

IS : 2090 - 1983
(Reaffirmed 1989)

Indian Standard
SPECIFICATION FOR
HIGH TENSILE STEEL BARS USED IN
PRESTRESSED CONCRETE
(*First Revision*)

Second Reprint SEPTEMBER 1993

UDC 669.14.018.295-422:666.982.4

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BUREAU OF INDIAN STANDARDS
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Indian Standard
SPECIFICATION FOR
HIGH TENSILE STEEL BARS USED IN
PRESTRESSED CONCRETE
(*First Revision*)

Joint Sectional Committee for Concrete Reinforcement, BSMDC 8

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Indian Standard
SPECIFICATION FOR
HIGH TENSILE STEEL BARS USED IN
PRESTRESSED CONCRETE
(*First Revision*)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 14 March 1983, after the draft finalized by the Joint Sectional Committee for Concrete Reinforcement had been approved by the Civil Engineering Division Council.

0.2 This standard was first published in 1962 to cover the requirements of high tensile steel bars used in prestressed concrete. The present revision has been taken up with a view to incorporating modifications found necessary as a result of experience gained in using this standard both by manufacturers and users.

0.3 In this revision, modifications have been incorporated in provisions relating to tolerances, proof stress and relaxation test. The requirement of young's modulus has been deleted. Further S.I. units have been adopted for specifying the various physical requirements in the standard and references to various other Indian Standards appearing in this standard have been updated.

0.4 In the formulation of this standard, due weightage has been given to international co-ordination among the standard and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

0.5 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*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard covers the requirements for high tensile steel bars used in prestressed concrete.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 **Bar** — A rolled rod or bar of steel of circular cross-section.

2.2 **Elongation** — The increase in length of a tensile test specimen under stress. The elongation at fracture is conventionally expressed as a percentage of the original gauge length of the standard test specimen.

2.3 **High Tensile Steel** — Alloy steel having a tensile strength of not less than 980 N/mm².

2.4 **Nominal Size** — The dimension of the diameter of the bar.

2.5 **Proof Stress** — The stress which produces a residual strain of 0.2 percent of the original gauge length (non-proportional elongation).

2.6 **Tensile Strength** — The maximum load reached in a tensile test divided by the original cross-sectional area of the gauge length portion of the test specimen.

3. MANUFACTURE AND CHEMICAL COMPOSITION

3.1 The steel shall be manufactured by the open-hearth, electric, duplex, acid bessemer, basic oxygen (LD) process or a combination of these processes with the addition of necessary alloying elements. In case any other process is employed in the manufacture, prior approval of the purchaser shall be obtained. The steel shall be hot rolled into bars and subsequently processed to give the required physical properties. Where the bars are threaded the thread shall be either cut or rolled. Threaded ends shall be protected from corrosion and damage.

3.1.1 The ladle analysis of steel when made in accordance with the relevant parts of IS : 228* shall show that steel contains not more than 0.050 percent of sulphur and not more than 0.050 percent of phosphorus.

3.2 All finished bars shall be cleanly rolled to specified dimensions. They shall be sound and free from splits, harmful surface flaws, rough, jagged and imperfect edges; and other defects. Unless otherwise agreed between the purchaser and the manufacturer, they shall not carry rust or other matter to a degree likely to impair their adhesion in concrete.

*Methods for chemical analysis of steels (second revision) (being issued in parts).

4. NOMINAL SIZES

4.1 Bars shall be manufactured in the following nominal sizes:

10, 12, 16, 20, 22, 25, 28 and 32 mm.

5. TOLERANCES

5.1 **Nominal Size** — The tolerance on the nominal size shall be ± 0.5 mm for bars up to and including 25 mm and ± 0.6 mm for bars above 25 mm.

5.2 **Mass** — The tolerance on the mass of the finished bar shall be ± 5 percent for bars of diameter up to and including 16 mm and ± 3 percent for bars above 16 mm.

NOTE — When bars are ordered by mass, the mass of the bars shall be calculated on the basis that high tensile steel weighs 0.785 kg/cm^2 of cross-sectional area per metre run.

5.3 When necessary, other tolerances may be agreed between the purchaser and the manufacturer.

6. PHYSICAL REQUIREMENTS

6.1 The tensile strength, proof stress and elongation, when determined in accordance with 7.2.2 shall be as given in Table 1.

TABLE 1 MECHANICAL PROPERTIES OF BARS

(Clause 8.1)

CHARACTERISTIC	REQUIREMENT
Tensile strength, <i>Min</i>	980 N/mm ²
Proof stress	Not less than 80 percent of the minimum specified tensile strength
Elongation at rupture on a gauge length $5.65 \sqrt{A}$, <i>Min</i> (where A is the area of cross-section)	10 percent

6.2 **Relaxation** — The relaxation of stress in the bar, when tested in accordance with 7.3, shall not exceed 49 N/mm^2 at the end of 1 000 hours. Alternatively, the manufacturer shall provide proof that the quality of bar supplied is such as to comply with this test requirement.

7. TESTS

7.1 Selection of Test Specimens

7.1.1 All test specimens shall be of sufficient length for the specified tests and may be cut either from the ends of the bars before cutting to

finished lengths or from any part of the bar in the presence of the purchaser or his authorized representative.

7.1.2 Before the specimens are selected, the manufacturer or supplier shall furnish the purchaser or his authorized representative with copies of mill records giving the number of bars in each cast with sizes, marks, etc, whereby the bars can be identified.

7.2 Tensile Test

7.2.1 The test specimens shall not be annealed or otherwise subjected to heat treatment unless the bars from which they are cut are similarly treated in which case the specimen shall be similarly and simultaneously treated with the bars before testing.

7.2.2 The tensile strength, proof stress and elongation shall be determined in accordance with the methods specified in IS : 1608-1972*.

NOTE — In cases where the manufacturing process includes cold working, test to determine compliance with proof stress requirements need not be made within 48 hours of such cold working.

7.3 Constant Strain Relaxation Test — *If required by the purchaser,* the manufacturer shall provide evidence from records of tests of similar bars that the relaxation of stress from an initial stress of 70 percent of the specified minimum tensile strength conforms to that specified in 6.2. During the whole period of test the temperature shall be maintained at $20 \pm 2^{\circ}\text{C}$. The initial load shall be applied in a period of not more than 5 minutes and shall then be held constant for a further period of one minute. Thereafter no adjustment of load shall be made, and the load relaxation readings shall commence from the end of sixth minute. On no account shall the test piece be overstressed. The number of specimens tested shall be as agreed between the purchaser and the manufacturer.

8. SAMPLING AND CRITERIA FOR CONFORMITY

8.1 Scale of Sampling

8.1.1 Lot — In any consignment, all the high tensile steel bars of the same size and manufactured from the same cast shall be grouped together to constitute a lot.

8.1.2 The number of bars to be selected at random from the lot shall depend upon the size of the lot and shall be in accordance with col 1 and col 2 of Table 2.

*Method for tensile testing of steel products (*first revision*).

TABLE 2 SIZE OF THE SAMPLE AND SUB-SAMPLE(*Clauses 8.1.2 and 8.2.3*)

LOT SIZE	SIZE OF SAMPLE	SIZE OF SUB-SAMPLE
(1)	(2)	(3)
Up to 50	5	2
51 to 100	10	2
101 to 200	15	2
201 to 300	20	3
301 to 500	30	3
501 and above	40	5

8.2 Number of Tests

8.2.1 All the bars selected as in **8.1.2** shall be examined for freedom from defects (*see 3.2*) and tolerance on nominal size and mass (*see 5*).

8.2.2 Requisite material from any one of the bars in the lot shall be subjected to chemical analysis (*see 3.1.1*).

8.2.3 The number of bars to be subjected to the tensile test (*see 7.2*) shall be equal to the size of the sub-sample as given in col 3 of Table 2.

8.3 Criteria for Conformity

8.3.1 The lot shall be considered as conforming to the requirements of this specification if the conditions mentioned in **8.3.2** to **8.3.5** are satisfied.

8.3.2 The number of bars failing to satisfy one or more of the requirements specified in **4** and **6** shall not exceed the corresponding permissible number given below:

<i>Size of Sample</i>	<i>Permissible Number</i>
5	0
10	1
15	1
20	2
30	3
40	3

8.3.3 The results of chemical analysis for phosphorus and sulphur content on the sample tested shall satisfy the requirements given under

3.1.1 If the test results for any of the characteristics fail to satisfy the corresponding requirements, two more tests for that characteristic shall be done and both these test results shall satisfy the requirements for that characteristic.

8.3.4 For physical requirements except proof stress, the mean and the range of the test results obtained for the various characteristic shall satisfy the appropriate condition(s) given below:

- a) (Mean + 0.6 Range) shall be less than or equal to the maximum specification limit.
- b) (Mean — 0.6 Range) shall be greater than or equal to the minimum specification limit.

8.3.5 For proof stress, all the test specimens shall satisfy the requirements of the characteristic.

9. DELIVERY, INSPECTION AND TESTING FACILITIES

9.1 Unless otherwise specified, general requirements relating to the supply of material, inspection and testing shall conform to IS : 1387-1967*.

9.2 No material shall be despatched from the manufacturers' or suppliers' premises prior to its being certified by the purchaser or his authorized representative as having fulfilled the tests and requirements laid down in this standard except where the bundle or coil containing the wire is marked with the ISI Certification Mark.

9.3 The purchaser or his authorized representative shall be at liberty to inspect and verify the steel maker's certificate of cast analysis at the premises of the manufacturer or supplier; when the purchaser required an actual analysis of finished material, this shall be made at a place agreed to between the purchaser and the manufacturer or supplier.

9.4 Manufacturer Certificate — In the case of bars which have not been inspected at the manufacturer's works, the manufacturer or supplier, as the case may be, shall supply the purchaser or his authorized representative with the certificate stating the process of manufacture and test sheets signed by the manufacturer giving the result of each mechanical test applicable to the material, and the chemical composition if required. Each test sheet shall indicate the number or identification mark to be found on the material.

9.5 When test for relaxation is required to be carried out, the cost of testing shall be borne by the purchaser.

*General requirements for the supply of metallurgical materials (*first revision*).

10. IDENTIFICATION AND MARKING

10.1 The bar manufacturer shall attach to every bundle a suitable metal tag which shall bear the manufacturer's name, the size of the bar, the heat number of the cast from which the bars have been rolled and the designation of the standard. All bars or bundles of bars shall be marked in such a way that it is possible to trace all finished bars to the cast from which they were made.

10.1.1 Each bar or the metal tag attached to every bundle of bars may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1936 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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AMENDMENT NO. 1 JULY 1988

TO

IS:2090-1983 SPECIFICATION FOR HIGH TENSILE
STEEL BARS USED IN PRESTRESSED CONCRETE

(First Revision)

(Page 4, clause 3.2, third sentence) -
Substitute the following for the existing matter:

'Unless otherwise agreed between the purchaser and the manufacturer or supplier the bars shall not carry on its surface lubricants, rust or other matter to a degree likely to impair its adhesion to concrete.'

(BSMDC 8) Reprography Unit, BIS, New Delhi, India