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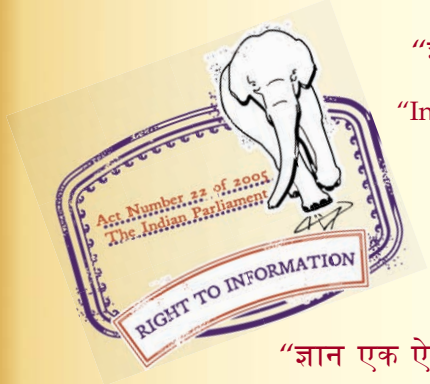
IS 6528 (1995): Stainless steel wire [MTD 16: Alloy Steels and Forgings]



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स्टेनलैस इस्पात के तार — विशिष्टि

(पहला पुनरीक्षण)

Indian Standard

STAINLESS STEEL WIRE — SPECIFICATION

(First Revision)

First Reprint AUGUST 1997

ICS 77 : 140·20

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

December 1995

Price Group 3

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Alloy Steels and Special Steels Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This Indian Standard was first published in the year 1972. While reviewing this Indian Standard, the committee felt that it should be revised taking note of the present practices being followed in the country in this field.

In this revision following changes are made:

Two new grades X20Cr13 and X30Cr13 have been added with their chemical composition and mechanical properties.

An informative Annex A has been given for the benefit of the purchaser giving particulars to be specified by the purchaser while placing order for the steels covered in this standard.

This Indian Standard keeps in view the manufacturing and trade practices followed in the country in this field. In the formulation of this standard assistance has been derived from the following:

ISO/DIS 683/XIII Heat-treated steels, alloy steels and free cutting steels — Part 13 : Wrought stainless steels. International Organization for Standardization.

BS : 970 Part 4 : 1970 Wrought steels (Blooms, billets, bars and forgings) — Part 4 Stainless heat resisting and valve steels. British Standards Institution.

ASTM A 580-1967 Stainless and heat-resisting steel wire. American Society for Testing and Materials.

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

STAINLESS STEEL WIRE — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard covers the requirement for stainless steel wire for general corrosion resistance.

1.2 This standard shall not apply to wire used for manufacture of welding electrodes.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
228 : 1959	Methods of chemical analysis of steels (*second revision*)
1608 : 1995	Mechanical testing of metals — Tensile testing (*second revision*)
1716 : 1985	Method for reverse bend test for metallic wire (*second revision*)
1717 : 1985	Method for simple torsion test for wire (*second revision*)
1755 : 1983	Method for wrapping test of wire (*first revision*)
1762 (Part 1) : 1974	Code for designation of steels: Part 1 Based on letter symbols (*first revision*)
1956 (Part 5) : 1976	Glossary of terms relating to iron and steel: Part 5 Bright steel bars and wire (*first revision*)
6527 : 1995	Stainless steel wire rod
8910 : 1978	General technical delivery requirements for steel and steel products
10461 (Part 1) : 1994	Method for determination of resistance to inter-granular corrosion of austenitic stainless steels : Part 1 Corrosion test in nitric acid medium by measurement of loss in mass (Huey test) (*first revision*)
10461 (Part 2) : 1994	Method for determination of resistance to intergranular corrosion of austenitic stainless steels : Part 2 Corrosion test in a sulphuric acid/copper sulphate medium in the presence of copper turnings (Monypenny Strauss test)

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1956 (Part 5) : 1976 shall apply.

4 SUPPLY OF MATERIAL

General requirements for the supply of material shall conform to IS 8910 : 1978.

5 MANUFACTURE

Unless agreed otherwise in the order the processes used in making the steel and the product are left to the discretion of the manufacturer. When so desired, the purchaser, shall be informed of steel making process.

6 FREEDOM FROM DEFECTS

The surface of the wire shall be smooth and free from harmful surface defects. When required by the purchaser, the depth of longitudinal cracking, for example, hair seam at each end of the wire shall not exceed the limits given below:

Diameter, mm	*Depth of Cracking*, mm
2·00 Up to and including 8·00	0·07 and under
Over 8·00	To be agreed upon between the purchaser and the supplier

7 CHEMICAL COMPOSITION

7.1 The ladle analysis of steels when carried out either by the method specified in 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 relevant parts of IS 228 shall be referee method.

Table 1 Chemical Composition

(*Clauses* 7.1, 7.2, 7.3 *and* 12.1)

Steel Designation [(*See* IS 1762 (Part 1)) : 1974]	C	Si, *Max*	Mn	Ni	Cr	Mo	S *Max*	P *Max*	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
X04Cr13	0·08 *Max*	1·0	1·0 *Max*	1·0 *Max*	11·5-13·5	—	0·030	0·040	(Al 0·10-0·30)
X12Cr13	0·09-0·15	1·0	1·0 *Max*	1·0 *Max*	11·5-14·0	—	0·030	0·040	—
X20Cr13	0·16-0·25	1·0	1·0 *Max*	1·0 *Max*	12·0-14·0	—	0·030	0·040	—
X30Cr13	0·26-0·35	1·0	1·0 *Max*	1·0 *Max*	12·0-14·0	—	0·030	0·040	—
X02Cr18Ni11	0·030 *Max*	1·0	2·0 *Max*	8·0-12·0	17·0-20·0	—	0·030	0·045	—
X04Cr18Ni10	0·08 *Max*	1·0	2·0 *Max*	8·0-12·0	17·0-20·0	—	0·030	0 045	—
X07Cr18Ni9	0·15 *Max*	1·0	2·0 *Max*	8·0-10·0	17·0-19·0	—	0·030	0·045	—
X04Cr17Ni12Mo2	0·08 *Max*	1·0	2·0 *Max*	10·0-14·0	16·0-18·5	2·0-3·0	0·030	0·045	—
X02Cr17Ni12Mo2	0·030 *Max*	1·0	2·0 *Max*	10·0-14·0	16·0-18·5	2·0-3·0	0·030	0·045	—
X10Cr17Mn6Ni4N	0·15 *Max*	1·0	5·5-7·5	3·5-5·5	16·0-18·0	—	0·030	0·060	(N 0·05-0·25)

7.2 Product Analysis

Permissible variation in the case of product analysis from the limits specified in Table 1 shall be as given in Table 2.

Table 2 Permissible Variation Between Specified Analysis and Product Analysis

(*Clauses* 7.2 *and* 12.1)

Element	Permissible Content in the Ladle Analysis, Percent		Permissible Deviation Percent*
	Over	Up to and Including	
C	—	0·030	+0·005
	0·030	0·20	±0·01
Si	—	1·0	+0 05
Mn	—	1·0	+0·03
	1·0	3·0	±0·04
	5·	7·5	±0·10
Al	—	0·30	+0·05
Cr	11·5	14·5	±0·15
	16	20·0	±0·20
Mo	2·0	3·0	±0·10
Ni	—	1·0	+0·03
	3·5	5·5	±0·07
	8·0	10·0	±0·10
	10·0	14·0	±0·15
N	0·05	0·25	+0·02 −0·01
S	—	0·030	+0·005
P	—	0·040	+0·005
	0·040	0·060	±0·010

*Means that in one case the deviation may occur over the upper value of the specified range in Table 1, but not both at the same time.

7.3 Elements not specified in Table 1 shall not be added to the steel except where agreed to, other than for the purpose of finishing the heat and shall not exceed the following limits:

Constituents	*Percent, Max*		
	Ferritic and Martensitic Steel	Austenitic Steels	
		Without specified molybdenum	With specified molybdenum
Titanium	—	0·10	0·10
Niobium	—	0·20	0·20
Molybdenum	0·30	0·70	—
Copper	0·30	0·50	0·70

8 HEAT TREATMENT

8.1 Steel wire may be supplied in the annealed condition.

8.2 Recommended heat treatment for the steels covered by this standard is given in Annex B.

9 DIMENSIONAL TOLERANCES

9.1 Sectional tolerances for stainless steel wire shall be as given in Tables 3 to 6.

9.2 Length tolerances shall be mutually agreed to between the manufacturer and the purchaser.

10 MECHANICAL PROPERTIES

10.1 Tensile Test

The tensile properties of wire when tested in accordance with IS 1608 : 1995 shall be within the limits as given in Table 7.

Table 3 Permissible Deviation in Size of Round Bright Stainless Steel Wire

(*Clause* 9.1)

Diameter		Tolerance	Out of Round
From	Up to and Excluding		
mm	mm	mm	mm
0·071	0·125	±0·003	0·003
0·125	0·200	±0·005	0·005
0·200	0·300	±0·008	0·008
0·300	0·600	±0·01	0·01
0·600	0·850	±0·013	0·013
0·850	1·120	±0·02	0·020
1·120	12·5	±0·04	0·04
12·5	—	±0·05	0·05

Table 4 Permissible Deviation in Size of Drawn Stainless Steel Wire (Square, Hexagon and Octagon)

(*Clause* 9.1)

Size* mm	Permissible Deviation, mm	
	Over	Under
From 3·15 up to and excluding 8·00	0	0·050
From 8·00 up to and excluding 12·5	0	0·08
12·5	0	0·10

*Distance across flats.

Table 5 Permissible Deviation in Size of Cold Finished Stainless Steel Flat Wire

(*Clause* 9.1)

All dimensions in millimetres.

Specified Width	Thickness Tolerance Over and Under for Given Thickness		Width Tolerance	
	Under 0.75	0·75 Up to But not Including 0·90	0·90 Up to But not Including 4·75	Over	Under
Above 1·5 up to and excluding 9·5		0·04	0·05	0·13	0·15

Table 6 Permissible Deviation in Size of Wire for which the Final Operation is Surface Treatment for the Purpose of Removing Scale or Drawing Lubricant

(*Clauses* 9.1 *and* 14.2)

All dimensions in millimetres.

Specified Size		Tolerance
From	Up to and Excluding	
0·600	0·850	±0 02
0·850	1·120	±0·03
1·120	8	±0·06
8·00	12·5	±0·08
12·5	—	±0·10

Table 7 Mechanical Test Requirements

(*Clauses* 10.1 *and* 12.2)

Steel Designation [*See* IS 1762 (Part 1) : 1974]	Condition (*See* Table 8)	Final Operation	Tensile Strength *Min*, MPa[1]	Yield Strength *Min*, [MPa[1]	Elongation Percent *Min* GL = 40 mm	Reduction Percent *Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
X04Cr13	A	Cold finish	480	270	16	45
X12Cr13		Annealed	480	270	20	45
X12Cr13	T	Cold finished	690	550	12	40
	M	Cold finished	820	620	12	40
X20Cr13	A		750 *Max*			
X30Cr13	A		800 *Max*			
X02Cr18Ni11 X04Cr18Ni10 X07Cr18Ni9 X04Cr17Ni12Mo2 X02Cr17Ni12Mo2 and X10Cr17Mn6Ni4 X04Cr18Ni10 X07Cr18Ni9		Annealed or softened	520	210	35	50
X04Cr17Ni12Mo2 X10Cr17Mn6Ni4	B	Cold finished	860	690	12	35

[1] 1MPa = 1N/mm² = 0·102 kgf/mm².

10.2 Reverse Bend Test

If required by the purchaser, reverse bend test for steel wire shall be carried out in accordance with IS 1716 : 1985.

10.3 Torsion Test

If required by the purchaser, the torsion test shall be carried out in accordance with IS 1717 : 1985.

10.4 Wrapping Test

If required by the purchaser, the wrapping test shall be carried out in accordance with IS 1755 : 1983.

10.5 The requirements of test specified in **10.2**, **10.3** and **10.4** shall be as agreed to between the purchaser and the manufacturer.

11 SAMPLING

11.1 Sampling for Chemical Analysis

The ladle analysis shall be supplied by the manufacturer. If the product analysis is required by the purchaser, at least one sample product shall be taken from each test.

11.2 Sampling for Mechanical Test

Unless otherwise specified, for the purpose of mechanical test, one sample shall be taken for each size grouping from each heat treatment batch representing the same cast. If the product is continuously heat-treated, the sample for mechanical test shall be agreed to between the purchaser and the manufacturer.

12 RETESTS

12.1 Retests for Product Analysis

If the results of the product analysis do not conform to the requirements given in Tables 1 and 2, unless otherwise agreed between the purchaser and the manufacturer, two new samples shall be taken on different pieces from the same cast. Should the two analysis satisfy the requirements, the lot represented shall be accepted; should either of the samples fail, the material shall be taken as not complying with this standard.

12.2 Retests for Mechanical Properties

Should any of the original test pieces fail to satisfy these requirements of the mechanical tests specified in Table 7 and clause **10.5**, two further samples shall be selected for retest for each test pieces which failed.

12.2.1 The mechanical properties obtained form the test pieces prepared from the two additional test samples shall comply with the specified requirements. Should either of the retests fail to meet the specified requirements, the material shall be taken as not complying with this standard, except that the manufacturer may reheat-treat (not more than twice) the material represented and resubmit it for testing.

13 CONDITION OF SUPPLY

13.1 The stainless steel wire may be supplied in any one of the conditions given in Table 8.

Table 8 Condition

(*Clause* 13.1)

Designation	Condition A/S (Annealed or Softened)	Condition B (Cold Worked High Tensile)	Condition T (Intermediate Temper)	Condition H (Hard Temper)
X04Cr13	A	—	—	—
X12Cr13	A	—	T	H
X20Cr13	A	—	—	—
X30Cr13	A	—	—	—
X02Cr18Ni11	S	—	—	—
X04Cr18Ni10	S	B	—	—
X07Cr18Ni9	S	B	—	—
X04Cr17Ni12Mo2	S	B	—	—
X02Cr17Ni12Mo2	S	—	—	—
X10CrI7Mn6Ni4	S	B	—	—

14 FINISH

14.1 Wire, cold finished to size, may be supplied with one of the following finishes:

a) Cold drawn,

b) Centreless ground (round wire in straight length only), and

c) Centreless ground and polished (round wire in straight length only).

14.2 Wire annealed or heat-treated and pickled as final operation shall be furnished to the tolerances given in Table 6.

15 CORROSION RESISTANCE

15.1 If required by the purchaser, the material shall be tested for corrosion resistance in accordance with IS 10461 (Part 1) : 1994 and IS 10461 (Part 2) : 1985.

16 PACKING AND MARKING

16.1 Packing

Each coil or bundle of wire (when supplied in straight lengths) shall be suitably bound and packed as agreed to between the purchaser and the manufacturer.

16.2 Marking

Each coil or bundle of wire shall be legibly marked with the following information:

a) Indication of the source of manufacture,

b) Designation of steel,

c) Condition of supply and finish,

d) Wire diameter,

e) Cast or batch number, and

f) Date of manufacture.

16.3 BIS Certification Marking

The material may also be marked with the Standard Mark.

16.3.1 The use of Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made there-under. The details of conditions under which 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)

INFORMATION TO BE GIVEN BY THE PURCHASER

A-1 BASIS FOR ORDER

A-1.1 While placing an order the purchase of stainless steel wires, covered by this standard, the purchaser should specify the following:

a) Designation of steel;

b) Description regarding size, length, etc;

c) Condition of delivery and finish;

d) Test required;

e) Method of manufacture;

f) Any special requirements; and

g) Test report, if required.

ANNEX B

(*Clause* 8.2)

RECOMMENDED HEAT TREATMENT FOR STAINLESS STEELS

Steel Designation	Symbols*	Annealing Softening Temperature °C	Cooling Media†
Ferritic Steels			
X04Cr13	A	750 to 800	f, a
Martensitic Steels			
X12Cr13	A	700 ,, 780	a
	A	770 ,, 870	f
X20Cr13	A	700 ,, 870	f
X30Cr13	A	700 ,, 870	f
Austenitic Steels			
X02Cr18Ni11	S	1000 ,, 1120	w, a
X04Cr18Ni10	S	1000 ,, 1120	w, a
X07Cr18Ni9	S	1000 ,, 1120	w, a
X04Cr17Ni12Mo2	S	1000 ,, 1120	w, a
X02Cr17Ni12Mo2	S	1000 ,, 1120	w, a
X10Cr17Mn6Ni4	S	1000 ,, 1120	w, a

*A = Annealing, and S = Softening.

†f = Furnace, a = Air and w = Water.

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Review of Indian Standards

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