

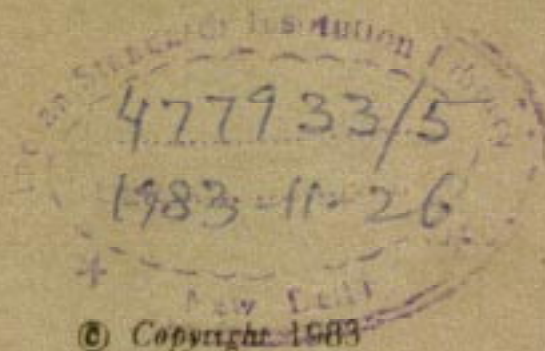
Indian Standard

SPECIFICATION FOR
PLAIN HARD-DRAWN STEEL WIRE FOR
PRESTRESSED CONCRETE

PART I COLD DRAWN STRESS-RELIEVED WIRE

(*Second Revision*)

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

Indian Standard

SPECIFICATION FOR PLAIN HARD-DRAWN STEEL WIRE FOR PRESTRESSED CONCRETE

PART I COLD DRAWN STRESS-RELIEVED WIRE

(Second Revision)

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IS : 1785 (Part I) - 1983

(Continued from page 1)

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Indian Standard
SPECIFICATION FOR
PLAIN HARD-DRAWN STEEL WIRE FOR
PRESTRESSED CONCRETE

PART I COLD DRAWN STRESS-RELIEVED WIRE

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Part I) (Second 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 1961 and was revised in 1966. In the first revision, the standard was published in two parts, one covering the requirements of stress-relieved plain wire which was a revision of the 1961 version of the standard and the other covering as-drawn plain wire for the first time. The present revision has been taken up with a view to modifying the earlier requirements in the light of experience gained in using this specification by both manufacturers and users.

0.3 In this revision, modifications have been incorporated in provisions relating to chemical composition, tolerance on nominal diameter and requirements of relaxation and stress corrosion. Further, SI units have been adopted in specifying the physical requirements. References to related Indian Standards also have been updated.

0.4 In the formulation of this standard, due weightage has been given to international co-ordination among the standards 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 (Part I) covers the requirements for the manufacture, supply and testing of plain, cold drawn, stress-relieved steel wire for use in prestressed concrete.

2. TERMINOLOGY

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

2.1 Bundle — Two or more 'coils' or a number of lengths properly bound together.

2.2 Coil — One continuous length of wire in the form of a coil.

2.3 Elongation — The increase in length of a tensile test piece under stress. The elongation after fracture is conventionally expressed as a percentage of the original gauge length of a standard test piece.

2.4 Parcel — Any quantity of finished wire presented for examination and test at any one time.

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 piece.

3. MANUFACTURE AND CHEMICAL COMPOSITION

3.1 The wire shall be cold drawn from the steel made by the open hearth, electric, duplex, acid bessemer, basic oxygen, or a combination of these processes. In case any other process is employed in the manufacture of steel, prior approval of the purchaser shall be obtained.

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

3.2 The bars or rods obtained from the rolling mill shall be treated if required to make it suitable for cold drawing and thereafter the diameter of the rod or bar shall be successively decreased to the required diameter by cold drawing it through a series of dies. The resultant wire shall be subjected to the process of stretching or straightening and/or strain ageing or other suitable process to reduce creep losses and/or to relieve the concentration of stresses, and coiled.

*Method for chemical analysis of steels (*second revision*). (Being issued in parts.)

3.3 All finished wires, subject to the provisions of 3.2 and 6 shall be clearly drawn to the specified size and shall be sound, free from splits, harmful surface flaws, piping and other defects likely to impair its use in prestressed concrete, and finished in a workmanlike manner.

3.4 The surface of wire shall be clean, uniform, smooth and free from harmful scratches, flat parts, longitudinal or transverse ribs, etc. Unless otherwise agreed to between the purchaser and the manufacturer/supplier, the wire shall not carry on its surface, lubricants or other matter to a degree likely to impair its adhesion to concrete. Slight rust may be permitted, provided there is no surface pitting visible to the naked eye.

3.5 There shall be no welds or joints in the finished wire as supplied to the purchaser. Any welds or joints made during manufacture to promote continuity of operations shall be removed before supply.

4. NOMINAL SIZES

4.1 The nominal diameters of the finished wires shall be 2.50, 3.00, 4.00, 5.00, 7.00 and 8.00 mm.

5. TOLERANCES

5.1 The tolerance on the nominal diameter shall be as given below:

<i>Nominal Diameter</i>	<i>Tolerance</i>
mm	mm
8.00	±0.05
7.00	±0.05
5.00	±0.05
4.00	±0.05
3.00	±0.04
2.50	±0.025

5.1.1 For purposes of determining whether the actual diameter of the wire is within the specified tolerances, the diameter shall be determined with a micrometer by taking two measurements at right angles to each other at three places along a length of not less than 250 mm and the average of these six measurements shall be taken as the diameter of the wire.

6. PHYSICAL REQUIREMENTS

6.0 The wire shall conform to the physical requirements specified in 6.1 to 6.5.

NOTE — For special purposes, test evidence may be required to show that the wire is not susceptible to stress corrosion. In such case, the test method shall be mutually agreed upon between the manufacturer and the purchaser.

6.1 Tensile Strength — Unless otherwise agreed to between the purchaser and the manufacturer or supplier, the tensile strength of wire determined in accordance with 7.3 and based on the nominal diameter of the wire shall be as given below:

<i>Nominal Diameter</i>	<i>Tensile Strength, Min</i>
mm	N/mm ²
2.50	2 010
3.00	1 865
4.00	1 715
5.00	1 570
7.00	1 470
8.00	1 375

NOTE — Wires of diameter 5, 7 and 8 mm may be manufactured to give higher minimum tensile strength. In such cases, minimum tensile strength of 1 715, 1 570 and 1 470 N/mm² are recommended for wires of nominal diameter 5, 7 and 8 mm respectively; but other requirements shall remain the same.

6.2 Proof Stress — Unless otherwise specified, the proof stress of the wire shall be not less than 85 percent of the minimum specified tensile strength.

6.3 Ductility — The wire shall withstand the reverse bend test specified in 7.5.

6.4 Elongation After Fracture — Elongation after fracture, over a gauge length of 200 mm, when determined in accordance with 7.6 shall be as below:

<i>Nominal Diameter</i>	<i>Elongation, Percent</i>
mm	<i>Min</i>
2.50	2.5
3.00	2.5
4.00	3.0
5.00	4.0
7.00	4.0
8.00	4.0

6.5 Relaxation — The relaxation stress in the wire, when tested in accordance with 7.7 shall not exceed 5 percent of the initial stress as specified in 7.7 at the end of 1 000 h. Alternatively, the manufacturer shall provide proof that the quality of wire supplied is such as to comply with this requirement.

6.5.1 When it is not possible to conduct 1 000 h relaxation test, the wire may be accepted on the basis of 100 h relaxation test, provided the manufacturer furnishes proof establishing a relation between the relaxation stress values at 1 000 h and 100 h and provided that the relaxation stress at 100 h is not more than 3.5 percent of the initial stress as specified in 7.7.

7. TESTS

7.1 All test pieces of wire of sufficient length for the specified tests shall be selected by the purchaser or his authorized representative, either

- a) from the cuttings of lengths of wires or ends of coils of wire, or
- b) if he so desires, from the coil or length of wire, after it has been cut to the required or specified length and the test piece taken from any part of it.

7.1.1 In neither case, the test piece shall be detached from the coil or length of wire, except in the presence of the purchaser or his authorized representative.

7.1.2 Before test pieces are selected, the manufacturer or supplier shall furnish the purchaser or his authorized representative with copies of the mill records giving the number of coils or bundles in each cast with sizes as well as the identification marks, whereby each coil or bundle of wire can be identified.

7.2 Test samples shall not be subjected to any form of heat treatment. Any straightening which the test samples may require shall be done cold.

7.3 Tensile Test — The tensile strength shall be determined in accordance with IS : 1521-1972*.

7.4 Test for Proof Stress — Proof stress shall be determined in accordance with IS : 1521-1972*.

7.4.1 When stress at 1.0 percent extension under load method is to be determined, an initial load corresponding to a stress of 196 N/mm² shall be applied to the test piece and a sensitive extensometer then attached. The dial of the extensometer shall be set to a reading equal to 0.001 mm/mm of the gauge length to represent the extension due to the initial load.

The load shall be increased until the extensometer shows an extension corresponding to 1.0 percent of the gauge length, when the load shall be noted. The stress calculated for this load shall be not less than the value specified for the 0.2 percent proof stress.

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

7.5 Reverse Bend Test — The test piece taken in accordance with 7.1 shall be capable of being bent in the following manner without showing signs of failure.

One end of the test sample shall be firmly gripped in a vice fitted with radiused jaws. The free end of the wire shall be bent round the appropriate radius specified in Table 1 through an angle of 90° and then back to the original position; this constitutes one bend. Thereafter, the test piece shall be bent through 90° in the opposite direction and back through 90° and then through 90° in the reverse direction and back through 90°. The wire shall withstand 3 reverse bends without fracture.

TABLE 1 REVERSE BEND TEST

DIAMETER OF WIRE	RADIUS OF JAWS
mm	mm
2.50	7.50
3.00	10.0
4.00	12.5
5.00	15.0
7.00	20.0
8.00	25.0

7.6 Elongation After Fracture — The elongation after fracture shall be determined in accordance with IS : 1521-1972*.

7.7 Test for Relaxation — If required by the purchaser, the manufacturer shall provide evidence from records of tests of similar wire that the relaxation of load from an initial stress of 70 percent of the specified minimum tensile strength conforms to that specified in 6.5. 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 5 minutes and shall then be held constant for a further period of one minute. Thereafter no adjustment of load shall be made, and load relaxation readings shall commence from the end of the sixth minute. On no account shall the test specimen be overstressed.

8. SAMPLING AND CRITERIA FOR CONFORMITY

8.1 Scale of Sampling

8.1.1 Lot — In any consignment, all the coils of wire of the same nominal diameter and manufactured at the same place under similar

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

conditions of production and storage shall be grouped together to constitute a lot.

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

TABLE 2 SAMPLE SIZE

NO. OF COILS IN THE LOT	NO. OF COILS TO BE SELECTED
Up to 25	3
26 to 65	4
66 to 180	5
181 to 300	7
301 and above	10

8.2 Number of Tests

8.2.1 All the coils, selected as in **8.1.2** shall be tested for chemical composition (see **3.1.1**), diameter (see **5.1**), tensile strength (see **6.1**), proof stress (see **6.2**), ductility (see **6.3**) and elongation (see **6.4**).

8.2.1.1 From each coil, one test specimen shall be selected for each test and tested in accordance with the appropriate test method.

8.3 Criteria for Conformity

8.3.1 The lot shall be considered as conforming to the requirements of this specification if the conditions specified under **8.3.2** to **8.3.4** are satisfied for all the characteristics.

8.3.2 *Chemical Composition, Diameter, Tensile Strength and Proof Stress* — For each of the characteristics, the mean and the range calculated from the test results shall satisfy the appropriate condition 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.

NOTE — The range is the difference between the maximum and the minimum value of the test results.

8.3.3 *Elongation* — In case of test for elongation after fracture every sample tested shall satisfy the requirements of **6.4** and the percentage elongation for none of the samples shall fall below the value specified in **6.4**.

8.3.4 Ductility — The number of defective test specimens (those not satisfying the requirements of the test) shall not exceed the corresponding permissible number given below:

<i>No. of Specimens Tested</i>	<i>Permissible No. of Defective Test Specimens</i>
3	0
4	0
5	1
7	1
10	2

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's Certificate — In the case of wires 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 representatives with the certificate stating the process of manufacture and also the test sheet signed by the manufacturer giving the result of each mechanical test and the chemical composition, if required. Each test sheet shall indicate the number or identification mark of the cast to which it applies, corresponding to the number or identification mark to be found on the material.

9.5 When tests for susceptibility to stress corrosion and relaxation are 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*).

9.6 Unless otherwise agreed to by the purchaser and the manufacturer, wire shall be supplied in coils of sufficiently large diameter to ensure that the wire runs off straight and the purchaser may specify the diameter of the coil, if he so desires.

For wires up to 5 mm diameter, coils of about 1.5 m diameter and of wires above 5 mm diameter, coils of about 2 m diameter, without breaks, joints and welds are generally recommended. The mass of the coil shall be as mutually agreed to between the purchaser and the manufacturer or supplier. Each coil shall have at least four tight ligatures.

10. IDENTIFICATION AND MARKING

10.1 The manufacturer or supplier shall have ingots, billets and wires, or coil of wires marked in such a way that all finished wires can be traced to the cast from which they were made. Every facility shall be given to the purchaser or his authorised representative for tracing the wires to the cast from which they were made.

10.2 Each bundle or coil containing the wires may also be suitably marked with the ISI Certification Mark in which case the concerned test certificate shall also bear the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI 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 ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹).
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

AMENDMENT NO. 1 NOVEMBER 1989
TO
IS : 1785 (PART 1) - 1983 SPECIFICATION
FOR PLAIN HARD-DRAWN STEEL WIRE
FOR PRESTRESSED CONCRETE

PART 1 COLD DRAWN STRESS-RELIEVED WIRE

(Second Revision)

(Page 4, Clause 3.2) — Substitute the following for the existing clause:

'3.2 The wire rods obtained from the rolling mill shall be heat treated if required to make it suitable for cold drawing and thereafter the diameter of the wire rod shall be successively decreased to the required diameter by cold drawing it through a series of dies. The resultant wire shall be subjected to straightening and stress relieving process.'

(Page 7, clause 7.4) — Add the following at the end:

'Alternatively, stress at 1.0 percent extension under load method as specified in 7.4.1 may be determined.'

(BSMDC 8)

TO

IS 1785 (Part 1) : 1983 SPECIFICATION FOR PLAIN
HARD-DRAWN STEEL WIRE FOR PRESTRESSED
CONCRETE

PART 1 COLD-DRAWN STRESS - RELIEVED WIRE

(Second Revision)

(Page 4, clause 2.1) — Delete and renumber the subsequent clauses as 2.1 to 2.5.

(Page 5, clause 5.1.1) — Add new clause 5.1.2 as follows:

5.1.2 Where the diameter measurements (taken in two directions at right angles in the same plane) show an ovality of not more than half of the total diameter tolerance, no checks on section by weighing shall be necessary. Where ovality is more than half of the total diameter tolerance, check on section by weighing shall be made. Nominal mass and tolerance on nominal mass of the finished wire shall be as given below:

<i>Nominal Diameter</i>	<i>Nominal mass</i>	<i>Tolerance</i>
mm	g/m	g/m
8.00	395	±5.9
7.00	302	±4.3
5.00	154	±3.1
4.00	98.9	±2.0
3.00	55.5	±1.5
2.50	38.5	±1.25

(Page 6, clause 6.1) — Add the following as Note 2 and renumber the existing note as Note 1:

NOTE 2 — The Modulus of elasticity is to be taken as $205 \pm 10 \text{ kN/mm}^2$, unless otherwise indicated by the manufacturer.

(Page 6, clause 6.2) — Delete 'Unless otherwise specified' from the beginning of this clause.

(*Page 8, clause 7.7*) — Delete 'If required by the purchaser' from the beginning of this clause.

(*Page 10, clause 8.3.4*) — Rewrite as follows:

'8.3.4 Ductility — In case one or more of the test pieces first selected fail to pass this test, twice the number of samples originally tested shall be selected for testing. All the samples so tested shall satisfy the requirement of this test. Should any of the test piece from these additional samples fail, the material represented by the samples shall be considered as not having complied with this standard.'

(*Page 10, clause 9.4, line 6*) — Delete 'if required'.

(*Page 11, clause 9.6*) — Add the following para at the end:

'It is necessary to protect the wires against damage and contamination during transport and storage. The coils of wire shall be packed as agreed to between the purchaser and the manufacturer.'

TO

**IS 1785 (Part 1) : 1983 SPECIFICATION FOR
PLAIN HARD-DRAWN STEEL WIRE FOR
PRESTRESSED CONCRETE**

PART I COLD DRAWN STRESS-RELIEVED WIRE

(Second Revision)

(Page 4, clause 3.1.1, line 3) — Substitute ‘0.040 percent’ for ‘0.050 percent’.

(Page 5, clause 5.1) — Delete the following values of Nominal Diameters and its corresponding values of Tolerances:

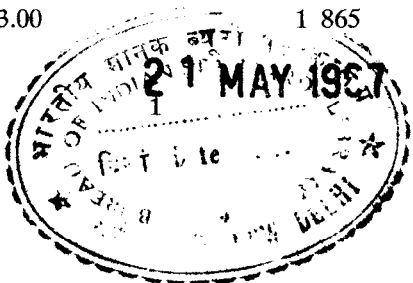
<i>Nominal Diameter</i>	<i>Tolerance</i>
mm	mm
3.00	± 0.04
2.50	± 0.025

[Page 5, clause 5.1.2 (see also Amendment No. 2)] — Delete the following values of Nominal Diameter and its corresponding values of Nominal Mass and Tolerance:

<i>Nominal Diameter</i>	<i>Nominal Mass</i>	<i>Tolerance</i>
mm	g/m	g/m
3.00	55.5	± 1.5
2.50	38.5	± 1.25

(Page 6, clause 6.1) — Delete the following values of Nominal Diameter and its corresponding values of Tensile Strength:

<i>Nominal Diameter</i>	<i>Tensile Strength, Min</i>
mm	N/mm ²
2.50	2 010
3.00	1 865



Amend No. 3 to IS 1785 (Part 1) : 1983

(Page 6, clause 6.4) — Delete the following values of Nominal Diameter and its corresponding values of Elongation, Percent:

<i>Nominal Diameter</i> mm	<i>Elongation, Percent</i> Min
2.50	2.5
3.00	2.5

(Page 8, clause 7.5) — Delete the following values of Diameter of Wire and its corresponding values of Radius of Jaws:

<i>Diameter of Wire</i> mm	<i>Radius of Jaws</i> mm
2.50	7.50
3.00	10.00

(CED 54)