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(तीसरा पुनरीक्षण)

Indian Standard
LOW TENSILE STRUCTURAL STEELS —
SPECIFICATION
(*Third Revision*)

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard (Third 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 and 1975. While reviewing the standard, the Committee observed that at present there is no Indian Standard for steel structural products with tensile strength less than 410 MPa whereas various other overseas specifications have provisions for tensile strength even below 300 MPa. The Committee, therefore, decided to revise the standard in order to cover the existing gap.

In this revision, the following changes have been made:

- a) The title of the standard has been changed to 'Low tensile structural steel — Specification'
- b) The scope of the standard has been modified by covering the product in the tensile range of 290 to 470 MPa.
- c) The number of grades have been increased to three.
- d) The chemical composition and mechanical properties of grades have been modified.

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 the standard.

Indian Standard

LOW TENSILE STRUCTURAL STEELS — SPECIFICATION

(Third Revision)

1 SCOPE

1.1 This standard covers the requirements of low carbon steel plates, sections, flats, bars, etc, for general structural purposes in the tensile range of 290 to 470 MPa.

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

1.2 When 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)'.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
228	Methods of chemical analysis of steel
1599 : 1985	Method for bend test (<i>second revision</i>)
1608 : 1995	Mechanical testing of metals—Tensile testing (<i>second revision</i>)
1852 : 1985	Rolling and cutting tolerances for hot rolled steel products (<i>fourth revision</i>)
1956	Glossary of terms relating to iron and steel
3083 (Part 1) : 1989	Steel — Conversion of elongation values: Part 1 carbon and low alloy steels (<i>second revision</i>)
8910 : 1978	General technical delivery requirements for steel and steel products

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 Microalloying Elements

Elements, such as niobium, vanadium and titanium, added singly or in combination to obtain higher strength levels combined with better formability, weldability and toughness as compared with non-alloyed steel produced to equivalent strength levels.

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.

4 SUPPLY OF MATERIAL

4.1 General requirements relating to supply of structural steel shall conform to IS 8910 : 1978.

4.2 The steel plates can be supplied either with mill edges or sheared edges in as rolled condition.

5 GRADES

There shall be three grades of steel as given in Table 1 and Table 3.

6 MANUFACTURE

6.1 The processes used in making the steel and in manufacturing hot rolled steel plates, sections, flats, bars, etc, are left to the discretion of the manufacturer.

6.2 Steel shall be semi-killed or killed. Rimming steel may be supplied by mutual agreement between the manufacturer and the purchaser.

7 FREEDOM FROM DEFECTS

7.1 All finished steel shall be well and cleanly rolled to the dimensions, section 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 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.

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 direction.

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

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. However, where the method is not given in IS 228 its relevant parts, the referee method shall be as agreed to between the purchaser and the manufacturer.

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.

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

Table 1 Chemical Composition
(Clauses 5 and 8.1)

Grade Designation	Ladle Analysis, Percent, <i>Max</i>			
	C	Mn	S	P
(1)	(2)	(3)	(4)	(5)
Fe 290	0.25	1.25	0.055	0.055
Fe 330	0.25	1.25	0.055	0.055
Fe 370	0.25	1.25	0.055	0.055

NOTES

- 1 When the steel is aluminium killed, the total aluminium content shall not be less than 0.02 percent. When the steel is silicon killed, silicon content shall not be less than 0.10 percent. When the steel is silicon-aluminium killed, the silicon shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent.
- 2 Micro alloying may be allowed subject to mutual agreement between the purchaser and the supplier. Micro alloying elements like Nb, V or Ti, when used individually or in combination, the total content shall not exceed 0.20 percent.
- 3 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 Fe 330 Cu.
- 4 Nitrogen content of steel shall not exceed 0.012 percent which shall be ensured by the manufacturer by occasional check analysis.

Table 2 Permissible Variation for Product Analysis
(Clause 8.2)

Constituent	Variation Over the Specified Limit, Percent, <i>Max</i>
(1)	(2)
Carbon	0.02
Manganese	0.05
Sulphur	0.005
Phosphorus	0.005
Copper	0.03

NOTE — Product analysis shall not apply to rimming quality steel.

possible information regarding properties in the cross-sectional and longitudinal planes. The recommended location 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.

9.2 Wherever practical, 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 28 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 may 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 sections, flat, strips and plates, 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 sections, flats and plates 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 or flame-cutting is employed, an adequate allowance shall be left for removal by machining.

9.9 Test samples shall not be annealed or otherwise subjected to heat treatment unless the material from which they are cut is similarly treated, in which case the test samples shall be 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 Test

10.1.1 Plates, Sections (Angles, Tees, Beams, Channels, etc) and Flats

One tensile test shall be made from finished steel for

every 40 tonnes or part thereof rolled continuously from each cast, a separate test being made for each class of steel product (namely, plates, sections and flats) rolled from a cast.

10.1.1.1 Where plates, sections or flats of more than one thickness are rolled from the same cast, one additional tensile test shall be made from the material in each class of product for each variations in thickness of 6 mm.

10.1.2 Bars (Round, Square and Hexagonal)

One tensile test shall be made from finished product for every 40 tonnes or part thereof. If more than one diameter or thickness of the bar is processed, one additional tensile test shall be made for each variation of 3 mm above or below the diameter or thickness of the bar ordered.

10.2 Tensile Test Pieces

The tensile strength, yield strength and percentage elongation of steel shall be determined from standard test pieces cut lengthwise or crosswise from plates and lengthwise from sections, flats and bars. The test shall be carried out on the standard test pieces prepared in accordance with IS 1608 : 1995, generally using a proportional gauge length $L_0 = 5.65 \sqrt{S_0}$, where S_0 is the cross sectional area of the test piece. Test pieces with a non-proportional gauge length may be used; in this case the elongation values shall be converted in accordance with IS 3803 (Part 1) : 1989.

10.3 Tensile Test

10.3.1 Tensile strength, yield strength and percentage elongation when determined in accordance with IS 1608 : 1995 shall be as given in Table 3.

Table 3 Tensile Properties

(Clause 5 and 10.3)

Grade Designation	Tensile Strength MPa	Yield Stress Min MPa	Percent Elongation at Gauge Length $5.65 \sqrt{S_0}$ Min	Internal Diameter of Bend
(1)	(2)	(3)	(4)	(5)
Fe 290	290-390	165	23	2t
Fe 330	330-430	170	23	3t
Fe 370	370-470	215	23	3t

where t is the thickness of test piece.

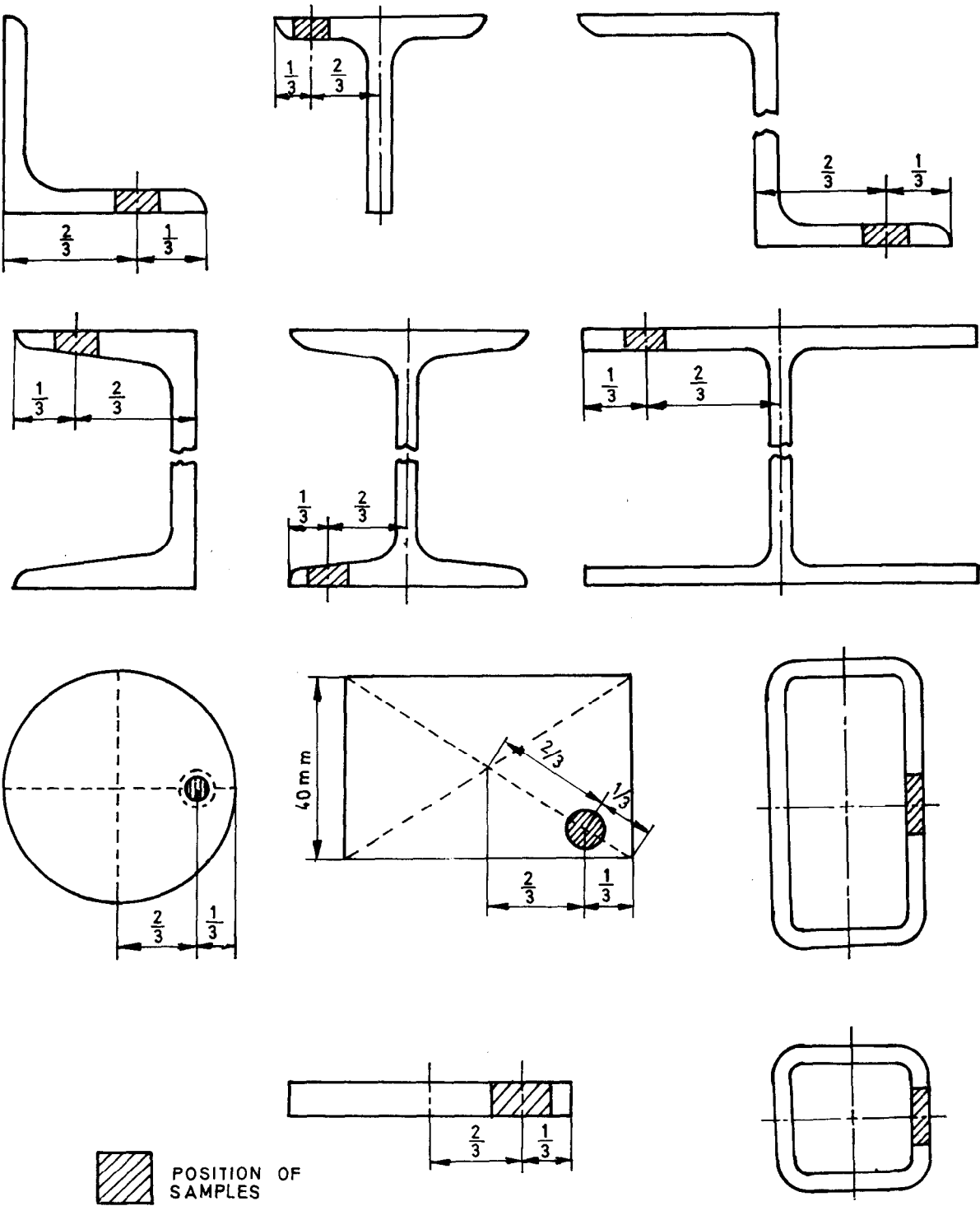


FIG. 1 STRUCTURAL STEEL SECTIONS, POSITION AND ORIENTATION OF SAMPLES

10.3.2 Should a tensile test piece break outside the middle half of the gauge length (*see* IS 1608 : 1995) and the percentage elongation obtained is less than that specified, the test may be discarded at the manufacturer's option and another test made from the sample plate, section flat or bar.

11 BEND TEST

11.1 Number of Bend Tests

Bend test shall be made from finished steel from each cast. The number of tests for every 20 tonnes of material or part thereof, rolled continuously, shall be as given below. One additional test shall be made for each class of product and for each variation of thickness.

<i>Class of Steel Product</i>	<i>No. of Bend Tests</i>
Sections	One lengthwise for each type
Plates	One lengthwise and /or one crosswise
Flats and bars (round, hexagonal, etc)	One lengthwise

11.2 Bend Test Piece

The test pieces shall be cut lengthwise or crosswise from plates, and lengthwise from sections, flats and bars. When sections permit, these shall be not less than 40 mm wide. If the manufacturer so desires the 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.

11.2.2 The test pieces shall not be annealed or otherwise subjected to heat treatment unless the material from which these are taken is similarly treated. In such cases, the test pieces shall be similarly treated in the same furnace with the material before testing.

11.3 Bend Test

Bend test shall be conducted in accordance with IS 1599 : 1985.

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 3 without cracking.

12 DIMENSIONS

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

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

Product	Relevant Indian Standards
Beam column, channel and angle sections	IS 808 : 1989 Dimensions for rolled steel beam, column, channel and angle sections (<i>third revision</i>)
Tee bars	IS 1173 : 1978 Hot rolled slit steel tee bars (<i>second revision</i>)
Bulb angles	IS 1252 : 1961 Dimension of hot rolled steel bulb angles (<i>first revision</i>)
Plates, sheets and strips	IS 1730 : 1989 Dimensions for steel plates, sheets, strips and flats for general engineering purposes (<i>second revision</i>)
Round and square bars	IS 1732 : 1989 Dimensions for round and square steel bars for structural and general engineering purposes (<i>first revision</i>)
Bulb flats	IS 1863 : 1979 Hot rolled steel bulb flats (<i>first revision</i>)
Sheets, piling section	IS 2314 : 1986 Steel sheet piling sections (<i>first revision</i>)
Channel section	IS 3954 : 1991 Hot rolled steel channel sections for general engineering purposes (<i>first revision</i>)
Track shoe sections	IS 10182 (Part 1) : 1982 Dimensions and tolerances for hot rolled track shoe sections : Part 1 Section TS-L1 IS 10182 (Part 2) : 1985 Dimensions and tolerances for hot rolled track shoe sections: Part 2 Section TS-H1

13 TOLERANCES

Unless otherwise agreed 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 : 1985.

14 RETEST

Should any one of test pieces selected fail to pass any of the test 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 the 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.

15 CALCULATION OF MASS

The mass of steel shall be calculated on the basis that steel weighs 7.85 g/cm³.

16 DELIVERY

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

17 MARKING

17.1 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.

17.2 Every heavy and medium structural mill product and each plate of thickness 10 mm and over shall be marked with the cast number. In case of plates below 10 mm thickness, the top plate of each pile (which may consist of approximately 16 plates) shall be marked with cast number and the remaining plates have suitable identification marking.

17.3 BIS Certification Marking

The material may also be marked with the Standard Mark.

17.3.1 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.

Bureau of Indian Standards

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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 Handbook' and 'Standards : Monthly Additions'.

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Amendments Issued Since Publication

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AMENDMENT NO. 1 JUNE 2001
TO
IS 1977 : 1996 LOW TENSILE STRUCTURAL
STEELS — SPECIFICATION

(Third Revision)

(Page 3, clause 10.1.1) — Substitute the following for the existing clause:

‘10.1.1 Plates, Sections (Angles, Tees, Beams, Channels, etc) and Flats

Number of samples to be tested from a cast/heat and a class of steel product (namely, plates, sections and flats) shall be as follows:

- a) For cast/heat size up to 100 tonnes — 2 samples
- b) For cast size between 100-200 tonnes — 3 samples
- c) For cast size over 200 tonnes — 4 samples.’

(MTD 4)

**AMENDMENT NO. 2 NOVEMBER 2002
TO
IS 1977 : 1996 LOW TENSILE STRUCTURAL
STEELS — SPECIFICATION**

(*Third Revision*)

(*Foreword*) — Insert the following before last para:

‘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.’

(MTD 4)

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