Australian Standard®

Methods for impact tests on plastics

Part 2: Charpy impact resistance

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The following interests are represented on Committee PL/10/2:

CSIRO—Division of Building, Construction and Engineering

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PREFACE

This Standard was prepared by Standards Australia's Committee PL/10/2, Mechanical Testing of Plastics, under the authority of the Plastics Standards Board.

The Standard provides procedures for testing of plastics materials using the Charpy Impact Test, which have not hitherto been covered by an Australian Standard.

The Standard is applicable to a range of plastics materials, and does not refer to specific materials. The subject matter dealing with equipment and specimen preparation is technically similar to ISO 179, *Plastics—Determination of Charpy impact strength of rigid materials,* which is currently under review by ISO.

This Australian Standard takes cognizance of several draft revisions of ISO 179—1982 but, as these are yet to be finalized, the text of this Standard differs editorially from the proposed drafts.

CONTENTS

FOREWORD

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

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 ends of the broken specimen (toss factor); and

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

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.

Thus, the indicated impact strength of a material for all practical purposes is based on Items (a), (b), (c) and (d) above. In the case of relatively brittle materials, the tearing energy is small compared with the fracture energy, whereas in the case of tough ductile fibre filled or cloth laminated materials, the reverse is true.

In the Charpy test the specimen is supported as a horizontal simple beam and is broken by a single swing of the pendulum, with the impact line midway between the supports and directly opposite the notch for notched specimens.

This test has a greater range of applicability than the Izod test of AS 1462.1, especially for materials displaying interlaminate shear fracture and for the investigation of surface influences.

To be valid, the Charpy test requires that the specimen break completely. For tough materials the pendulum may not have the energy necessary to complete the breaking of the extreme fibres and toss the broken piece or pieces. Results obtained from unbroken specimens, or other types of partially broken specimens, are considered to be invalid for the purposes of this Standard.

STANDARDS AUSTRALIA

Australian Standard
Method for impact tests on plastics

Part 2—Charpy impact resistance

1 SCOPE. This Standard specifies a method for the determination of the Charpy impact strength of rigid plastics using a pendulum type testing machine.

Different test parameters are specified according to the type of test specimen and the type of notch (see Clause 6.1, Table 2 and Figures 2 to 4).

The method is used for investigating the behaviour of specified specimens under specified impact stresses, and for estimating the brittleness or the toughness of specimens within the limitations inherent in the test conditions.

This Standard is applicable, *inter alia,* to the following materials:

(a) Rigid thermoplastics moulding and extrusion materials, including filled and reinforced compounds, and rigid thermoplastics sheet.

(b) Rigid thermosetting moulding materials, including filled and reinforced compounds.

(c) Fibre thermosetting sheet, including laminates.

(d) Fibre reinforced materials (composites), incorporating mat, woven fabric, woven rovings, chopped strands, chopped rovings, rovings, and milled fibres, including pre-impregnated materials (prepregs).

(e) Unidirectional fibre reinforced materials (composites), including pre-impregnated materials (prepregs).

NOTE: The use of notched specimens is unsuitable for long fibre reinforced plastics. The method may not be suitable for foamed materials.

The method is applicable to specimens prepared from moulding materials or from specimens taken from finished and semi-finished products, i.e. mouldings, laminates, extruded or cast sheets.

The method is suitable for production control, as well as for the acceptance and rejection of materials according to specifications for moulding materials and products.

The results obtained by testing specimens of different dimensions and prepared under different conditions are generally not comparable.

NOTE: The method is not suitable as a source of data for design calculations on components. Information on the typical behaviour of a material can be obtained, however, by testing at different temperatures, by varying the notch radius, and by testing specimens prepared under different conditions.

2 REFERENCED DOCUMENTS. The following documents are referred to in this Standard:

AS
1146 Methods for impact tests on plastics
1146.1 Part 2: Izod impact resistance
1146.3 Part 3: Calibration of the testing machine
1327 Plastics—Standard environments for conditioning and testing plastics materials

ISO
293 Plastics—Recommended practice for compression moulding test specimens of thermoplastic materials
294 Plastics—Recommended practice for injection moulding test specimens of thermoplastic materials
295 Plastics—Recommended practice for compression moulding test specimens of thermosetting materials
1268 Plastics—Recommended practice for preparation of glass fibre reinforced, resin bonded, low pressure laminated plates or panels for test purposes
2557 Plastics—Amorphous thermoplastic moulding materials—Preparation of test specimens with a defined level of shrinkage
2557-1 Part 1—Test specimens in the form of parallelepipedic bars (injection moulding and compression moulding)
2557-2 Part 2—Test specimens in the form of rectangular plates (injection moulding)
2818 Plastics—Preparation of test specimens by machining
3167 Plastics—Preparation and use of multipurpose test specimens

3 DEFINITIONS. For the purpose of this Standard the definitions below apply.

3.1 Charpy impact strength of unnotched specimens—the impact energy absorbed in breaking an unnotched specimen, referred to the original cross-sectional area of the specimen.

NOTE: In this Standard, the units of kilojoules per square metre are used.

3.2 Charpy impact strength of notched specimens—the impact energy absorbed in breaking a notched specimen, referred to the original cross-sectional area of the specimen at the notch.

NOTE: In this Standard, the units of kilojoules per square metre are used.

3.3 Specimen dimensions—thickness (t), width (w) and length (l), where—

$$t \leq w < l$$

3.4 Normal impact—impact where the direction of a blow is normal to the laminate plane of sheet materials (see Figure 5(a) 'edgewise normal').

3.5 Parallel impact—impact where the direction of a blow parallel to the laminate plane of sheet materials (see Figure 6(a) 'edgewise parallel').

3.6 Edgewise impact—impact where the direction of blow is normal to the thickness (t), with impact on the narrow longitudinal surface ($t \times l$) of the specimen (see Figure 5(a) and Figure 6(a)).