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R 180

PLASTICS

DETERMINATION OF THE IZOD IMPACT RESISTANCE OF RIGID PLASTICS

(IZOD IMPACT FLEXURAL TESTS)

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 180, *Determination of the Izod Impact Resistance of Rigid Plastics (Izod Impact Flexural Tests)*, was drawn up by Technical Committee ISO/T 61, *Plastics*, the Secretariat of which is held by the American Standards Association, Incorporated (ASA).

Work on this matter which the Technical Committee had begun since 1956, came to an end in 1957, with the adoption of a proposal as a Draft ISO Recommendation.

On 8 May 1959, the Draft ISO Recommendation (No. 214) was distributed to all the ISO Member Bodies and was approved, by the following Member Bodies:

Austria	India	Spain
Belgium	Israel	Sweden
Burma	Italy	Switzerland
Czechoslovakia	Japan	Turkey
Finland	Netherlands	United Kingdom
Germany	Portugal	U.S.A.
Greece	Romania	U.S.S.R.

Two Member Bodies opposed the approval of the Draft :
France, Hungary.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in February 1961, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 180 February 1961

PLASTICS

DETERMINATION OF THE IZOD IMPACT RESISTANCE OF RIGID PLASTICS*

(IZOD IMPACT FLEXURAL TESTS)

1. SCOPE

The two methods of test described in this ISO Recommendation are intended to determine the relative sensitivity to fracture by shock of rigid plastics as indicated by the energy expended by a standard pendulum type impact machine in breaking in one blow a standard Izod (Cantilever beam) specimen.

2. TYPES OF TESTS

Either of the two following methods may be employed, according to the circumstances:

2.1 **Method A** is the Cantilever beam or Izod Type Test in which the specimen is broken by a blow delivered at a fixed distance from the edge of the specimen clamp. The test requires a notched specimen in all cases. The notch is intended to produce a standard degree of stress concentration.

2.2 **Method B** is the Cantilever beam or Izod Type Test for materials of less than 2.75 kgf · cm per centimetre of notch. Method B adds to Method A a technique for the determination of the energy expended in tossing the specimen. The value reported is called the " estimated notched Izod impact strength ". This method is recommended in place of Method A for materials which have an Izod impact strength of less than 2.75 kgf · cm per centimetre of notch. It is not to be used for materials which have higher Izod impact strength values than 2.75 kgf · cm per centimetre of notch.

2.3 The instructions contained in sections 3 to 7 (pages 6 to 10) apply to both Method A and Method B. On the other hand, the instructions contained in Sections 8 and 9 (pages 11 and 12) differ for the two methods.

* For the determination of the Charpy impact resistance, see ISO Recommendation R 179, *Determination of the Charpy Impact Resistance of Rigid Plastics (Charpy Impact Flexural Test)*.

3. SIGNIFICANCE OF TEST

3.1 The excess energy pendulum impact test indicates the energy to break standard test specimens of specified size under stipulated conditions of specimen mounting, notching (stress concentration) and rate of loading.

3.2 The energy indicated by the apparatus after breaking a standard test piece is the sum of:

(a) the energy to deform the specimen,

(b) the energy to initiate fracture of the specimen,

(c) the energy to propagate the fracture across the specimen,

(d) the energy to throw the free end of the broken specimen (" toss factor ") and

(e) the energy lost through friction and through vibration of the apparatus and its base.

3.3 The notch, which is always present in the standard Izod test specimen, serves to concentrate the stress and largely prevents plastic deformation.

Friction losses are largely eliminated by careful design and proper operation of the testing machine. Energy losses due to vibration of the apparatus are generally assumed to be negligible for plastics, but may be considerable if the machine is not correctly designed with sufficient mass for the specified range and is not of rigid construction.

3.4 Thus, the indicated impact strength of a material for all practical purposes is based on items *(a)*, *(b)*, *(c)* and *(d)* as indicated in clause 3.2. In the case of relatively brittle materials, the tearing energy is small compared with the fracture energy, whereas in the case of tough, ductile materials of fibre filled or cloth laminated materials, the reverse is true, the toss factor may represent a very large fraction of the total energy absorbed when testing relatively brittle materials (less than 2.75 kgf · cm per centimetre of notch). A correction for the toss factor is specified in clause 8. 2. 4 (Method B). This correction is especially important when comparing materials of widely ranging densities.

4. APPARATUS

4.1 The machine should be of the pendulum type, as illustrated in Figure 1, of rigid construction, accurate to 0.14 kgf · cm for readings of less than 14 kgf · cm and to 1 per cent for higher values. Accurate correction should be made for friction and windage losses.

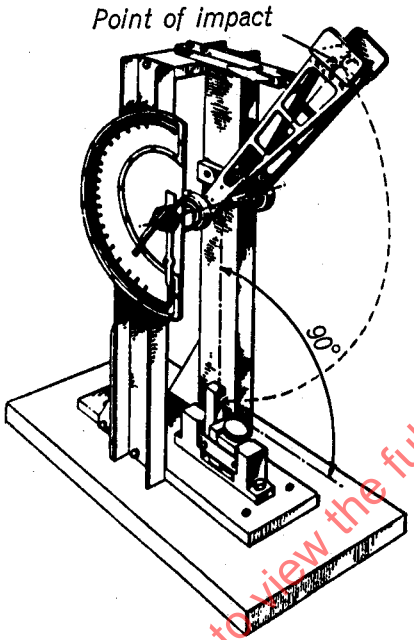

Fig. 1.—**Cantilever beam (Izod Type) impact machine**

4.2 The dimensions of the machine should be such that the centre of percussion of the striker (see Note 1) is at the point of impact; that is, the centre of the striking edge.

4.3 The pendulum should be released from such a position that the linear velocity of the centre of the striking edge (centre of percussion) at the instant of impact should be approximately 335 cm/s, which corresponds to an initial elevation of this point of 61 cm.

NOTES

1. The distance from the axis of support to the centre of percussion may be determined experimentally from the period of oscillation of the pendulum through a small angle, by means of the following equation:

$$l = 24.7\ T^2$$

where

l = distance, in centimetres, from the axis of support to the centre of percussion,

T = time, in seconds, for a complete swing (to and fro).

4.4 The striking edge of the pendulum should be a cylindrical surface of 0.8 mm, with its axis horizontal. The cylindrical surface should be, when the pendulum is hanging free, tangent to the specimen in a line 2.20 cm above the surface of the vice. The pendulum above the cylindrical portion of the striking edge should be recessed or inclined at a suitable angle so that there is no chance of its coming into contact with the specimen during break.

4.5 Means should be provided for clamping the specimen rigidly in position with the edges of the supporting surfaces at 90° angles (see Note 2).

4.6 Means should be provided for determining the impact value of the specimen, which is the energy expended in breaking the specimen. This value is equal to the difference in energy in the pendulum blow and the energy remaining in the pendulum after breaking the specimen, after suitable correction has been made for energy losses due to windage and friction.

5. SPECIMENS

5.1 The test specimen should conform to the dimensions shown in Figure 2, except as modified in accordance with clauses 5.2, 5.3 and 5.4. To insure the correct contour and condition of the specified notch, all specimens should be notched as directed in section 6.

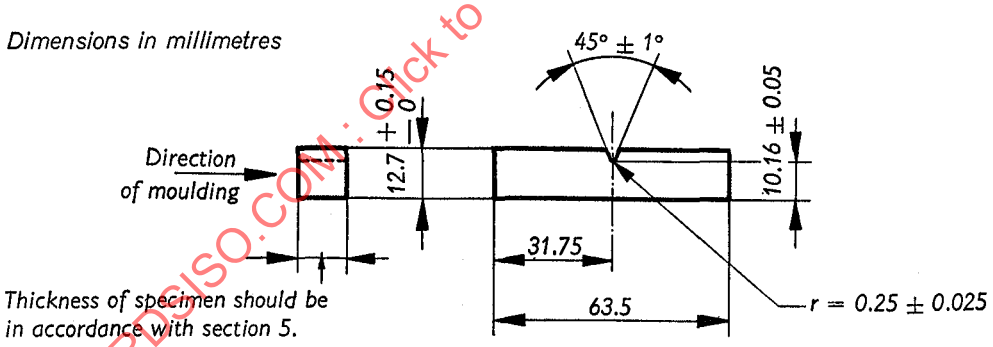

Fig. 2.—Specimen for Cantilever beam (Izod Type) impact machine

NOTES *(continued)*

2. Some plastics are sensitive to clamping pressure; therefore cooperating laboratories should agree on means of standardizing the gripping form, such as by using a torque wrench on the screw of the specimen vice.

5.2 For moulded material (see Note 3), the specimen should be 1.27 cm by any dimension from 0.32 to 1.27 cm, agreed upon as representative of the cross-section in which the particular material is to be used. For all specimens having one dimension less than 1.27 cm, the notch should be cut in the narrower side (see Note 4). For all compression-moulded specimens, the notch should be in the side parallel to the direction of application of the moulding pressure (see Note 5).

5.3 For sheet material the specimens should be cut from the sheet in both the lengthwise and crosswise directions, unless otherwise specified (see Note 6).

The thickness should be the thickness of the sheet, except that it should not exceed 1.27 cm. Sheet material thicker than 1.27 cm should be machined down to 1.27 cm. Such material may be tested either edgewise or flatwise, as specified. When specimens are tested flatwise, the notch should be made on the machined surface if the specimen is machined on one side only. When the specimen is cut from a thick sheet, notation should be made from what portion of the thickness of the sheet the specimen is cut, for example, centre, top surface or bottom surface.

5.4 For sheet materials less than 1.27 cm in thickness, the test specimen may be a composite specimen consisting of a number of individual thin pieces aggregating 0.32 to 1.27 cm in thickness. The individual pieces of the test specimen should all be accurately aligned with each other and should be tested edgewise. Pieces less than 1.6 mm in thickness should be laminated together with a suitable adhesive (see Note 7) to prevent buckling or twisting during impact. Single specimens less than 1.27 cm in thickness may be used, provided the width is sufficient for firm, accurate clamping and the impact value of the material is sufficiently high to be accurately determined by a machine of the capacity used (see Note 8).

NOTES *(continued)*

3. The type of mould used to produce test specimens has an effect on the results obtained. Cooperating laboratories should, therefore, agree upon standard moulds, and upon moulding procedure, to obtain concordant results.

4. The indicated impact strength of some materials varies somewhat with the width (dimension along the notch) of the test specimen used. For interlaboratory comparisons on different compositions, moulded specimens of a fixed width should be used.

5. The impact strength may be different if the notch is perpendicular to the direction of moulding instead of parallel.

6. In referring to the cutting of the specimens of laminated sheet materials and the applications of the load, the following descriptions of terms apply:

   Flatwise. Load applied to the flat side of the original sheet or plate.

   Edgewise. Load applied to the edge of the original sheet or plate.

   Lengthwise. In the direction of the length of the sheet.

   Crosswise. In the direction at right angles to the direction of the length of the sheet. When the sheet has the same length and width, one dimension shall arbitrarily be designated as the *A* direction and the other as the *B* direction.

7. Care should be taken to select an adhesive that does not affect the impact values. If the adhesive contains solvents, a conditioning procedure should be followed which will allow the complete removal of the solvent. It is known that the presence of solvents with some materials (such as cellulosics) does affect the impact values.

8. This may lead to higher values due to the adhesive.