IS 14268 : 1995
(Reaffirmed 1997)

भारतीय मानक

पूर्व प्रतिबलित काँक्रीट के लिए अलेपित कम शिथिलन वाले सात-प्लाई के स्ट्रैंड — विशिष्टि

Indian Standard

UNCOATED STRESS RELIEVED LOW RELAXATION SEVEN-PLY STRAND FOR PRESTRESSED CONCRETE — SPECIFICATION

UDC 666.982-426

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

May 1995

Price Group 3

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Concrete Reinforcement Sectional Committee had been approved by the Civil Engineering Division Council.

With the development of prestressed concrete technology and its successful application in the field of construction, it became necessary to use prestressing tendons capable of developing and retaining large concentrated prestressing forces. This led to the development of stress relieved strand. Low relaxation strand is further improvement in this field.

The low relaxation property is achieved by a process called 'stabilising'. This is essentially a hot stretching process, in which prestressing strand is subjected to a pre-determined tension during stress-relieving heat treatment. This results in linear hardening of the steel which substantially increases the resistance to creep and thereby reduces the relaxation losses.

The composition of the Committee responsible for the formulation of this standard is given at 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

UNCOATED STRESS RELIEVED LOW RELAXATION SEVEN-PLY STRAND FOR PRESTRESSED CONCRETE — SPECIFICATION

1 SCOPE

This standard covers the requirements for manufacture, supply and testing of un-coated, stress relieved 'low relaxation' seven-ply steel strands for prestressed concrete.

2 REFERENCES

The Indian Standards listed below are necessary adjuncts to this standard:

IS No.	*Title*
228 (Part 3) : 1987	Methods of chemical analysis of steel: Part 3 Determination of phosphorus by alkalimetric method (*third revision*)
228 (Part 9) : 1989	Methods of chemical analysis of steel : Part 9 Determination of sulphur in plain carbon steel by evaluation method (*third revision*)
1521 : 1972	Method of tensile testing of steel wire (*first revision*)
1956 (Part 1) : 1976	Glossary of terms relating to iron and steel: Part 1 General metallurgy, heat treatment and testing (*first revision*)
1956 (Part 2) : 1976	Glossary of terms relating to iron and steel: Part 2 Steel making (*first revision*)
1956 (Part 3) : 1975	Glossary of terms relating to iron and steel : Part 3 Hot rolled steel products (excluding sheet and strip)
1956 (Part 5) : 1976	Glossary of terms relating to iron and steel: Part 5 Bright steel bar and steel wire

3 TERMINOLOGY

3.0 For the purpose of this standard the definitions given in IS 1956 (Part 1) : 1976, IS 1956 (Part 2) : 1976, IS 1956 (Part 3) : 1975 and IS 1956 (Part 5) : 1976 and the following shall apply.

3.1 Seven Wire Strand

Any length of finished material which comprises six wires formed together in helical form around a centre line.

3.2 Breaking Load

The maximum load reached in a tensile test of the strand.

3.3 Coil or Reel

One continuous length of strand in the form of a coil or reel.

3.4 Elongation

The increase in length of a tensile test piece under stress. In case of strands, the elongation is measured immediately prior to fracture of any of the component-wires and is expressed at the percentage of the original gauge length of a strand test piece.

3.5 Length of Lay

It is the distance (measured along a straight line parallel to the strand) in which a wire forms one complete helix.

3.6 Parcel

Any quantity of finished strand presented for examination and test at any one time.

3.7 Production Length

The maximum length of strand which can be manufactured, with or without welds, being made after drawing, in any of its component wire.

3.8 Proof Load

The load which produces a residual strain of 0.2 percentage of the original gauge length (non-proportional elongation).

4 MANUFACTURE

4.1 Wire

4.1.1 The base metal shall be carbon steel of such quality that when drawn to wire, fabricated into strand and then thermally treated, shall have the properties and characteristics prescribed in this specification.

4.1.2 The element wire to be used for strand shall be cold-drawn from plain carbon steel (*see* **4.1.1**)

and shall contain not more than 0.050 percent sulphur and not more than 0.050 percent of phosphorus, when tested in accordance with IS 228 (Part 3) : 1987 and IS 228 (Part 9) : 1989, respectively.

4.1.3 The wire used in the manufacture of the strand shall be well and cleanly drawn to the specified dimensions and shall be sound and free from splits, surface flaws, piping and any other defects likely to impair its use in the manufacture of the strand and the performance of the strand in prestressed concrete.

4.2 Strand

The seven wires strand shall have a centre wire atleast 1.5 percent greater in diameter than the surrounding wires enclosed tightly by six helically placed outer wires with a uniform length of lay of atleast 12 times but not more than 16 times of the nominal diameter of the strand. The wire in the strand shall be so formed that they shall not fly out of position when the strand is cut without seizing.

4.3 Joints

4.3.1 There shall be no strand joints or strand splices in any length of the completed strand, unless specifically permitted by the purchaser.

4.3.2 During process of manufacture of individual wires for stranding, welding is permitted only prior to or at the time of last heat treatment.

4.3.3 During fabrication of the seven wire strand, buttwelded joints may be made in the individual wires, provided there is not more than one such joint in any 45 m section of the completed strand.

4.4 Treatment of Strand

4.4.1 After stranding, all strands shall be subjected to a continuous thermal-mechanical treatment to produce the prescribed mechanical properties.

4.4.2 Temper colours that may result from the thermal operation are considered normal for the finished appearance of this strand.

4.4.3 After thermo-mechanical treatment, the strand shall be reformed into coils or wound on to reels, having core diameter of sufficient size and in any case not less than 600 mm to ensure that the strand will lay out straight.

4.5 Workmanship and Finish

The finished strand shall be uniform in diameter and shall be free from injuries, flaws and imperfections. Slight rusting, provided it is not sufficient to cause pits visible to the naked eye, shall not be a cause for rejection.

5 CLASS

The strand shall be either Class I or Class II depending on the breaking strength of the strand given in Table 1.

6 DIMENSION, TOLERANCE AND UNIT WEIGHT

6.1 The nominal diameter, tolerance, nominal cross sectional area and nominal mass per unit length of the strand shall be as given in Table 2.

6.2 Physical Requirements or Mechanical Properties

6.2.1 The breaking strength and 0.2 percent proof load of the strand shall be determined in accordance with IS 1521 : 1972 and shall be not less than the values specified in Table 1.

6.2.2 Alternatively by mutual agreement between the purchaser and the manufacturer, the load at 1.0 percent extension may be determined. In this test, an initial load equivalent to 10 percent of specified minimum breaking strength shall be applied to the test piece and a sensitive extensometer then attached. The dial of the latter shall be adjusted to read 0.001 mm/mm of the gauge length to represent the extension due to the initial load. In case of dispute, 0.2 percent proof stress shall apply. The load shall be increased until the extensometer shows an extension corresponding to 1.0 percent. The load at this extension shall not be less than the minimum 0.2 percent proof load specified in Table 1.

6.3 Elongation

6.3.1 The total elongation under load shall not be less than 3.5 percent on a minimum gauge length of 600 mm. The total elongation shall be measured by a suitable extensometer which is attached to the test piece, after an initial load equivalent to 10 percent of the required minimum breaking load as specified in Table 1 has been applied.

Following an extension of 1 percent, the extensometer may be removed and loading continued to ultimate failure. The elongation value is then determined by the movement between the jaw gripping the test piece on the new base length of jaw to jaw distance to which will be added the value of 1 percent determined by the extensometer.

6.4 Relaxation Properties

6.4.1 Low relaxation strand, when initially loaded to 70 percent of specified minimum breaking strength of the strand shall have relaxation losses of not more than 1.8 percent after 100 h and not more than 2.5 percent after 1 000 h when tested under the conditions given in **6.4.2** to **6.4.8.**

Table 1 Physical Properties
(*Clauses* 5, 6.2.1, 6.2.2 *and* 6.3)

Class	Nominal Dia of Strand	Breaking Strength of Strand		0.2 % Proof Load (90% of Breaking Strength)	
	mm	kN	kgs	kN	kgs
(1)	(2)	(3)	(4)	(5)	(6)
I	9.5	89.0	9 078	80.1	8 170
	11.1	120.1	12 250	108.1	11 026
	12.7	160.1	16 330	144.1	14 698
	15.2	240.2	24 500	216.2	22 052
II	9.5	102.3	10 434	92.1	9 394
	11.1	137.9	14 065	124.1	12 658
	12.7	183.7	18 737	165.3	16 860
	15.2	260.7	26 592	234.6	23 929

Table 2 Dimensions, Tolerances and Mass of Wire Strands
(*Clause* 6.1)

Class	Nominal Dia of Strand	Tolerance	Nominal Area of Strand	Nominal Mass of Strand
(1)	(2) mm	(3) mm	(4) mm^2	(5) kg/km
I	9.5	±0.40	51.6	405
	11.1	±0.40	69.7	548
	12.7	±0.40	92.9	730
	15.2	±0.40	139.4	1 094
II	9.5	+0.66 −0.15	54.8	432
	11.1	+0.66 −0.15	74.2	582
	12.7	+0.66 −0.15	98.7	775
	15.2	+0.66 −0.15	140.0	1 102

6.4.2 If required, the manufacturer shall provide relaxation evidence from the manufacturer's records of tests on similarly dimensioned strand of the same grade.

6.4.3 The temperature of the test piece shall be maintained at 20 ± 2°C.

6.4.4 The test piece shall not be subjected to loading prior to the relaxation test.

6.4.5 The initial load shall be applied uniformly over a period of not less than 3 minutes and not more than 5 days and the gauge length shall be maintained constant. Load relaxation readings shall commence 1 minute after application of the total load.

6.4.6 Over-stressing of the test sample during the loading operations shall not be permitted.

6.4.7 The duration of the test shall be 1 000 h or a short computed period, extrapolated to 1 000 h, which can be shown by records to provide similar relaxation values.

6.4.8 The test gauge length should be atleast 40 times the nominal strand diameter.

7 SAMPLING AND CRITERIA FOR CONFORMITY

7.1 Selection of Test Samples

Test samples of sufficient length to permit the tests for breaking load, 0.2 percent proof load and elongation shall be cut from one end of a coil selected at random from a group of every 5 numbers of coils.

7.1.1 The test piece shall not be detached from the coil or length of strand, except in the presence of purchaser or his authorised representative.

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

7.2 **Criteria for Conformity**

7.2.1 Should any sample fail any of the tests, by agreement between the manufacturer and the purchaser, two additional test samples from the same end of the same coil shall be taken and subjected to the test or tests in which the original sample failed. Should both additional samples pass the test or tests, the coil from which they were taken shall be deemed to comply with the requirements of this standard. Should either of them fail, the coil shall be deemed not to comply.

7.3 Should 10 percent or more of the selected coils fail to fulfil the requirement of this standard, the parcel from which they were taken shall be deemed not to comply with this standard.

8 PACKING

8.1 Unless otherwise agreed to between the purchaser and the supplier the strands shall be supplied as indicated in **8.1.1** or **8.1.2.**

8.1.1 Strand shall be supplied in reels or in reelless packs having a minimum core diameter of 600 mm. Lengths on reels or reelless packs shall be as per agreement between the manufacturer and the purchaser.

8.1.2 The coil shall be securely strapped to prevent distortion of the coil in transit and unless otherwise specified the coil shall be protected against damage in transit by wrapping with hessian.

8.1.3 By mutual agreement between the purchaser and the manufacturer, water soluble oil may be applied on strands.

9 MARKING

9.1 Each reel or reelless pack shall carry a label giving the following details:

a) Indication of the source of manufacture,
b) Coil number,
c) Nominal diameter of strand, and
d) Class, where applicable.

9.2 **BIS Certification Marking**

9.2.1 Each coil containing the strands may also be suitably marked with the standard mark.

9.2.2 The use of Standard Mark is governed by the provisions of *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

Concrete Reinforcement Sectional Committee, CED 54

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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.

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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 1997
TO
IS 14268 : 1995 UNCOATED STRESS RELIEVED LOW RELAXATION SEVEN-PLY STRAND FOR PRESTRESSED CONCRETE — SPECIFICATION

(*Page* 1, *clause* **3.1**, *line* 3) — Substitute 'central wire' *for* 'centre line'.

(*Page* 1, *clause* **4.1.1**, *line* 3) — Substitute 'thermomechanically' *for* 'thermally'.

(*Page* 2, *clause* **6.2.2**, *lines* 9 *and* 10) — Delete the following from ninth and tenth line and insert at the end:

'In case of dispute, 0.2 percent proof-stress shall apply.'

(*Page* 3, *Table* 1) — Insert the following Note below the table:

'NOTE —The modulus of elasticity is to be taken as 195 ± 10 kN/mm^2, unless otherwise indicated by the manufacture.'

(*Page* 3, *Table* 2) — Insert the following Note below the table:

'NOTE — The nominal cross-sectional area and the nominal mass of strand are given for information only.'

(*Page* 3, *clause* **6.4.5**, *line* 3) — Substitute '5 minutes' *for* ' 5 days'.

(CED 54)

Reprography Unit, BIS, New Delhi, India