include the following information:

a) a reference to this part of ISO 2507;

b) the complete identification of the pipe or fitting tested;

c) the thickness of the test pieces and, if applicable, whether they consist of two parts;

d) the immersion fluid;

e) the methods of conditioning and of annealing used, if any;

f) the Vicat softening temperature (VST) obtained for each of the two test pieces, in degrees Celsius;

g) any alterations in the appearance of the test pieces during the test or after their immersion;

h) the results expressed in accordance with 7.7;

i) all operational details not included in this part of ISO 2507, and any occurrences which may have influenced the results.