भारतीय मानक

Indian Standard

IS 2062 (Part 1) : 2025

संरचनात्मक इस्पात

भाग 1 तप्त बेल्लित मध्यम एवं उच्च तन्यता के इस्पात

(आठवाँ पुनरीक्षण)

Structural Steel

Part 1 Hot Rolled Medium and High Tensile Steel

(Eight Revision)

ICS 77.140.01

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

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Wrought Steel Products Sectional Committee, MTD 04

FOREWORD

This Indian Standard (Eight Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1962 and subsequently revised in 1969, 1975, 1984, 1992, 1999, 2006 and 2011. While reviewing the standard, in the light of experience gained during these years, the Committee decided to revise it to bring in line with the present practices being followed by the Indian steel industry, both in the integrated as well as secondary sectors. The Committee further decided to harmonize the standard with the overseas standards on carbon-manganese and high strength low alloy (HSLA) of structural steels.

In this revision, the standard is split into two parts, other part of the series is:

Part 2 Hot rolled quenched and tempered steel plates and wide flats

In this revision the following changes have been made:

a) Title has been modified and Amendment No. 1 has been incorporated;

b) Number of basic grades has been changed to eleven. New grades E235 and E500 are added in line with ISO/European Standards, to take care of the requirements of medium and high tensile structural steels in the infrastructure and construction segment;

c) Table 2 and Table 3 are interchanged. Table 1 and Table 3 are added with new grades and modifications in few grades are done in line with ISO/European Standards;

d) Clauses **13** and **20.2** are removed;

e) New clauses **3.5**, **3.6**, **3.7**, **12.5**, **19.3** are added; Table 1 Note 4, Table 3 Note 4, Note 5, Note 6 are also added; and

f) Clauses 1.1, **2**, 3.4, 5.0, 6.2, 7.3, **9.1**, Fig.1, **10.1**, **10.2**, **11.1**, **11.2**, **12.1.1**, new designated clauses **15**, **19.1**, , Table 2, Table 3 Note 2 and Table 4 have been modified.

While revising the standard, assistance has been derived from the following international specifications:

International Standard	*Title*
ISO 630-2 : 2021	Structural steels Part 2: Technical delivery conditions for structural steels for general purposes
ISO 630-3 : 2021	Structural steels Part 3: Technical delivery conditions for fine-grain structural steels

The composition of the Committee responsible for the revision of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

STRUCTURAL STEEL

PART 1 HOT ROLLED MEDIUM AND HIGH TENSILE STEEL

(Eight Revision)

1 SCOPE

1.1 This standard covers the requirements of steel including micro-alloyed steel plates, sheets, strips, shapes and sections (angles, tees, beams, channels, etc), flats, bars, rods, etc, for use in structural work.

1.1.1 The steels are suitable for welded, bolted and riveted structures and for general engineering purposes.

1.1.2 Where welding is employed for fabrication and guaranteed-weldability is required, welding procedure should be as specified in IS 9595 : 1996 'Metal arc welding of carbon and carbon manganese steels —Recommendations (*first revision*)'.

1.1.3 This standard does not include those steels, which are covered by other Indian Standards, examples are as follows:

a) Steel plates of drawing quality (*see* IS 1079);

b) Steels for boilers and pressure vessels (*see* IS 2002 and IS 2041);

c) Steels for structural forming and flanging (*see* IS 5986);

d) Steels for the manufacture of welded gas cylinders/containers (*see* IS 6240 and IS 15914);

e) Steel wire rods for general engineering purposes (*see* IS 7887);

f) Steels for manufacture of agricultural tillage discs (*see* IS 9442);

g) Steels for welded tubes and pipes (*see* IS 10748 and IS 15647); and

h) Steels for cold rolling purposes (*see* IS 11513).

2 REFERENCES

The standards listed in Annex A contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 1956 and the following definitions shall apply.

3.1 Micro-Alloying Elements — Elements, such as niobium, vanadium and titanium added singly or in combination to obtain high strength to weight ratio combined with better toughness, formability and weldability as compared to unalloyed steel of similar strength level.

3.2 Weldability — A metallic substance is considered to be weldable by a given process and for the given purpose, when metallic continuity to a stated degree can be obtained by welding using a suitable procedure, so that the joints comply with the requirements specified in regard to both their local properties and their influence on the construction of which they form a part.

3.3 Controlled Rolling — A hot rolling process in which the temperature of the steel and its reduction ratio are controlled, particularly during the final rolling passes, in order to achieve fine grain microstructure and optimum mechanical properties.

3.4 Normalizing Rolling — A rolling process in which the final deformation is carried out in a certain temperature range leading to a material condition equivalent to that obtained after normalizing so that the specified values of the mechanical properties are retained even after normalizing.

NOTE — In international publications for both the normalizing rolling, as well as the thermo-mechanical rolling, the expression "controlled rolling" may be found. However, in view of the different applicability of the products a distinction of the terms is necessary.

3.5 As-Rolled — Delivery condition without any special rolling which means conventional hot rolling without any normalized rolling or thermo-mechanical rolling and/or heat treatment like normalizing or quenching

3.6 Normalizing — Heating to a suitable temperature above the transformation range (austenitizing) followed by air cooling.

3.7 Thermo-Mechanical Rolling — A rolling process in which the final deformation is carried out in a certain temperature range leading to a material condition with certain properties which cannot be achieved or repeated by heat treatment alone.

NOTES

1 Subsequent heating above 580 °C may lower the strength values.

2 Thermo-mechanical rolling can include processes with an increasing cooling rate with or without tempering including self-tempering but excluding direct quenching and quenching and tempering.

3 In some publications the word TMCP (Thermo-mechanical control process) is also used.

4 SUPPLY OF MATERIALS

General requirements relating to the supply of material shall conform to IS 8910.

5 DESIGNATION AND GRADES

There shall be eleven grades of steel as given in Table 1 and Table 3. For grades E 235 to E 410, there shall be four sub-qualities (A, BR, B0 and C) and for grades E 450 to E 650, there shall be two sub-qualities (A and BR). Sub-qualities A, BR, B0 and C indicate requirement of impact test and mode of de-oxidation as indicated below:

A — Impact test not required, semi-killed/killed

BR — Impact test optional; if required at room temperature; semi-killed/killed

B0 — Impact test mandatory at 0 °C, semi-killed/killed

C — Impact test mandatory at – 20 °C, killed

While placing the order, the steel should be designated by ‘grade designation’ and ‘quality’ (*see* Table 1 and Table 3).

6 MANUFACTURE

6.1 Steel may be supplied in semi-killed/killed condition, where killed steel shall be supplied by mutual agreement between the purchaser and the manufacturer/supplier. The steel may be ingot cast or continuously cast.

6.2 The processes used in the steel making, casting and further hot rolling into steel plates, sheets, strips, sections, flats, bars, rods, etc, are left to the discretion of the manufacturer/supplier. If required, secondary refining in the form of ladle refining, vacuum degassing may follow steel making. The products may be rolled and supplied in as-rolled/ normalizing/ normalizing rolling/ controlled rolling/ thermo-mechanical rolling and accelerated cooling conditions as per the agreement between the purchaser and the manufacturer/supplier.

6.3 Material produced by re-rolling finished products (virgin or used or scrap), or by rolling material for which the metallurgical history is not fully documented or not known, are not acceptable as per this standard.

7 FREEDOM FROM DEFECTS

7.1 All finished steel shall be well and cleanly rolled to the dimensions, sections and masses specified. The finished material shall be reasonably free from surface flaws; laminations; rough/jagged and imperfect edges and all other harmful defects.

7.2 Minor surface defects may be removed by the manufacturer/supplier by grinding provided the thickness is not reduced locally by more than 4 percent below the minimum specified thickness. Reduction in thickness by grinding greater than 4 percent but not exceeding 7 percent may be made subject to mutual agreement between the purchaser and the manufacturer/supplier.

7.2.1 Subject to agreement with the purchaser, surface defects which cannot be dealt with as in **7.2** may be repaired by chipping or grinding followed by welding and inspection by a mutually agreed procedure such that:

a) after complete removal of the defects and before welding, the thickness of the item is in no place reduced by more than 20 percent;

b) welding is carried out by approved procedure by competent operators with approved electrodes and that the welding is ground smooth to the correct nominal thickness; and

c) subsequent to the finish grinding, the item maybe required to be normalized or otherwise heat-treated at the purchaser’s discretion.

7.3 Welding as mentioned in **7.2.1** is not permissible for grade designations E 235C, E 250C, E 275C, E 300 to E 650 material.

8 CHEMICAL COMPOSITION

8.1 Ladle Analysis

The ladle analysis of the steel, when carried out by the method specified in the relevant parts of IS 228 or IS 8811 any other established instrumental/ chemical method, shall conform to the requirements as given in Table 1. This analysis shall be made from a test sample,

preferably taken during casting/ teeming of the heat. In case of dispute, the procedure given in IS 228 and its relevant parts shall be the referee method and where test methods are not specified shall be as agreed to between the purchaser and the manufacturer/supplier. The ladle analysis shall be reported in the test certificate.

8.2 Product Analysis

The product analysis shall be carried out on the finished product from the standard position. Permissible limits of variation in case of product analysis from the limits specified in Table 1 shall be as given in Table 2.

Table 1 Chemical Composition

(*Foreword*, *Clauses* 5, 8.1 *and* 8.2)

Sl No.	Grade Designation	Quality	Ladle Analysis, Percent, *Max*					Carbon Equivalent (CE), *Max*	Mode of De-oxidation
			C	Mn	S	P	Si		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	E 235	A	0.20	1.40	0.045	0.045	0.40	0.40	Semi-killed/killed
		BR B0	0.20	1.40	0.045	0.045	0.40	0.39	Semi-killed/killed
		C	0.17	1.40	0.040	0.040	0.40	0.38	Killed
ii)	E 250	A	0.23	1.50	0.045	0.045	0.40	0.42	Semi-killed/killed
		BR B0	0.22	1.50	0.045	0.045	0.40	0.41	Semi-killed/killed
		C	0.20	1.50	0.040	0.040	0.40	0.39	Killed
iii)	E 275	A	0.23	1.50	0.045	0.045	0.40	0.43	Semi-killed/killed
		BR B0	0.22	1.50	0.045	0.045	0.40	0.42	Semi-killed/killed
		C	0.20	1.50	0.040	0.040	0.40	0.41	Killed
iv)	E 300	A BR	0.22	1.50	0.045	0.045	0.45	0.44	Semi-killed/killed
		B0	0.20	1.50	0.045	0.045	0.45	0.44	Semi-killed/killed
		C	0.20	1.50	0.040	0.040	0.45	0.44	Killed
v)	E 350	A BR	0.22	1.60	0.045	0.045	0.45	0.47	Semi-killed/killed
		B0	0.20	1.60	0.045	0.045	0.45	0.47	Semi-killed/killed
		C	0.20	1.60	0.040	0.040	0.45	0.45	Killed
vi)	E 410	A BR	0.22	1.65	0.045	0.045	0.45	0.50	Semi-killed/killed
		B0	0.20	1.65	0.045	0.045	0.45	0.50	Semi-killed/killed
		C	0.20	1.65	0.040	0.040	0.45	0.50	Killed
vii)	E 450	A	0.22	1.70	0.045	0.045	0.45	0.52	Semi-killed/killed
		BR							
viii)	E 500	A	0.22	1.70	0.030	0.030	0.50	0.53	Semi-killed/killed
		BR							
ix)	E 550	A	0.22	1.70	0.020	0.025	0.50	0.54	Semi-killed/killed
		BR							
x)	E 600	A	0.22	1.70	0.020	0.025	0.50	0.54	Semi-killed/killed
		BR							
xi)	E 650	A	0.22	1.70	0.015	0.025	0.50	0.55	Semi-killed/killed
		BR							

NOTES

1 For semi-killed steel, silicon shall be less than 0.10 percent. For killed steel, when the steel is killed by aluminium alone, the total aluminium content shall not be less than 0.02 percent. When the steel is killed by silicon alone, the silicon content shall not be less than 0.10 percent. When the steel is silicon-aluminium killed, the silicon content shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent.

Table 1 (*Concluded*)

2 Steels of qualities A, BR, B0 and C are generally suitable for welding processes. The weldability increases from quality A to C for grade designation E 235, E 250 and E 275.

3 Carbon equivalent (CE) would be calculated based on ladle analysis, only. CE = $C + \frac{Mn}{6} + \frac{(Cr+Mo+V)}{5} + \frac{(Ni+Cu)}{15}$

4 For grade E 350, Designation A and BR, Carbon up to 0.24 percent is allowed in case the steel is not Micro-alloyed.

5 Micro-alloying elements like Nb, V, and Ti may be added singly or in combination. Total micro-alloying elements shall not be more than 0.25 percent.

6 Alloying elements such as Cr, Ni, Mo and B may be added under agreement between the purchaser and the manufacturer/supplier. The limit of these elements, either singly or in combination, shall not exceed 0.50 percent for grades from E235 to E600 and 0.60 percent for grade E650.

7 Copper may be present between 0.20 percent to 0.35 percent as mutually agreed to between the purchaser and the manufacturer/supplier. The copper bearing quality shall be designated with a suffix Cu, for example E 250 Cu. In this case, the maximum carbon equivalent value of Table 1 shall be increased by 0.02 percent.

8 *Incidental elements* — Elements not quoted in Table 1 shall not be intentionally added to steel without the agreement of the purchaser, other than for the purpose of finishing the heat. As residual, maximum permissible limit of Cu is 0.20 percent. All reasonable precautions shall be taken to prevent the addition from scrap or other materials used in manufacture of such elements which affect the hardenability, mechanical properties and applicability.

9 Nitrogen content of steel shall not exceed 0.012 percent which shall be ensured by the steel manufacturer by occasional check analysis.

10 The steel, if required, may be treated with calcium based compound or rare earth element for better formability.

11 Lower limits for carbon equivalent and closer limits for other elements may be mutually agreed to between the purchaser and the manufacturer/supplier.

Table 2 Permissible Variation for Product Analysis

(*Foreword*, *Clauses* 5 *and* 8.2)

Sl No.	**Constituent**	**Percentage Limit of Constituent**	**Permissible Variation Over/Under the Specified Limit, Percent**, *Max*
(1)	(2)	(3)	(4)
i)	Carbon	< 0.20	0.02
		≥ 0.20	0.03
ii)	Manganese	-	0.05
iii)	Sulphur	-	0.005
iv)	Phosphorus	-	0.005
v)	Silicon	-	0.05
vi)	Copper	-	0.03
vii)	Vanadium	-	0.01
viii)	Niobium	-	0.01
ix)	Titanium	-	0.01
x)	Nitrogen	-	Nil

NOTE — The deviation of the product analysis in one heat for a given element may occur over the upper value or under the lower value of the specified range of the ladle analysis, but not both at the same time.

9 SELECTION AND PREPARATION OF TEST SAMPLES

9.1 The position from which test samples are taken shall be so located in the product as to yield the clearest possible information regarding properties in the cross-sectional and longitudinal planes. The recommended locations for taking test samples for plates, sheets, strips, sections, flats, bars and rods are indicated in Fig. 1. Selection of location of test pieces may also be mutually agreed to between the purchaser and the manufacturer/supplier.

The sampling position of test piece shall be at a quarter-width from the edge of the sheet, strip and plate. If this is infeasible, the sampling should be made as close to the aforementioned position as possible. Tensile and bend test piece direction shall be as per below table:

Class of Steel Product	*Direction of Test Piece*
Plates, Sheets and Strips	Crosswise (Transverse)
Sections	Lengthwise for each type
Flats, bars (round, hexagonal, etc) and rods	Lengthwise

Alternative test piece direction may also be mutually agreed to between the purchaser and the manufacturer/supplier.

9.2 Wherever practicable, the rolled surface of the steel shall be retained on the two opposite sides of the test samples.

9.3 In case of flat test samples for tensile test, both surfaces are normally to be left on the test samples for sheets, strips, and plates up to 32 mm thick. At least one rolled surface shall be left on rectangular test samples taken from plates exceeding 32 mm in thickness. Round test samples are permitted, but should only be adopted for thickness exceeding 20 mm.

9.4 In case of flats up to 16 mm thick, the test sample shall undergo, if possible, no machining whatever, prior to use as a test piece. If this is not possible, the test sample shall undergo the minimum amount of machining.

9.5 Bars below 28 mm and rods shall be tested without machining. In case of bars having diameters or thicknesses between 28 and 71 mm, the bars may be symmetrically reduced by machining. For bars having diameters or thicknesses exceeding 71 mm, the test sample may be taken from the position shown in Fig. 1.

9.6 In the case of plates, sheets, strips, sections, flats and bars, bend tests shall be carried out on rectangular test samples which as far as possible, should be of the full thickness of the product. In the case of sections, flats and plates exceeding 25 mm in thickness, it is permissible to remove metal from one side of the test sample before using it as a test piece. The rolled surface of the test piece shall be on the outer side of the bend during the test.

9.7 Before test samples are detached, full particulars regarding cast number, size and mass of plates, sheets, strips, sections, flats, rods and bars in each case shall be furnished by the manufacturer/supplier to the purchaser. In case of plates, the number of plates in each cast shall also be given.

9.8 Test samples shall be cut in such a manner that the deformation is avoided as far as possible. If shearing or flame-cutting is employed, an adequate allowance shall be left for removal by machining.

9.9 Test samples shall not be subjected to heat treatment unless the material from which they are cut is similarly and simultaneously treated with the material before testing. Any slight straightening of test samples which may be required shall be done cold.

10 TENSILE TEST

10.1 Number of Tensile Tests

Number of test samples shall be 2 from each cast/heat of same form, grade, quality and delivery condition irrespective of cast/heat size.

NOTE — For supply of only one mother plate from a cast/heat, then the frequency of tensile test shall be 1 sample.

10.2 Tensile Test Pieces

The tensile strength, yield strength and percentage elongation of steel shall be determined from standard test pieces. The test shall be carried out as on the standard test pieces prepared in accordance with IS 1608 (Part 1).

10.2.1 As a rule, test pieces with a proportional gauge length complying with the requirements $L_o = 5.65\sqrt{S_o}$ should be used for the tensile test, where L_o is the gauge length and S_o is the cross-sectional area of the test piece.

10.2.1.1 Test pieces with a non-proportional gauge length, other than $5.65\sqrt{S_o}$ may be used in which case the elongation values shall be converted to $5.65\sqrt{S_o}$ in accordance with IS 3803 (Part 1).

10.3 Tensile Test

Yield strength, tensile strength and percentage elongation, when determined in accordance with IS 1608 (Part 1), shall conform to the requirements as given in Table 3.

10.3.1 In case of sections, the thickness of which is not uniform throughout the profile, the limits of sizes given in Table 3 shall be applied according to the actual maximum thickness of the piece adopted for testing.

10.3.2 Should a tensile test piece break outside the middle half of the gauge length (*see* IS 1608 (Part 1) and the percentage elongation obtained is less than that specified, the test may be discarded at the manufacturer/supplier's option and another test made from the sample sheet, plate, strip, section, flat, bar or rod

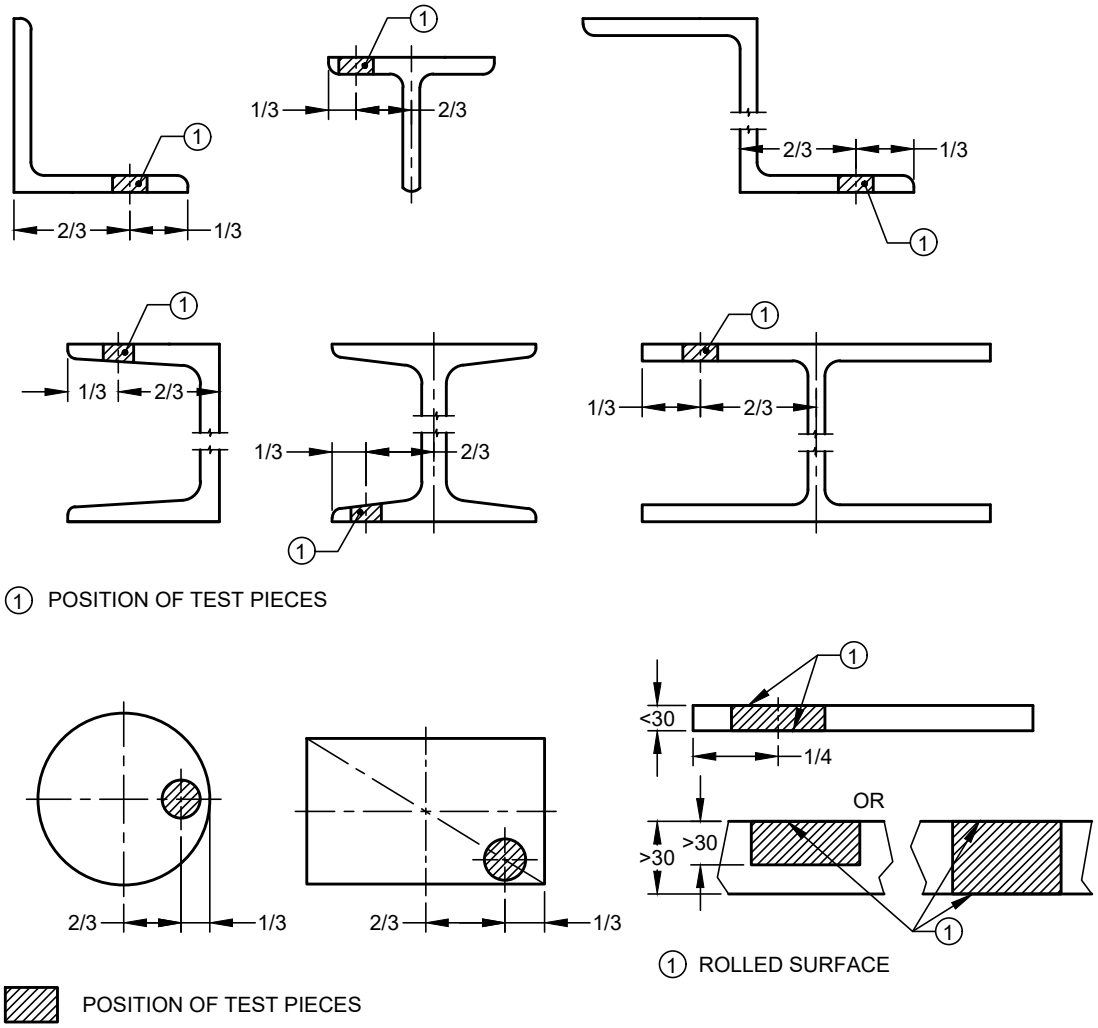

FIG. 1 STRUCTURAL STEEL SECTIONS, POSITION AND ORIENTATION OF SAMPLE

Table 3 Mechanical Properties

(*Foreword*, *Clauses* 5, 10.3, 10.3.1, 11.3.1, 12.2, 12.4 *and* 12.5)

Sl No.	Grade Designation	Quality	Tensile Strength R_m, *Min* MPa[7] (*See* Note 1)	Yield Stress R_{eH}, *Min* MPa[7] (*See* Note 4)				Percentage Elongation **A**, *Min* at Gauge Length, $L_0=5.65\sqrt{So}$ (*See* Note 5 and Note 6)				Internal Bend Diameter *Max* (*See* Note 2)		Charpy Impact Test (*See* Note 3)	
				Thickness/Diameter, mm				Thickness/Diameter, mm				Thickness/ Diameter, mm		Temp°C	*Min* J
				≤ 16	> 16 to 40	> 40 to 100	> 100	≤ 40	> 40 to ≤ 63	> 63 to ≤ 100	> 100	≤ 25	> 25 to ≤ 30		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	16)
i)	E 235	A	360	235	225	215	195	26	25	24	22	2t	3t	—	—
		BR												RT	27
		B0												0	27
		C												(-)20	27
ii)	E 250	A	410	250	240	230	210	23	22	21	21	2t	3t	—	—
		BR												RT	27
		B0												0	27
		C												(-)20	27
iii)	E 275	A	430	275	265	255	225	23	22	21	19	2t	3t	—	—
		BR												RT	27
		B0												0	27
		C												(-)20	27
iv)	E 300	A	440	300	290	280	250	22	20	19	19	2t	—	—	—
		BR												RT	27
		B0												0	27
		C												(-)20	27
v)	E 350	A	490	350	330	320	290	22	21	20	18	2t	—	—	—
		BR												RT	27
		B0												0	27
		C												(-)20	27

Table 3 (*Concluded*)

Sl No.	Grade Designation	Quality	Tensile Strength R_m, *Min* MPa[7] (*See* Note 1)	Yield Stress R_{eH}, *Min* MPa[7] (*See* Note 4)				Percentage Elongation **A**, *Min* at Gauge Length, $L_0=5.65\sqrt{So}$ (*See* Note 5 and Note 6)				Internal Bend Diameter *Max* (*See* Note 2)		Charpy Impact Test (*See* Note 3)	
				Thickness/Diameter, mm				Thickness/Diameter, mm				Thickness/ Diameter, mm		Temp°C	*Min* J
				≤ 16	> 16 to 40	> 40 to 100	> 100	≤ 40	> 40 to ≤ 63	> 63 to ≤ 100	> 100	≤ 25	> 25 to ≤ 30		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	16)
vi)	E 410	A	540	410	390	380	350	20	19	18	18	2t	—	—	—
		BR												RT	25
		B0												0	25
		C												(-)20	25
vii)	E 450	A	570	450	430	420	390	17	17	17	17	2.5t	—	—	—
		BR												RT	20
viii)	E 500	A	580	500	480	470	450	15	15	15	15	3t	—	—	—
		BR												RT	15
ix)	E 550	A	650	550	530	520	—	12	—	—	—	3t	—	—	--
		BR												RT	15
x)	E 600	A	700	600	580	570	—	12	—	—	—	3.5t	—	—	—
		BR												RT	15
xi)	E 650	A	750	650	630	620	—	12	—	—	—	4t	—	—	—
		BR												RT	15

NOTES

1 In case of product thickness/diameter more than 100 mm, lower value than above minimum limit of tensile strength may be mutually agreed to between the purchaser and the manufacturer/supplier.

2 Bend test not required for thickness/diameter > 30 mm for grades E 235 to E 275. Bend test not required for thickness/diameter > 25 mm for grades E 300 to E 650. 't' is the thickness/diameter of the test piece.

3 For sub-quality BR, impact test is optional; if required, at RT - room temperature (23 °C ± 5°C).

4 For thickness/diameter > 100 mm for grades E 550 to E 650, yield stress may be mutually agreed to between the purchaser and the manufacturer/supplier.

5 The elongation values mentioned in this table applies to longitudinal (lengthwise) test piece. For crosswise (transverse) test piece (plates, sheets and strips) the values shall be reduced by 2 percent for grades E235 to E500 for thickness up to 100 mm. Above 100 mm thickness the values for both lengthwise and crosswise shall be as per above table. For E550 to E650 grades, the elongation for transverse test piece shall be mutually agreed. Elongation in other gauge lengths may be mutually agreed to between the purchaser and the manufacturer/supplier.

6 For thickness/diameter >40 mm for grades E 550 to E 650, elongation may be mutually agreed to between the purchaser and the manufacturer/supplier.

7 1 MPa = 1 N/mm^2 = 1 MN/m^2 = 0.102 kgf/mm^2 = 144.4 psi.

11 BEND TEST

11.1 Number of Bend Tests

Number of test samples shall be 2 from each cast/heat of same form, grade, quality and delivery condition irrespective of cast/heat size.

NOTE — For supply of only one mother plate from a cast/heat, then the frequency of bend test shall be 1 sample.

11.2 Bend Test Piece

When sections permit, test pieces shall be not less than 40 mm wide. If the manufacturer/supplier so desires, round, square, hexagonal and flat bars and structural sections shall be bent in the full section as rolled.

11.2.1 In all bend test pieces, the rough edges arising as a result of shearing may be removed by filing or grinding or machining, but the test pieces shall receive no other preparation.

11.3 Bend Test

Bend test shall be conducted in accordance with IS 1599.

11.3.1 For bend test, the test piece at room temperature shall withstand bend through 180° to an internal diameter not greater than that given in Table 3 without cracking.

12 IMPACT TEST

12.1 Impact test shall normally be carried out on products having thickness/diameter greater than or equal to 12 mm. The test specimen is parallel to the direction of rolling and the base closer to the rolled surface is more than 1mm from it. The notch axis shall be perpendicular to the rolled surface.

12.1.1 If stated in the order, impact tests may be carried out on products having a thickness less than 12 mm but minimum thickness applicable is 6mm, the dimensions of the test pieces shall be inconformity with IS 1757 (Part 1). The minimum impact energy values of reduced sizes shall be as shown in Fig. 2 for grades E 235, E 250, E 275, E 300, E 350. For other grades, the values shall be reduced in direct proportion to the cross-sectional area of the test piece.

12.2 This test is carried out using a V-notch test piece (*see* IS 1757 (Part 1)) the value for consideration being the arithmetic mean of the results obtained on three test pieces taken side by side from the same product (*see* Table 3).

12.3 The test sample shall be taken from the thickest product. If the test sample taken from the thickest product rolled from a cast meets the requirements, the whole cast shall be deemed to meet the requirements of the test, if not, the test shall be performed on a section of next lower thickness rolled from same cast, if it meets the requirements specified, this particular thickness as also other sections of lower thickness shall be deemed to satisfy this specification. If this thickness also does not meet the requirements, the test shall be carried out on the next lower thickness and so on, because the toughness of the product will be dependent on the rolling direction as well as on the section size.

12.3.1 One test sample shall be taken from thickest product per cast/heat.

12.4 The material represented shall be deemed to comply with this standard, if the average value of 3 test specimens, meets the requirements given in Table 3 provided no individual value shall be less than 70 percent of the specified value. If the average value of the three Charpy impact tests fails to comply by an amount not exceeding 15 percent of the specified minimum average value, three additional test pieces from the same sample shall be tested and the results added to those previously obtained and a new average calculated. Provided this new average complies with the specified requirement, the material represented shall be deemed to comply with this standard.

12.5 Impact test at different temperatures other than specified in Table 3 may be mutually agreed between the purchaser and the manufacturer/ supplier accordingly the impact test values may be mutually agreed between the purchaser and the manufacturer/supplier.

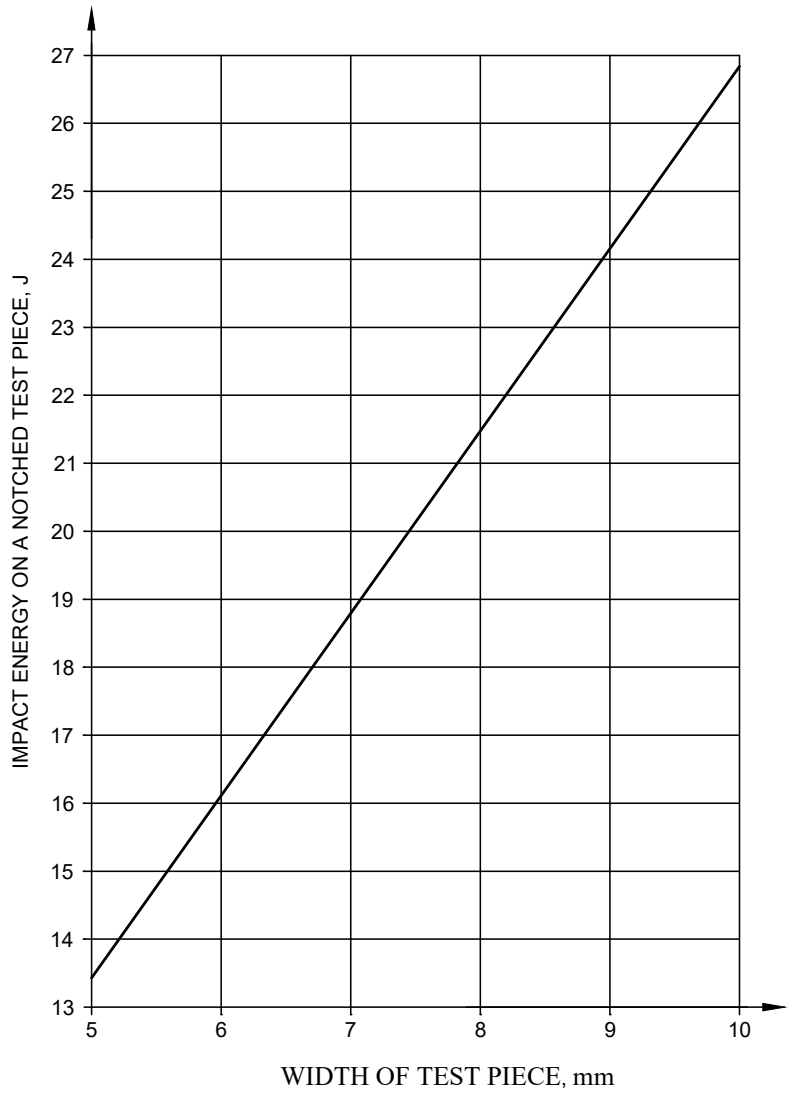

FIG. 2 MINIMUM IMPACT ENERGY VALUES FOR TEST PIECES WITH A WIDTH BETWEEN 5 mm AND 10 mm

Table 4 Indian Standards which give Nominal Dimensions of Rolled Steel Products

(*Clause* 14)

Sl No.	Product	Relevant Indian Standard
(1)	(2)	(3)
i)	Beam, column, channel and angle sections including parallel beam and column sections	IS 808
ii)	Tee bars	IS 1173
iii)	Bulb angles	IS 1252
iv)	Plates, sheets, strips and flats	IS 1730
vi)	Round and square bars	IS 1732
vii)	Bulb flats	IS 1863
viii)	Sheet piling sections	IS 2314 (Part 1)
ix)	Channel sections	IS 3954

13 OTHER TESTS

13.1 The material may be subjected to non-destructive testing to determine the soundness of material subject to mutual agreement between the purchaser and the manufacturer/supplier.

13.2 Metallurgical tests for grain size, directionality, inclusion content may be carried out subject to mutual agreement between the purchaser and the manufacturer/supplier.

13.3 Strength of joint in case of steel sheet piling section shall be tested as per IS 2314 (Part 1).

14 DIMENSIONS

Unless otherwise agreed to between the purchaser and the manufacturer/supplier, the nominal dimensions of rolled products conforming to this standard shall be in accordance with the relevant Indian Standard. Currently available Indian Standards are listed in Table 4.

15 TOLERANCES

Unless otherwise agreed to between the purchaser and the manufacturer/supplier, the rolling and cutting tolerances for steel products conforming to this standard shall be those specified in IS 1852 except for parallel flange beams and columns for which the tolerances shall be as per IS 12779. Other tolerances may be followed within the total tolerance range as specified in IS 1852 and IS 12779 as applicable.

16 RE-TESTS

16.1 If a test does not give the specified results, two additional tests shall be carried out at random on the same lot. Both retests shall conform to the requirements of this standard; otherwise, the lot shall be rejected.

16.2 Re-heat Treatment

If any heat treated material fails to meet the mechanical requirements specified, the supplier may re-heat treat the material and in that case, all mechanical properties shall be re-evaluated.

17 CALCULATION OF MASS

The mass of the steel shall be calculated on the basis that steel weighs 7.85 g/cm^3.

18 DELIVERY

Subject to prior agreement between the manufacturer/supplier and the purchaser, a suitable protective treatment may be given to the material after rolling.

19 MARKINGAND PACKING

19.1 Plates, sheets, sections, bars and flats may be supplied in bundles, and strips and rods either in bundles or coils. Each bundle/coil/product shall carry a tag or label/sticker bearing the cast number or identification mark or lot number traceable to the cast number and the manufacturer's name or trade mark. Alternatively, top sheet/plate or strips in each bundle shall be legibly marked with the cast number or identification mark or lot number traceable to the cast number, name of the manufacturer or trade mark.

19.2 The ends of the rolled products may be painted with a color code, as agreed to between the purchaser and the manufacturer/supplier.

19.3 Unless otherwise agreed, the packing shall be adequate to ship the material safely and in good condition.

19.4 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 228 (in various parts)	Methods of chemical analysis of steels
IS 808 : 2021	Hot rolled steel beam, column, channel and angle sections — Dimensions and properties (*fourth revision*)
IS 1173 : 1978	Specification for hot rolled and slit steel tee bars (*second revision*)
IS 1252 :1991	Hot rolled steel bulb angles — Dimensions (*first revision*)
IS 1599 : 2023/ ISO 7438: 2020	Metallic materials — Bend test (*fifth revision*)
IS 1608 (Part 1) : 2022/ISO 6892-1 : 2019	Metallic materials — Tensile testing — Part 1 Method of test at room temperature (*fifth revision*)
IS 1730 : 1989	Steel plates, sheets, strips and flats for structural and general engineering purposes — Dimensions (*second revision*)
IS 1732 : 1989	Steel bars, round and square for structural and general engineering purposes — Dimensions (*second revision*)
IS 1757(Part 1) : 2020/ISO 148-1 : 2016	Metallic materials — Charpy pendulum impact test: Part 1 Test method (*fourth revision*)
IS 1852 : 1985	Specification for rolling and cutting tolerances for hot rolled steel products (*fourth revision*)
IS 1863 : 1979/ISO 657-19 : 1980	Specification for rolled steel bulb flats (*first revision*)
IS 1956 (various parts)	Glossary of terms relating to iron and steel (*second revision*)
IS 2314 (Part 1) : 2023	Steel sheet piling section — Specification: Part 1 Hot rolled sheet pile (*second revision*)
IS 3803 (Part 1): 2023/ISO 2566-1 : 2021	Steel — Conversion of elongation values: Part 1 Carbon and low alloy steels (*third revision*)
IS 3954 : 1991	Hot rolled steel channel sections for general engineering purposes — Dimensions (*first revision*)
IS 8811 : 1998	Method for emission spectrometric analysis of plain carbon and low alloy steels point to plane technique (*first revision*)
IS 8910 : 2022/ISO 404 : 2013	General technical delivery requirements for steel and steel products (*second revision*)
IS 12779 : 1989	Rolling and cutting tolerances for hot rolled parallel flange beam and column sections — Specification

To access Indian Standards click on the link below:

https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/knowyourstandards/Indian_standards/isdetails/

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Wrought Steel Products Sectional Committee, MTD 04

Organization	*Representative*(*s*)
SAIL, Research & Development Center for Iron & Steel, Ranchi	SHRI SANDIP KUMAR KAR **(*Chairperson*)**
All India Induction Furnaces Association, New Delhi	SHRI PRABHAKAR MISHRA SHRI KAMAL AGGARWAL (*Alternate*)
AM/NS Steel Hazira, Surat	SHRI DEEPAK GUPTA SHRI KALPESH DAVE (*Alternate*)
Bharat Heavy Electrical Ltd, Bhopal	SHRI ANTONY HARISON MC SHRI A. SUDHEER (*Alternate*)
Cold Rolled Steel Manufacturers Association of India, New Delhi	SHRI SHIVAJEE PATHAK SHRI N. K. SOOD (*Alternate*)
Directorate General of Quality Assurance, Ministry of Defence, Ichapur	SHRI K. YADAV DR JANA BHATTACHARAYA ROY (*Alternate*)
Indian Steel Association, Delhi	SHRI RAVINDER KUMAR BHAN SHRI ANUP KASHAYAP (*Alternate*)
Jindal Steel and Power, New Delhi	SHRI MORESHWAR BORKAR SHRI JOY DUTTA (*Alternate*)
Jindal (India) Limited, Howrah	SHRI CHANCHAL KUMAR KARMAKAR
JSW JFE Electrical Steel Nashik Private Ltd, Nashik	SHRI KAPIL KAPOOR
JSW Ltd, Bellary	SHRI DEVASISH MISHRA SHRI G. V. RAMANA (*Alternate*)
JSW Steel Coated Products Ltd, Mumbai	SHRI ABHIJIT CHIVANE SHRI AWADHESH MISHRA (*Alternate*)
JSW Steel Ltd, Raigad	SHRI AMIT KUNDU
JSW Steel Ltd, Salem	SHRI S. SIVAKUMAR
Ministry of Steel (Government of India), New Delhi	SHRI G. SARATHY RAJA SHRI BHAGIRATHI PRADHAN (*Alternate*)
Rashtriya Ispat Nigam Limited, Vishakapatnam	SHRIMATI RUCHIRA GUPTA SHRI S. K. SEET (*Alternate*)
Research Designs and Standards Organization (RDSO), Lucknow	SHRI SHAILESH ORAON SHRI UDAY PRASAD (*Alternate*)
SAIL, Bhilai Steel Plant, Bhilai	SHRI SHRIRANG KHANKHOJE SHRI K. V. SHANKAR (*Alternate*)
SAIL, Bokaro Steel Plant, Bokaro	SHRIMATI BISWASI SUNITA MINZ SHRI MUKESH ROSHAN (*Alternate*)

Organization	*Representative*(s)
SAIL, Research & Development Center for Iron & Steel, Ranchi	SHRI S. SRIKANTH DR ANJANA DEVA (*Alternate*)
SAIL, Rourkela Steel Plant, Rourkela	SHRI KUNTAL PATWARI SHRI RAMAKRISHNAN P. (*Alternate*)
Society of Indian Automobile Manufacturers (SIAM), New Delhi	SHRI AMIT KUMAR MS KANISHKA CHANA (*Alternate*)
Steel Authority of India Limited, IISCO Steel Plant, Barddhaman	SHRI SAIKAT DE SHRI BISWAJIT PANJA (*Alternate*)
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Tata Steel Ltd (Tinplate Division), Jamshedpur	SHRI S. J. DEY SHRI SUBRATA SADHU (*Alternate*)
BIS Directorate General	SHRI SANJIV MAINI, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (METALLURGICAL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRIMATI CHALLAKONDA VIDISHA
SCIENTIST 'C'/DEPUTY DIRECTOR
(METALLURGICAL ENGINEERING), BIS

Bureau of Indian Standards

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Amendments Issued Since Publication

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	265 9930
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