IS 2062 : 2006
(Superseding IS 1977 : 1996
and IS 8500 : 1991)

भारतीय मानक

तप्त बेल्लित अल्प, मध्यम एवं उच्च तन्यता के संरचना इस्पात

(छठा पुनरीक्षण)

Indian Standard

HOT ROLLED LOW, MEDIUM AND HIGH TENSILE STRUCTURAL STEEL

(Sixth Revision)

ICS 77.140.01

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

October 2006

Price Group 5

FOREWORD

This Indian Standard (Sixth 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 revised in 1969, 1975, 1984, 1992 and 1999. While reviewing this 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 industry and overseas standards of structural steels.

In this revision the following changes have been made:

a) Title of this standard has been modified.

b) Amendments No. 1, 2, 3 and 4 have been incorporated.

c) A new clause on references has been incorporated.

d) Number of grades have been increased to nine.

e) International grades designation system based on yield stress has been adopted, simultaneously old designations have also been given in parentheses.

f) Provision of normalizing rolling/controlled cooling have been incorporated.

g) Requirements of IS 1977 and IS 8500 have been incorporated.

The revised standard shall supersede the following standards:

a) IS 1977 : 1996 Low tensile structural steels

b) IS 8500 : 1991 Structural steel — Microalloyed (medium and high strength qualities)

To keep the pace of technical upgradation in the steel industry, the Committee agreed to reduce the sulphur and phosphorus content, during the next revision.

For all the tests specified in this standard (chemical/physical/others), the method as specified in relevant ISO Standard may also be followed as an alternate method.

While revising the standard assistance has been derived from ISO 630 : 1995 'Structural steels — Plates, wide flats, bars, sections and profiles'.

The composition of the Committee responsible for formulation of this standard is given in Annex A.

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 : 1960 'Rules for rounding off numerical values (*revised*)'. 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

HOT ROLLED LOW, MEDIUM AND HIGH TENSILE STRUCTURAL STEEL

(Sixth Revision)

1 SCOPE

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

2 REFERENCES

The standards listed below 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 the standards indicated below:

IS No.	*Title*
228 (in various parts)	Method for chemical analysis of steel
808 : 1989	Dimensions for hot rolled steel beam, column, channel and angle sections (*third revision*)
1173 : 1978	Hot rolled slit steel tee bars (*second revision*)
1252 : 1991	Hot rolled steel bulb angles — Dimensions (*first revision*)
1599 : 1985	Method for bend test (*second revision*)
1608 : 2005	Metallic materials — Tensile testing at ambient temperature (*third revision*)
1730 : 1989	Steel plates sheets, strips and flats for structural and general engineering purposes (*second revision*)
1731 : 1971	Dimensions for steel flats for structural and general engineering purposes (*first revision*)
1732 : 1989	Dimensions for round and square steel bars for structural and general engineering purposes (*first revision*)
1757 : 1988	Method for Charpy impact test (V-notch) for metallic material (*second revision*)
1852 : 1985	Rolling and cutting tolerances for hot rolled steel products (*fourth revision*)
1863 : 1979	Hot rolled steel bulb flats (*first revision*)
1956 (in various parts)	Glossary of terms relating to iron and steel (in various parts)
2314 : 1986	Steel sheet piling sections (*first revision*)
3803 (Part 1) : 1989	Steel — Conversion of elongation values : Part 1 Carbon and low alloy steels (*second revision*)
3954 : 1991	Hot rolled steel channel sections for general engineering purposes (*first revision*)
8910 : 1978	General technical delivery requirements for steel and steel products
9595 : 1996	Metal arc welding of carbon and carbon manganese steels — Recommendations (*first revision*)
10182	Dimensions and tolerances for hot rolled track shoe sections:
(Part 1) : 1982	Sections TS 1.1
(Part 2) : 1985	Sections TS H.1
10842 : 1984	Testing and evaluation procedure for Y groove crackability test
12778 : 1989	Dimensions for hot rolled steel parallel flange beam and column sections

3 TERMINOLOGY

For the purpose of this standard, the following definitions in addition to those given in the relevant parts of IS 1956 shall apply.

3.1 Micro-Alloying Elements — Elements, such as niobium, boron, vanadium and titanium added singly or in combination to obtain higher 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 micro structure and optimum mechanical properties.

3.4 Normalizing Rolling — A hot rolling process in which the final rolling passes are carried out at a suitable higher temperature, followed by cooling in natural air to a temperature below the transformation temperature, in order to produce a structure, analogous to that obtained by a separate normalizing treatment of hot rolled product.

4 SUPPLY OF MATERIAL

General requirements relating a supply of structural steel shall conform to IS 8910.

5 GRADES

There shall be nine grades of steel as given in Tables 1 and 2. While placing the order the steel should be designated by 'Designation' (*see* Tables 1 and 2).

6 MANUFACTURE

The processes used in the steel making and further hot rolling into steel plates, strips, sections, flats, bars, etc, are left to the discretion of the manufacturer/ supplier. If required, secondary refining may follow steel making, as also normalizing rolling/controlled rolling during manufacturing of sections or as the agreement between the purchaser and the manufacturer/supplier.

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 may be 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 designation E 250 C 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 any other established instrumental/chemical method, shall be as given in Table 1. 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.

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 3.

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, sections and bars are indicated in Fig. 1. Alternatively, in case of sections, the samples may be taken from the web. For testing of flat products like plates tensile and bend test pieces may be cut in the transverse direction. Selection of location of test pieces may also be mutually agreed between the purchaser and the manufacturer/supplier.

Table 1 Chemical Composition

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

Grade Designation	Quality	Ladle Analysis, Percent, *Max*					Carbon Equivalent[1] (CE), *Max*	Method of Deoxidation[1]
		C	Mn	S	P	Si		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
E 165 (Fe 290)	–	0.25	1.25	0.045	0.045	–	–	Semi-killed or killed
E 250 (Fe 410 W)	A	0.23	1.50	0.045	0.045	0.40	0.42	Semi-killed or killed
E 250 (Fe 410 W)	B	0.22	1.50	0.045	0.045	0.40	0.41	Killed
E 250 (Fe 410 W)	C	0.20	1.50	0.040	0.040	0.40	0.39	Killed
E 300 (Fe 440)	–	0.20	1.30	0.045	0.045	0.45	0.40	Semi-killed or killed
E 350 (Fe 490)	–	0.20	1.50	0.045	0.045	0.45	0.42	Semi-killed or killed
E 410 (Fe 540)	–	0.20	1.60	0.045	0.045	0.45	0.44	Semi-killed or killed
E 450 (Fe 570)	D	0.22	1.60	0.045	0.045	0.45	0.46	Semi-killed or killed
E 450 (Fe 590)	E	0.22	1.80	0.045	0.045	0.45	0.48	Semi-killed or killed

NOTES

1 Carbon equivalent (CE) based on ladle analysis $= C + \frac{Mn}{6} + \frac{(Cr + Mo + V)}{5} + \frac{(Ni + Cu)}{15}$

2 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.

3 Microalloying elements like Nb, V, Ti and B shall be added singly or in combination. Total microalloying elements shall not be more than 0.25.

4 New grades designation system based on yield stress has been adopted, simultaneously old designations have also been given in parentheses.

5 Steels of qualities A, B and C are generally suitable for welding processes. The weldablity increases from quality A to C.

6 Copper may be present between 0.20 to 0.35 percent as mutually agreed to between the purchaser and the manufacturer. The copper bearing quality shall be designated with a suffix Cu, for example, E 250 Cu. In case of product analysis the copper content shall be between 0.17 and 0.38 percent.

7 Nitrogen content of steel shall not exceed 0.012 percent which shall be ensured by the manufacturer by occasional check analysis. For micro alloyed steel this is to be reduced to 0.009 percent.

8 The steel if required may be treated with rare earth element for better formability.

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

10 *Incidental element* — 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. 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.

[1] To be supplied subject to the agreement between the purchaser and the manufacturer.

Table 2 Mechanical Properties

(*Clauses* 5, 10.3 *and* 10.3.1)

Grade Designation	Quality	Tensile Strength R_m *Min* MPa	Yield Stress, R_{eH} *Min* MPa			Percentage Elongation, A at Gauge Length, L_o $5.65\sqrt{S_o}$ *Min*	Internal Bend Diameter *Min*[1]		Charpy V-Notch Impact Energy *Min* *J*	
			< 20	20-40	> 40		≤ 25	> 25	Room Temp[2]	–20°C
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
E 165 (Fe 290)	–	290	165			23	2t	–	–	–
E 250 (Fe 410 W)	A	410	250	240	230	23	3t	2t	–	–
E 250 (Fe 410 W)	B	410	250	240	230	23	2t	3t	27[2] (*see* Note 3)	
E 250 (Fe 410 W)	C	410	250	240	230	23	2t	3t	27[2] (*see* Note 3)	
E 300 (Fe 440)	–	440	300	290	280	22	2t	3t	50	30
E 350 (Fe 490)	–	490	350	330	320	22	2t	3t	50	25
E 410 (Fe 540)	–	540	410	390	380	20	2t	3t	50	25
E 450 (Fe 570)	D	570	450	430	420	20	2t	3t	45	20
E 450 (Fe 590)	E	590	450	430	420	20	2t	3t	45	20

NOTES

1 1 MPa = 1N/mm² = 1MN/m² = 0.102 kgf/mm² = 144.4 psi

2 Temperature of Charpy impact values will be subject to mutual agreement.

3 The more stringent requirements than those given above may be as agreed to between the purchaser and the manufacturer.

[1] t is the thickness of the test piece.

[2] Room temperature = 25 ±2°C for Impact test.

Table 3 Permissible Variation for Product Analysis

(*Clause* 8.2)

Constituent	Permissible Variation Over the Specified Limit, Percent, *Max*
Carbon	0.02
Manganese	0.05
Silicon	0.03
Copper	0.03
Sulphur	0.005
Phosphorus	0.005

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 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

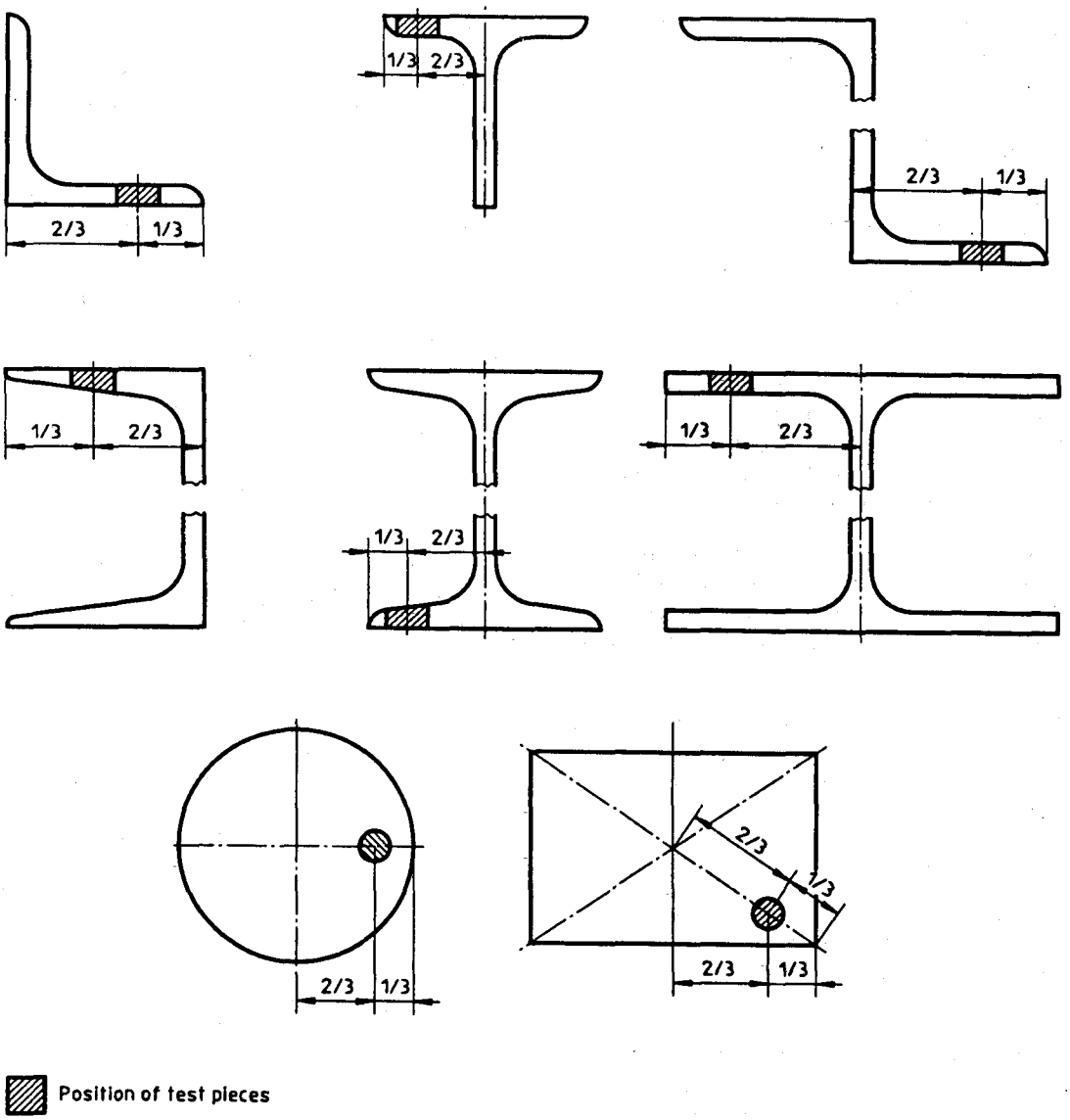

FIG. 1 STRUCTURAL STEEL SECTIONS, POSITION AND ORIENTATION OF SAMPLE

test sample shall undergo the minimum amount of machining.

9.5 Bars below 28 mm shall be tested without machining. In case of bars having diameters or thickness between 28 mm 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 case of plates, strips, sections and flats, 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 case of plates, sections and flats exceeding 28 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, strips, sections, flats and bars in each cast shall be furnished by the manufacturer 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 of 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 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 per cast/heat and a class of steel product irrespective of cast/heat size.

10.2 Tensile Test Pieces

The tensile strength, yield strength and percentage elongation of steel shall be determined from standard test pieces cut crosswise from plates and strips and lengthwise from sections, flats and bars. The test shall be carried out as on the standard test pieces prepared in accordance with IS 1608.

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

Tensile strength, yield strength and percentage elongation when determined in accordance with IS 1608 shall be as given in Table 2.

10.3.1 In case of sections the thickness of which is not uniform throughout the profile, the limits of sizes given in Table 2 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) 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 plate, strip, section, flat or bar.

11 BEND TEST

11.1 Number of Bend Test

Number of bend test shall be 2 per cast/heat

Class of Steel Product	*Direction of Bend Tests*
Plates strips, Sections	Crosswise
Flats and bars (round hexagonal, etc)	Lengthwise for each type Lengthwise

11.2 Bend Test Piece

The test pieces shall be cut crosswise from plates and strips and lengthwise from sections, flats and bars. When section permits, these 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 edge arises resulting from 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 bending through 180° to an internal diameter not greater than that given in Table 2 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 or subject to mutual agreement between the purchaser and the manufacturer/supplier. The test specimen is parallel to the direction of rolling and the base closer to the rolled surface is more than 1 mm 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, the dimensions of the test pieces shall be in conformity with IS 1757. The minimum impact energy values of reduced sizes shall be as shown in Fig. 2.

12.2 This test is carried out using a V-notch test piece (*see* IS 1757) 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 2). Temperature of Charpy impact test will be subject to mutual agreement.

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 the 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.

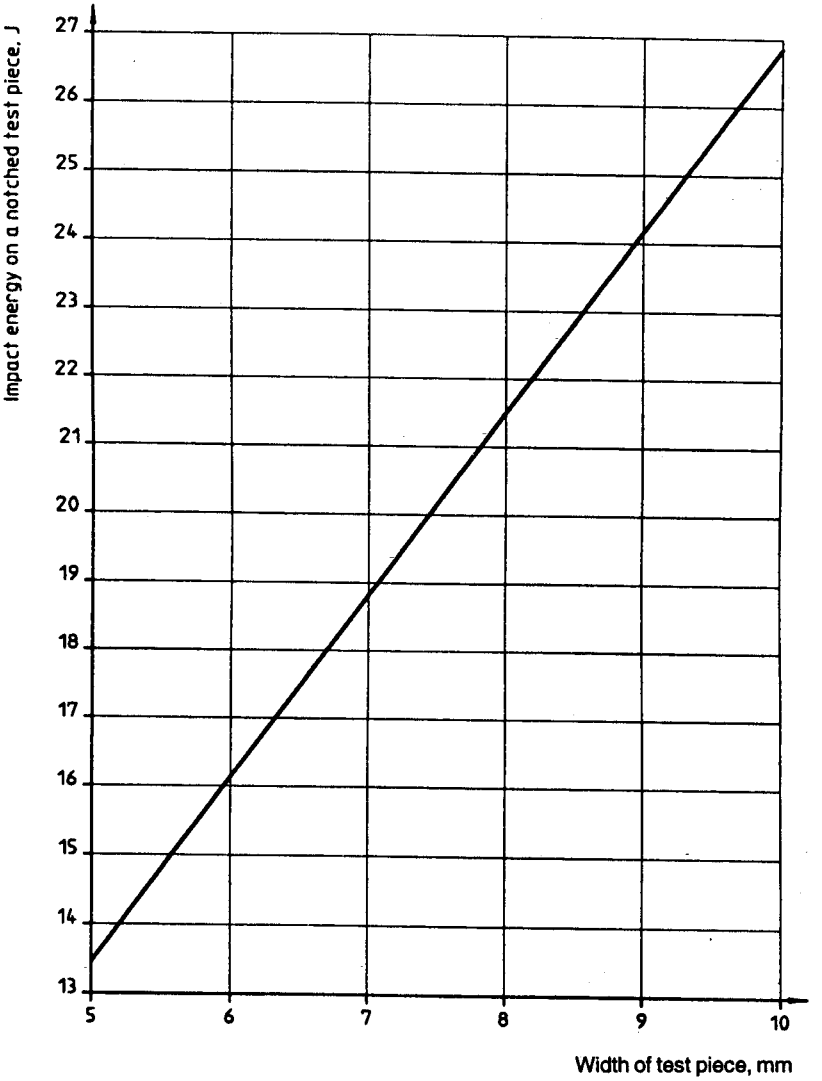

FIG. 2 MINIMUM IMPACT ENERGY VALUES FOR TEST PIECES WITH A WIDTH BETWEEN 5 mm AND 10 mm

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 the standard, if the average value of 3 test specimens, meets the requirements given in Table 2 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.

13 Y GROOVE CRACKABILITY TEST

Y groove crackability tests may be carried out in accordance with IS 10842 for products of only Grade E 250 C material having thickness 12 mm and above, if specifically agreed to between the purchaser and the manufacturer/supplier.

NOTE — The Y groove crackability test will not be applicable for rounds and it is mainly for plates and sections.

14 OTHER TESTS

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

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

15 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 Standard are listed in Table 4.

Table 4 Indian Standards Which Give Nominal Dimensions of Rolled Steel Products

Products	Relevant Indian Standard
Beam, column, channel and angle section	IS 808
Tee bars	IS 1173
Bulb angles	IS 1252
Plates, strips and flats	IS 1730
Flats	IS 1731
Round and square bars	IS 1732
Bulb flats	IS 1863
Sheet piling sections	IS 2314
Channel sections	IS 3954
Track shoe sections	IS 10182 (Part 1) IS 10182 (Part 2)
Parallel beam and column sections	IS 12778

16 TOLERANCES

Unless otherwise agreed to between the purchaser and the manufacturer, the rolling and cutting tolerances for steel products conforming to this standard shall be those specified in IS 1852. Stricter tolerances may be followed, if agreed to between the purchaser and the manufacturer/supplier.

17 RETESTS

Should any one of test pieces first selected fail to pass any of the tests specified in this standard, two further samples shall be selected for testing in respect of each failure. Should the test pieces from both these additional samples pass, the material represented by the test samples shall be deemed to comply with the requirements of that particular test. Should the test pieces from either of these additional samples fail, the material represented by the test samples shall be considered as not having complied with this standard.

18 CALCULATION OF MASS

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

19 DELIVERY

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

20 MARKING

20.1 Each product, with the exception of round, square and hexagonal bars and flats, shall carry a tag or be marked with the manufacturer's name or trade-mark. Bars and flats shall carry a tag bearing the manufacturer's name or trade-mark. Designation of steel should also be similarly marked on the product or tag.

20.2 Every heavy, medium structural mill and plate mill product shall be marked with the cast number. Plates produced from strip in coil form shall be marked with cast/heat number on top plate of each pile/ packet.

20.3 The ends of the rolled products shall be painted with a colour code, as agreed to between the purchaser and the manufacturer/supplier.

20.4 BIS Certification Marking

The material may also be marked with the Standard Mark.

20.4.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Wrought Steel Products Sectional Committee, MTD 4

Organization	*Representative(s)*
SAIL, Rourkela Steel Plant, Rourkela	DR SANAK MISHRA (***Chairman***) SHRI N. K. SOOD (*Alternate*)
All India Induction Furnace Association, New Delhi	SHRI R. P. VARSHNEY SHRI C. M. KOHLI (*Alternate*)
Atomic Minerals Division, Hyderabad/New Delhi	DR H. C. ARORA DR ADARSH KUMAR (*Alternate*)
Bharat Heavy Electricals Ltd, Bhopal	SHRI R. K. SETH SHRI K. K. GUPTA (*Alternate*)
Central Boilers Board, New Delhi	SHRI V. K. GOEL SHRI M. L. AHUJA (*Alternate*)
Consumer Protection Council, Rourkela	SHRI B. VAIDYANATHAN
Defence Metallurgical Research Lab (DMRL), Hyderabad	SHRI A. V. ATHAVALE SHRI V. LALITHA KUMARI (*Alternate*)
DGS & D, Bhilai Nagar	SHRI S. K. GANGULY SHRI B. S. RANA (*Alternate*)
Escorts R &D Centre, Faridabad	SHRI ALOK NAYAR
Institute of Steel Development and Growth, Kolkata	DR R. K. P. SINGH SHRI JAYANTA KUMAR SAHA (*Alternate*)
Jindal South West Steel Ltd, Vasind/Vijaynagar	SHRI M. K. MAHESHWARI SHRI S. K. HEGDE (*Alternate*)
M. N. Dastur & Co Ltd, Kolkata/New Delhi	SHRI SUBHABRATA SENGUPTA SHRI R. K. TYAGI (*Alternate*)
Ministry of Defence (DGOFB), Kolkata	SHRI S. K. GHOSH SHRI S. BHATTACHARYA (*Alternate*)
Ministry of Defence (DGQA), Ichapur	JOINT CONTROLLER QUALITY ASSURANCE OFFICER (*Alternate*)
Ministry of Railways (RDSO), Lucknow	JOINT DIRECTOR (CHEMICAL) JOINT DIRECTOR (I & L) (*Alternate*)
Ministry of Steel (Govt of India), New Delhi	SHRI S. S. SAHA SHRI A. C. R. DAS (*Alternate*)
Mukand Ltd, Thane	SHRI C. H. SHARMA SHRI K. R. SRINIVASAN (*Alternate*)
National Metallurgical Laboratory, Jamshedpur	DR S. TARAFDAR DR R. GOPAL KRISHNAN (*Alternate*)
National Physical Laboratory, New Delhi	DR ANIL KUMAR GUPTA SHRI R. C. ANANDANI (*Alternate*)
Nuclear Fuel Complex, Hyderabad	SHRI B. GOPALAN
Power Grid Corporation, Gurgaon	SHRI K. K. AGRAWAL SHRI ANIL AGRAWAL (*Alternate*)
Rashtriya Ispat Nigam Ltd (VSP), Vishakhapatnam	SHRI R. RANJAN SHRI S. MONDAL (*Alternate*)
SAIL, Bhilai Steel Plant, Bhilai	SHRI D. B. SHRIVASTAVA SHRI K. K. KUMAR (*Alternate* I) SHRI P. K. DATTA (*Alternate* II)
SAIL, Bokaro Steel Plant, Bokaro	SHRI G. B. PRADHAN DR M. M. S. SODHI (*Alternate*)
SAIL, Central Marketing Organization, Kolkata	SHRI B. V. S. PANDIT
SAIL, Durgapur Steel Plant, Durgapur	REPRESENTATIVE
SAIL, Research & Development Center for Iron & Steel, Ranchi	DR S. K. CHAUDHURI DR D. MUKHERJEE (*Alternate* I) SHRI B. K. PANIGRAHI (*Alternate* II)
SAIL, Salem Steel Plant, Salem	SHRI S. SISODIA SHRI H. K. ARORA (*Alternate*)
Steel Furnace Association of India, New Delhi	SHRI M. S. UNINAYAR
Steel Re-rolling Mills Association of India, Mandi Gobindgarh	SHRI R. P. BHATIA SHRI H. D. KHERA (*Alternate*)
Sunflag Iron & Steel Co Ltd, Faridabad, Bhandara	SHRI R. K. MALHOTRA SHRI R. K. VERMA (*Alternate*)
Tata Motors Limited, Pune	SHRI J. D. HARIDAS SHRI B. R. GALGALI (*Alternate*)

Organization	*Representative(s)*
Tata Steel Ltd, Jamshedpur	DR DEBASHISH BHATTACHARGEE DR M. D. MAHESHWARI (*Alternate* I) SHRI M. C. SADHU (*Alternate* II)
Thyssenkrupp Electrical Steel India Pvt Ltd, Distt Nasik	SHRI R. PRABHAKAR SHRI J. SREENIVAS (*Alternate*)
Usha Beltron Ltd, Kolkata	REPRESENTATIVE
Visvasvaraya Iron & Steel Ltd, Bhadrawati	DR S. S. ANAND
In personal capacity [*403, Udaigiri, Kaushambi, Distt Ghaziabad, (U.P.)*]	SHRI N. MITRA
BIS Directorate General	SHRI S. K.GUPTA, Scientist 'F' & Head (MTD) [Representing Director General (*Ex-officio*)]

Member Secretary
SHRI DEEPAK JAIN
Scientist 'E' (MTD), BIS

Flat Products Subcommittee, MTD 4 : 3

Tata Steel Ltd, Jamshedpur	DR M. D. MAHESHWARI (***Convener***) SHRI M. C. SADHU (*Alternate*)
Apex Chambers of Commerce, Ludhiana	SHRI P. D. SHARMA
Essar Steels Ltd, Distt Surat	SHRI R. K. BALASUBRAMANIAM SHRI S. R. BHATT (*Alternate*)
Federation of Engineering Industries of India, New Delhi	SHRI H. L. BHARDWAJ SHRI H. L. BANSAL (*Alternate*)
GKW Limited, Mumbai	SHRI B. R. BAPAT SHRI BHASKAR MAZUMDAR (*Alternate*)
Indian Gas Cylinders, Faridabad	SHRI E. M. PATEL
Indian Oil Corporation Limited, Noida	SHRI M. K. JHA SHRI T. BANDHOPADHYAY (*Alternate*)
Ispat Industries Limited, Dolvi	SHRI RAMBRIKSH SINGH SHRI RAJENDERA K. VERMA (*Alternate*)
Maruti Udyog Ltd, Gurgaon	SHRI SRIKANTH SUDHIR SHRI SUNIL MALHOTRA (*Alternate*)
The Tin Plate Company of India Ltd, Jamshedpur	SHRI T. K. GHOSH SHRI A. K. GHOSH (*Alternate*)
Verny Containers Ltd, Hyderabad	SHRI P. K. MATHUR
In personal capacity (*248, Akash Darhan Society, Mayur Vihar-I, Delhi-110091*)	SHRI AVTAR SINGH

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.

Copyright

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 from Doc: No. MTD 4 (4590).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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.org.in

Regional Offices: Telephones

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002 — 2323 7617, 2323 3841

Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi, KOLKATA 700054 — 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022 — 260 3843, 260 9285

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 — 2254 1216, 2254 1442, 2254 2519, 2254 2315

Western : Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400093 — 2832 9295, 2832 7858, 2832 7891, 2832 7892

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

Printed at Simco Printing Press, Delhi