IS : 1499 - 1977
(Reaffirmed 1999)
Edition 2.1
(1980-06)

Indian Standard

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

(First Revision)

(Incorporating Amendment No. 1)

UDC 620.178.746.22:669

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Price Group 2

Indian Standard

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

(First Revision)

Methods of Physical Tests Sectional Committee, SMDC 3

Chairman	*Representing*
SHRI P. K. CHAKRAVARTY	Tata Iron & Steel Co Limited, Jamshedpur
Members	
DR A. S. BHADURI	National Test House, Calcutta
SHRI B. C. BISWAS (*Alternate*)	
SHRI R. N. BOSE	Hindustan Aeronautics Ltd, Bangalore
DR M. K. MADHEKAR (*Alternate*)	
SHRI R. N. DATTA	Ministry of Defence (DGOF)
SHRI D. Y. MOGHE (*Alternate*)	
DEPUTY DIRECTOR (MET)-II, RDSO, LUCKNOW	Ministry of Railways
ASSISTANT DIRECTOR (MET), RDSO, LUCKNOW (*Alternate*)	
SHRI D. DUTTA	The Indian Tube Co Ltd, Jamshedpur
SHRI P. K. GANGOPADHYAY	Ministry of Defence (DGI)
SHRI D. K. MUKHERJEE (*Alternate*)	
SHRI N. T. GEORGE	Ministry of Defence (R & D)
SHRI G. R. K. MURTY (*Alternate*)	
SHRI A. K. GUHA	Directorate General of Supplies & Disposals
SHRI P. C. MUSTAFI (*Alternate*)	
SHRI M. K. DAS GUPTA	National Physical Laboratory (CSIR), New Delhi
SHRI S. B. IDNANI	Blue Star Limited, Bombay
SHRI A. L. CHADHA (*Alternate*)	
SHRI S. V. KULKARNI	Fuel Instruments & Engineer Pvt Ltd, Ichalkaranji
SHRI J. V. KULKARNI (*Alternate*)	
SHRI V. M. KULKARNI	Usha Martin Black (Wire Ropes) Ltd, Calcutta
DR A. CHAKRABORTY (*Alternate*)	
SHRI M. C. KUMARASWAMY	Tata Iron & Steel Co Ltd, Jamshedpur
DR T. MUKHERJEE (*Alternate*)	
DR D. M. LAKHIANI	The Indian Iron & Steel Co Ltd, Burnpur
SHRI R. DUTTA (*Alternate*)	
SHRI K. S. LAKSHMINARAYAN	Avery India Ltd, Calcutta
SHRI R. D. SHARMA (*Alternate*)	

(*Continued on page* 2)

(*Continued from page* 1)

Members	*Representing*
SHRI Y. L. MIDHA	Indian Sugar & General Engineering Corporation, Yamunanagar
SHRI MADAN SHARMA (*Alternate*)	
SHRI R. A. PADMANABHAN	Central Mechanical Engineering Research Institute (CSIR), Durgapur
SHRI N. A. PRABHU	M. N. Dastur & Co (P) Ltd, Calcutta
SHRI M. PRASAD	Hindustan Steel Ltd, Ranchi
SHRI D. P. GHOSH (*Alternate*)	
SHRI S. RADHAKRISHNAN	National Aeronautical Laboratory (CSIR) Bangalore
DR M. L. BHATIA (*Alternate*)	
SHRI N. V. RAGHAVAN	Mining & Allied Machinery Corpn Ltd, Durgapur
SHRI S. KUMAR (*Alternate*)	
REPRESENTATIVE	Union Carbide India Limited, Calcutta
SHRI F. C. SHARMA	Directorate General of Civil Aviation
SHRI K. C. SRIVASTAVA	Bharat Steel Tubes Limited, Ganuar
SHRI H. K. TANEJA	Indian Register of Shipping, Bombay
SHRI V. N. PANDEY (*Alternate*)	
SHRI A. UMAMAHESWARAN	Directorate General of Technical Development
DR VED PRAKASH	National Metallurgical Laboratory (CSIR), Jamshedpur
DR D. J. CHAKRAVARTI (*Alternate*)	
SHRI H. C. VERMA	Associated Instrument Manufacturers' (India) Pvt Ltd, New Delhi
SHRI O. P. CHUGH (*Alternate*)	
SHRI C. R. RAMA RAO, Director (Struc & Met)	Director General, ISI (*Ex-officio Member*)

Secretary

SHRI B. MUKHERJI

Deputy Director (Metals), ISI

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 This edition 2.1 incorporates Amendment No. 1 (June 1980). Side bar indicates modification of the text as the result of incorporation of the amendment.

0.5 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

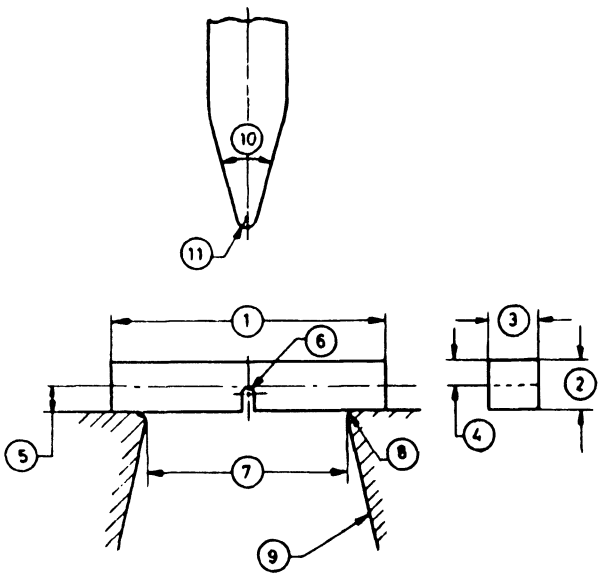
3.1 The following reference numbers have been used in this standard (*see* Fig. 1):

Reference Number	*Designation*
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:

Ref No.	*Item*	*Dimension*
7	Distance between supports	$40.0\ ^{+0.5}_{-0}$ mm
8	Radius of curvature of supports	$1.0\ ^{+0.5}_{-0}$ mm
9	Taper of supports	1 ± 0.1 in 5 slope
10	Angle at tip of hammer	$30° \pm 1°$
11	Radius of curvature of the tip of hammer	$2.0\ ^{+0.5}_{-0}$ 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 5 to 5.5 m/s.

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

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 : 3766-1972* 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 symmetry of notch and longitudinal axis of test piece	90°	± 2°	± 2°

*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 × 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 ± 2°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.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed by Technical Committee : SMDC 3

Amendments Issued Since Publication

Amend No.	Date of Issue
Amd. No. 1	June 1980

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002. Telegrams: Manaksanstha
Telephones: 323 01 31, 323 33 75, 323 94 02 (Common to all offices)

Regional Offices:		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	323 76 17 323 38 41
Eastern	: 1/14 C. I. T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	337 84 99, 337 85 61 337 86 26, 337 91 20
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43 60 20 25
Southern	: C. I. T. Campus, IV Cross Road, CHENNAI 600113	235 02 16, 235 04 42 235 15 19, 235 23 15
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	832 92 95, 832 78 58 832 78 91, 832 78 92

Branches : AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. NALAGARH. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISHAKHAPATNAM