

Indian Standard
METHOD FOR CHARPY IMPACT TEST
(U-NOTCH) FOR METALS
(*First Revision*)

Third Reprint MARCH 1992

UDC 620.178.746.22:669

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

Indian Standard

METHOD FOR CHARPY IMPACT TEST (U-NOTCH) FOR METALS

(First Revision)

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Indian Standard

METHOD FOR CHARPY IMPACT TEST (U-NOTCH) FOR METALS

(*First Revision*)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 15 November 1977, after the draft finalized by the Methods of Physical Tests Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1959. Since then considerable work has been done by ISO on this subject. Consequently this revision has been prepared on the basis of the International Standard ISO 83-1976 Steel-Charpy Impact Test (U-Notch). Assistance has also been derived from BS 131 : Part 3 : 1972 Methods for notched bar tests: Part 3 The Charpy U-notch impact test on metals.

0.3 The following major modifications have been incorporated in this revision:

- a) Scope of the standard have been modified to include all metals.
- b) In addition to the standard test piece, two subsidiary test pieces having a width of 7.5 mm or 5 mm have been specified. Any of these test pieces may be used when the standard test piece cannot be obtained from the material.
- c) In accordance with the decision taken at the ISO level, the impact energy is expressed in joules and is not related to the cross-sectional area of the material under the notch.

0.4 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard specifies the conditions for carrying out the Charpy impact test (U-notch) for determining the impact strength of metals.

*Rules for rounding off numerical values (revised).

2. PRINCIPLE OF TEST

2.1 The test consists of measuring the energy absorbed in breaking by one blow from a swinging hammer, under prescribed conditions, a test piece U-notched in the middle and supported at each end.

3. REFERENCE NUMBERS

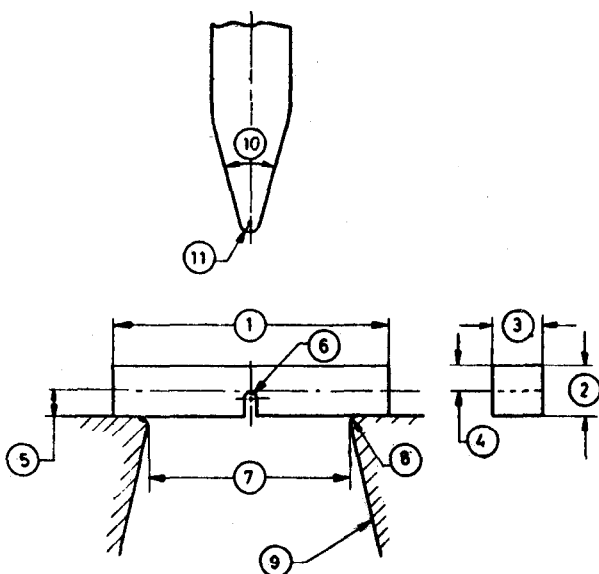
3.1 The following reference numbers have been used in this standard (see Fig. 1):

<i>Reference Number</i>	<i>Designation</i>
1	Length of test piece
2	Thickness of test piece
3	Width of test piece
4	Thickness of test piece minus depth of notch
5	Depth of notch
6	Radius of curvature of base of notch
7	Distance between supports
8	Radius of curvature of supports
9	Taper of supports
10	Angle at tip of hammer
11	Radius of curvature of the tip of hammer

4. TESTING MACHINE

4.1 The testing machine shall be constructed and installed steady and rigid. The dimensions of the machine shall be as follows:

<i>Ref No.</i>	<i>Item</i>	<i>Dimension</i>
7	Distance between supports	40.0 $\begin{smallmatrix} +0.5 \\ -0 \end{smallmatrix}$ mm
8	Radius of curvature of supports	1.0 $\begin{smallmatrix} +0.5 \\ -0 \end{smallmatrix}$ mm
9	Taper of supports	1 \pm 0.1 in 5 slope
10	Angle at tip of hammer	30° \pm 1°
11	Radius of curvature of the tip of hammer	2.0 $\begin{smallmatrix} +0.5 \\ -0 \end{smallmatrix}$ mm



NOTE — The numerals encircled are reference numbers (see 3.1).

FIG. 1 CHARPY IMPACT TEST

4.1.1 The speed of hammer at the instant of striking shall be 4.5 to 7 m/s.

4.1.2 The plane of swing of the striker shall be vertical and shall be within 0.5 mm of the plane midway between the supports. The machine shall be so constructed that the loss of energy (such as from translation, rotation or vibration) in the machine framework during a test is negligible.

4.1.3 The centre of percussion of the hammer shall be at the point of impact, which is taken to be the centre of the line of contact between the striker and the standard test piece when in position on the supports.

4.1.4 The accuracy of the graduation of the scale of the machine shall comply with the requirements specified in 2.3.3 of IS : 3766-1977*.

4.2 For a standard test the striking energy of the testing machine shall be 300 ± 10 J. The impact strength, obtained under these conditions, using the 5 mm deep U-notch, shall be denoted by KU.

4.3 Testing machines with different striking energies are permitted, in which case the value KU is supplemented by an appropriate index.

*Calibration of pendulum impact testing machines for testing metals (first revision).

4.4 For a test, in which a standard test piece, with a notch other than 5 mm deep, is used, the symbol KU shall be supplemented by indices denoting both the striking energy of the machine and the depth of the notch.

Examples:

a) KU 100/3 : striking energy 100 J, 3 mm deep notch.

b) KU 300/3 : normal striking energy, 3 mm deep notch.

4.5 The testing machine shall be verified in accordance with IS : 3766-1977* and shall comply with the relevant requirements of that standard.

5. TEST PIECE

5.1 The test piece shall be machined all over and shall be 55·00 mm long and in the centre of the length of one face there shall be a U-notch of specified depth with 1 mm root radius. The standard test piece and the subsidiary test pieces shall have dimensions and tolerances specified in Table 1.

TABLE 1 DIMENSIONS AND TOLERANCES OF FERROUS AND NON-FERROUS TEST PIECES

(Clauses 5.1 and 6.1)

SL No.	ITEM	NOMINAL DIMENSION	MACHINING TOLERANCES	
			Ferrous Test Pieces	Non-ferrous Test Pieces
(1)	(2)	(3)	(4)	(5)
		mm	mm	mm
i)	Length	55	± 0.60	± 0.5
ii)	Width:			
	Standard test piece	10	± 0.11	± 0.05
	Subsidiary test pieces	7.5	± 0.11	± 0.05
		5	± 0.05	± 0.025
iii)	Thickness	10	± 0.11	± 0.05
iv)	Root radius of notch	1.0	± 0.07	± 0.07
v)	Depth below notch	8 (2 mm notch)	± 0.09	± 0.05
		7 (3 mm notch)	± 0.09	± 0.05
		5 (5 mm notch)	± 0.09	± 0.05
vi)	Distance of centre of notch from ends of test piece	27.5	± 0.42	± 0.25
vii)	Angle between plane of sym- metry of notch and longi- tudinal axis of test piece	90°	$\pm 2^\circ$	$\pm 2^\circ$

*Calibration of pendulum impact testing machines for testing metals (first revision).

5.1.1 The standard test piece shall be of square cross-section 10 mm x 10 mm. Where the standard test piece cannot be obtained from the material, one of the subsidiary test pieces, having a rectangular cross-section shall be used with the notch cut in one of the narrower faces.

NOTE — It is emphasized that only results on test pieces of identical dimensions should be compared as no satisfactory correlation between results obtained from different sizes of test pieces has been established.

5.2 The notch may be made by any machining method. The notch shall be carefully prepared so that no grooves appear at the base of the notch.

6. TEST PROCEDURE

6.1 Position of Test Piece — The test piece shall lie squarely against the supports with the plane of symmetry of the notch within 0.5 mm of the plane of swing of the striker. In order to achieve this, where an end stop is used to position the test piece in the machine, it may be necessary to machine the test piece length to tolerances closer than those given in Table 1.

6.2 Temperature of Test — The temperature of the test piece at the moment of breaking shall not differ from the specified temperature by more than $\pm 2^{\circ}\text{C}$, unless some other tolerance is agreed. If the temperature of testing is not specified, it shall be taken as 27°C subject to the above tolerance. In all cases, including when the test is required to be carried out at ambient temperature, the test temperature shall be recorded.

6.2.1 When the impact properties are determined at specified sub-zero temperatures or at specified temperature up to 200°C , the test piece shall be brought to an appropriate temperature by immersion in a bath. In all cases the period of immersion of the test piece and the appliances in the bath at the required temperature shall be not less than 10 minutes and the test piece shall be broken within 6 seconds from the time of removal from bath.

NOTE — For tests at temperatures within the range 20 to 100°C , an oil bath is to be preferred to a water bath.

6.2.2 For test at temperatures above 200°C , the test piece shall be heated in an oven or salt bath, sufficient time at the required temperature being allowed for the test piece to reach this temperature. The test piece shall be broken within 6 seconds from the time of removal from bath or oven.

6.3 Number of Tests — Unless otherwise stated in the relevant material specification, an impact test shall consist of three specimens taken from a single test coupon or test location, the average value of which shall comply with the specified minimum with not more than one value being below the specified minimum, but in no case less than either two-thirds of the specified minimum value or 7 Joules, whichever is greater. If more than one

value is below the specified minimum, or if any one value is less than the greater of 7 Joules or two-thirds of the specified minimum, a retest of three additional specimens shall be made, each of which should have a value equal to or exceeding the specified minimum.

6.4 Unbroken Test Piece — If during the test, the test piece is not completely broken, the impact value obtained is indefinite. The test report should state that the test piece was not broken by striking energy of the testing machine.

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AMENDMENT NO. 1 JUNE 1980

TO

IS:1499-1977 METHOD FOR CHARPY IMPACT
TEST (U-NOTCH) FOR METALS

(First Revision)

Alteration

(Page 5, clause 4.1.1) - Substitute the following
for the existing clause:

'4.1.1 The speed of hammer at the instant of
striking shall be 5 to 5.5 m/s.

NOTE - Machine with striking velocity of 4.5 to
7 m/s may also be used.'

(SMDC 3)