*Indian Standard*

# THERMOPLASTICS PIPES AND FITTINGS — METHODS OF TEST

## PART 2 DETERMINATION OF VICAT SOFTENING TEMPERATURE

### 1 SCOPE

This standard (Part 2) specifies a method for the determination of the Vicat softening temperature for thermoplastics pipes and fittings.

### 2 PRINCIPLE

The determination of the temperature at which a standard indenter penetrates 1 mm into the surface of the test specimen, cut from the wall of a pipe or fitting, under a test load of 50 ± 1 N. During the test, the temperature is raised at a uniform rate.

The temperature at 1 mm penetration is quoted as the Vicat softening temperature (VST) in °C.

### 3 APPARATUS

**3.1 Rod** — Provided with the load carrying plate (*see* **3.4**), 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 specimen under the indenting tip at the end of the rod (*see* Fig. 1).

**3.2 Indenting Tip** — Preferably of hardened steel, 3 mm long, of circular cross-section, and area 1.000 ± 0.015 $mm^2$, fixed at the bottom of the rod (*see* **3.4**). The lower surface of the indenting tip shall be plane and perpendicular to the axis of the rod and be free from burrs.

**3.3 Micrometer Dial Gauge** — Graduated in divisions of 0.01 mm, to measure the penetration of the indenting tip into the test specimen. The thrust of the dial gauge, which contributes to the thrust on the test specimen, shall be known and shall comply with the requirements of **3.4**.

**3.4 Load-Carrying Plate** — Fitted to the rod (*see* **3.1**), and suitable weights adjusted centrally so that the total thrust applied to the test specimen can be made up to 50 ± 1 N (5.097 ± 0.1 kgf). The combined masses of the rod, indenting tip and load-carrying plate shall not exceed 1 N (100 g).

NOTE — If the rod and the components of the frame do not have the same linear coefficient of 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 metal of low coefficient of thermal 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.

**3.5 Heating Bath** — Containing a suitable liquid (*see* Notes 1 and 2) in which the apparatus is placed so that the specimen 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 so that the temperature is capable of being raised at a uniform rate of 50 ± 5°C/h (*see* Note 4). This heating rate shall be considered to be met if, over every 5 m interval during the test, the temperature change is within the specified limits.

NOTES

1 Liquid paraffin, transformer oil, glycerol and silicone oils may be suitable liquid heat-transfer media, but other liquids may be used. In all cases, it shall be established that the liquid chosen is stable at the temperature used and does not affect the material under test.

2 If no suitable liquid can be found for use as a heat-transfer medium as defined in Note 1, some different heating arrangement, for example, air, may be used. If air is used as the heat-transfer medium, it should be noted that errors in the quoted softening point may arise, unless care is taken to correct for possible differences in temperature between the air and the specimen.

3 A uniform rate of temperature rise can be obtained by controlling the heat input either manually or automatically, although the latter is strongly recommended. One method of operation found to be satisfactory is to provide an immersion heater adjusted to give the correct rate of temperature rise at the starting temperature of the test, and then to increase the power input (either in the same heater or in a subsidiary heater) by adjustment of a rheostat or a variable transformer.

4 It is desirable to have a cooling coil in the liquid bath in order to reduce the time required to lower the temperature between determinations. This must be removed or drained before starting a test, as boiling of coolant can affect temperature rise.

**3.6** Thermometer (or any other accurate temperature-measuring device) of appropriate range, and with graduations at least at each 0.5°C. The scale error at any reading shall not exceed 0.5°C. If a mercury-in-glass thermometer is used, it shall be calibrated for the depth of immersion as required under **5.3**.

### 4 TEST SPECIMENS

#### 4.1 Preparation

**4.1.1** Two test specimens shall be used for each sample. The test specimen shall consist of segments of