IS 4454 (Part 1) : 2001

भारतीय मानक

यांत्रिक स्प्रिंग के लिए इस्पात के तार — विशिष्टि

भाग 1 अतप्त कर्षित अमिश्रित इस्पात तार

(तीसरा पुनरीक्षण)

Indian Standard

STEEL WIRE FOR MECHANICAL SPRINGS — SPECIFICATION

PART 1 COLD DRAWN UNALLOYED STEEL WIRE

(Third Revision)

ICS 21.160; 77.140.25

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

March 2001

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FOREWORD

This Indian Standard (Part 1) (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 1967 and subsequently revised in 1975 and 1981. While reviewing the standard in the light of experience gained during these years, the Committee decided to revise it to bring it in line with the present practices being followed by the Indian industry.

In this revision following changes have been made:

a) Grade designation has been modified,

b) Chemical composition and tensile strength values have been modified,

c) Dimensional tolerances have been modified,

d) Provision of wrapping test, torsion test and decarburization test have been modified, and

e) Coating and surface finish requirements have been modified.

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

The properties governing the application of steels for springs may be considerably influenced by their chemical composition as well as the modes of mechanical treatment and heat treatment applied. It is for these reasons that a very large variety of steels may be employed in the manufacture of steel springs. This variety is further increased owing to the fact that in certain cases these springs have to exhibit considerable resistance against corrosive influences and withstand elevated temperature and that the mechanical stress is imposed on them vary considerably. In order to facilitate clear survey, the steels are classified into three categories.

This part is one of the series of Indian Standards on steel wire for mechanical springs. Other parts in the series are:

Part 2 Oil hardened and tempered steel wire

Part 4 Stainless steel wire

Examples of application for cold drawn unalloyed steel wire have been given in Annex B.

In the preparation of this standard, assistance has been derived from the following standards:

a) ISO/CD 8458-1 Steel wire for mechanical springs : Part 1 General requirements (Aug 98)

b) ISO/CD 8458-2 Steel wire for mechanical springs : Part 2 Patented and cold-drawn unalloyed steel wire (Aug 98)

c) prEN 10270-1 Steel wire for mechanical springs : Part 1 Patented and cold-drawn unalloyed steel wire (June 96)

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

STEEL WIRE FOR MECHANICAL SPRINGS — SPECIFICATION

PART 1 COLD DRAWN UNALLOYED STEEL WIRE

(Third Revision)

1 SCOPE

This standard (Part 1) covers the requirements of cold drawn unalloyed steel wires of circular cross section for the manufacture of mechanical springs for static duty and dynamic duty applications. Patenting, prior to drawing, may be carried out as and when required.

2 REFERENCES

The following Indian Standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
228 (in Parts)	Method for chemical analysis of steel
1608 : 1995	Mechanical testing of metals-tensile testing (*second revision*)
1717 : 1985	Method for simple torsion test for wire (*second revision*)
1755 : 1983	Method for wrapping test for metallic wire (*first revision*)
1956 (Part 5) : 1976	Glossary of terms relating to iron and steel : Part 5 Bright steel bar and steel wire (*first revision*)
4905 : 1968	Methods for random sampling
6396 : 1983	Method of measuring decarburized depth of steel (*first revision*)
8910 : 1978	General technical delivery requirements for steel and steel products

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 1956 (Part 5) and the following shall apply.

3.2 Cast; Helix; Pitch — The way in which a single ring of wire behaves when cut from coil.

NOTE — The terms spool, core-less spool and cheese are synonymous with coil.

3.3 Patented Cold-Drawn Wire — Wire drawn to size by cold deformation of a starting material that has been subjected to a thermal treatment of patenting.

3.4 Static Duty — Qualifies applications where springs are subjected to static stresses or infrequent dynamic loading, or a combination of both.

NOTE — This does not apply to situations of low frequency high stress.

3.5 Dynamic Duty — Qualifies applications where springs are subjected to frequent or predominantly dynamic loading and where small coiling ratios or severe bending radius is required.

3.6 Ring — One turn of wire from a coil, that is, one complete circle of wire.

NOTE — A ring of wire does not imply any specific length of wire or diameter of wire.

4 SUPPLY OF MATERIAL

General requirements relating to the supply of material shall be as laid down in IS 8910.

5 GRADES

The grade of spring wire used depends on the stress level and on the nature of duty. The wire diameter ranges and tensile strength grades normally available for static duty and dynamic duty are given in Table 1.

6 MANUFACTURE

6.1 The processes used in making the steel and in manufacturing patented and cold drawn spring steel wire are left to the discretion of the manufacturer. The customer should be informed of the manufacturing process, if he so desires.

6.2 The steel shall be supplied in fully killed condition.

Table 1 Spring Wire Grades

(*Clause* 5)

Tensile Strength	Static Duty	Diameter Range mm	Dynamic Duty	Diameter Range mm
(1)	(2)	(3)	(4)	(5)
Low tensile strength	SL	1.00-10.00	—	—
Medium tensile strength	SM	0.30-20.00	DM	0.08-20.00
High tensile strength	SH	0.30-20.00	DH	0.05-20.00

NOTE — For specific applications, other tensile strength requirements may be agreed.

7 CHEMICAL COMPOSITION

7.1 Ladle analysis of the material when carried out either by the method specified in the relevant part of IS 228 or any other established instrumental/chemical method, shall be as given in Table 2. In case of dispute, the procedure given in the relevant part of IS 228 shall be the referee method. However, where the method is not given in IS 228 or its relevant parts, the referee method shall be as agreed to between the purchaser and the manufacturer.

7.1.1 Elements not specified in Table 2 shall not be added to the steel, except where agreed to, other than for the purpose of finishing the heat.

7.2 Product Analysis

Permissible variations in case of product analysis from the limits specified in Table 2 shall be as given in Table 3.

7.2.1 In case of product analysis, copper content shall not exceed the limits specified in Table 2.

Table 2 Chemical Composition

(*Clauses* 7.1, 7.1.1 *and* 7.2, 7.2.1)

Grade	Constituent, Percent					
	C	Si	Mn	S *Max*	P *Max*	Cu *Max*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
SL,SM, SH	0.35-1.00	0.10-0.30	0.30-1.20	0.030	0.030	0.20
DM, DH	0.45-1.00	0.10-0.30	0.30-1.50	0.020	0.025	0.12

NOTES

1 Such a wide range of carbon is stipulated to accommodate for the whole range of sizes. For individual sizes, the carbon range is substantially more restricted, which has to be mutually agreed to between the purchaser and the manufacturer.

2 The range of manganese content is so wide to cope with various processing situations and the broad size range. The real figures as per size shall be more restricted, which has to be mutually agreed to between the purchaser and the manufacturer.

3 Stricter compositions may be mutually agreed between the purchaser and the manufacturer.

4 Micro alloying may be allowed subject to mutual agreement between the purchaser and the manufacturer. Micro alloying elements like Nb, V or Ti, when used individually or in combination, the total content shall not exceed 0.20 percent.

5 Nitrogen content shall not exceed 0.01%.

6 For grades SL, SM and SH, P%+S%=0.055% *Max* and Cu%+Ni%+Cr%=0.35% *Max*.

7 For grades DM and DH, P%+S%=0.040% *Max* and Cu%+Ni%+Cr%=0.25% *Max*.

Table 3 Permissible Variations for Product Analysis

(*Clause* 7.2)

Constituent	Permissible Variations Over and Under Specified Limit, Percent, *Max*
(1)	(2)
Carbon	0.02
Manganese	0.05
Silicon	0.03
Sulphur	0.005
Phosphorus	0.005

8 FREEDOM FROM DEFECTS

The surface of the wire shall be smooth and as free as possible from defects, such as grooves, seams, tears, rust, scale, scratches, pits, die-marks, and any other harmful defects, which may have a noticeable adverse effect on the application of the wire.

9 DIMENSIONS AND TOLERANCES

9.1 Tolerance on diameter of wire shall be as specified in Table 4. Class A tolerance is intended for wire grades SH, DM and DH. Class B tolerance is intended for wire grades SL and SM.

9.2 The difference between the maximum and minimum diameter of the wire at the same cross section shall not be more than 50 percent of the total permissible deviation specified in Table 4.

9.3 Sizes and tolerance other than those specified in Table 4 may be mutually agreed to between the purchaser and the manufacturer.

10 MECHANICAL PROPERTIES

10.1 Tensile Test

The tensile test shall be carried out in accordance with IS 1608. The tensile strength of the wire shall be as given in Table 5 and shall be calculated using the actual wire diameter.

10.2 Wrapping Test

The wrapping test shall be applied to wires with nominal diameter less than 3.00 mm. Wrapping test shall be carried out in accordance with IS 1755. The wire shall not show, on visual examination, any sign of fracture when closely coiled for at least four turns around a mandrel of diameter equal to that of the wire.

Table 4 Diameter Tolerance for Coiled Wire

(*Clauses* 9.1 *and* 9.2)

Nominal Diameter of Wire		Tolerance (±)		Nominal Diameter of Wire		Tolerance (±)	
Over	Up to and Including	Class A	Class B	Over	Up to and Including	Class A	Class B
mm	mm	mm	mm	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
—	0.05	0.003	—	1.78	2.78	0.025	0.030
0.05	0.09	0.003	—	2.78	4.00	0.030	0.030
0.09	0.17	0.004	—	4.00	5.45	0.035	0.035
0.17	0.26	0.005	—	5.45	7.10	0.040	0.040
0.26	0.37	0.006	0.010	7.10	9.00	0.045	0.045
0.37	0.65	0.008	0.012	9.00	10.00	0.050	0.050
0.65	0.80	0.010	0.015	10.00	11.10	0.070	0.070
0.80	1.01	0.015	0.020	11.10	14.50	0.080	0.080
1.01	1.78	0.020	0.025	14.50	18.30	0.090	0.090
				18.30	20.00	0.100	0.100

NOTES

1 Class A tolerance is intended for wire grades SH, DM and DH.

2 Class B tolerance is intended for wire grades SL and SM.

10.3 Torsion Test

10.3.1 The torsion test shall be applied to wires with nominal diameter from 0.70 mm up to and including 6 mm. Subject to mutual agreement between the manufacturer and the purchaser, the test may also be carried out for wires with nominal diameters over 6.00 mm and up to and including 10.00 mm.

10.3.2 The torsion test shall be carried out in accordance with IS 1717. The test piece shall be clamped into the device in such manner that its longitudinal axis is aligned to the clamping heads and the test piece remains straight during the test. One clamping head shall be turned at an uniform speed of rotation as possible (not exceeding one rotation per second) until the test piece fractures.

10.3.3 The test piece shall withstand being twisted without failure, the minimum number of turns as specified in Table 6 on a gauge length equivalent to $100 \times d$ where d is nominal diameter of the wire.

10.3.4 The test shall be continued until the fracture occurs, when the primary fracture shall be perpendicular to the axis of the wire and surface shall not split. During fly-back of the wire, secondary fractures may occur and these shall be ignored.

Table 5 Tensile Strength Requirements

(*Clause* 10.1)

Nominal Diameter of Wire, mm	Tensile Strength for Grades, MPa				
	SL	SM	DM	SH	DH
(1)	(2)	(3)	(4)	(5)	(6)
0.05	—	—	—	—	2800 - 3520
0.06	—	—	—	—	2800 - 3520
0.07	—	—	—	—	2800 - 3520
0.08	—	—	2780 - 3100	—	2800 - 3480
0.09	—	—	2740 - 3060	—	2800 - 3430
0.10	—	—	2710 - 3020	—	2800 - 3380
0.11	—	—	2690 - 3000	—	2800 - 3350
0.12	—	—	2660 - 2960	—	2800 - 3320
0.14	—	—	2620 - 2910	—	2800 - 3250
0.16	—	—	2570 - 2860	—	2800 - 3200
0.18	—	—	2530 - 2820	—	2800 - 3160
0.20	—	—	2500 - 2790	—	2800 - 3110
0.22	—	—	2470 - 2760	—	2770 - 3080
0.25	—	—	2420 - 2710	—	2720 - 3010
0.28	—	—	2390 - 2670	—	2680 - 2970
0.30	—	2370 - 2650	2370 - 2650	2 660 - 2 940	2660 - 2940
0.32	—	2350 - 2630	2350 - 2630	2 640 - 2 920	2640 - 2920
0.34	—	2330 - 2600	2330 - 2600	2 610 - 2 890	2610 - 2890
0.36	—	2310 - 2580	2310 - 2580	2 590 - 2 870	2590 - 2890
0.38	—	2290 - 2560	2290 - 2560	2 570 - 2 850	2570 - 2850
0.40	—	2270 - 2550	2270 - 2550	2 560 - 2 830	2570 - 2830
0.43	—	2250 - 2520	2250 - 2520	2 530 - 2 800	2570 - 2800
0.45	—	2240 - 2500	2240 - 2500	2 510 - 2 780	2570 - 2780
0.48	—	2220 - 2480	2240 - 2500	2 490 - 2 760	2570 - 2760
0.50	—	2200 - 2470	2200 - 2470	2 480 - 2 740	2480 - 2740
0.53	—	2180 - 2450	2180 - 2450	2 460 - 2 720	2460 - 2720
0.56	—	2170 - 2430	2170 - 2430	2 440 - 2 700	2440 - 2700
0.60	—	2140 - 2400	2140 - 2400	2 410 - 2 670	2410 - 2670
0.63	—	2130 - 2380	2130 - 2380	2 390 - 2 650	2390 - 2650
0.65	—	2120 - 2370	2120 - 2370	2 380 - 2 640	2380 - 2640
0.70	—	2090 - 2350	2090 - 2350	2 360 - 2 610	2360 - 2610

Table 5 (*Continued*)

Nominal Diameter of Wire, mm (1)	Tensile Strength for Grades, MPa				
	SL (2)	SM (3)	DM (4)	SH (5)	DH (6)
0.75	—	2070 - 2330	2070 - 2330	2340 - 2580	2340 - 2580
0.80	—	2050 - 2300	2050 - 2300	2310 - 2560	2310 - 2560
0.85	—	2030 - 2280	2030 - 2280	2290 - 2530	2290 - 2530
0.90	—	2010 - 2260	2010 - 2260	2270 - 2510	2270 - 2510
0.95	—	2000 - 2240	2000 - 2240	2250 - 2490	2250 - 2490
1.00	1720 - 1970	1980 - 2220	1980 - 2220	2230 - 2470	2230 - 2470
1.05	1710 - 1950	1960 - 2220	1960 - 2220	2210 - 2450	2210 - 2450
1.10	1690 - 1940	1950 - 2190	1950 - 2190	2200 - 2430	2200 - 2430
1.20	1670 - 1910	1920 - 2160	1920 - 2160	2170 - 2400	2170 - 2400
1.25	1660 - 1900	1910 - 2130	1910 - 2130	2140 - 2380	2140 - 2380
1.30	1640 - 1890	1900 - 2130	1900 - 2130	2140 - 2370	2140 - 2370
1.40	1620 - 1860	1870 - 2100	1870 - 2100	2110 - 2340	2110 - 2340
1.50	1600 - 1840	1850 - 2080	1850 - 2080	2090 - 2310	2090 - 2310
1.60	1590 - 1820	1830 - 2050	1830 - 2050	2060 - 2290	2060 - 2290
1.70	1570 - 1800	1810 - 2030	1810 - 2030	2040 - 2260	2040 - 2260
1.80	1550 - 1780	1790 - 2010	1790 - 2010	2020 - 2240	2020 - 2240
1.90	1540 - 1760	1770 - 1990	1770 - 1990	2000 - 2220	2000 - 2220
2.00	1520 - 1750	1760 - 1970	1760 - 1970	1980 - 2200	1980 - 2200
2.10	1510 - 1730	1740 - 1960	1740 - 1960	1970 - 2180	1970 - 2180
2.25	1490 - 1710	1720 - 1930	1720 - 1930	1940 - 2150	1940 - 2150
2.40	1470 - 1690	1700 - 1910	1700 - 1910	1920 - 2130	1920 - 2130
2.50	1460 - 1680	1690 - 1890	1690 - 1890	1900 - 2110	1900 - 2110
2.60	1450 - 1660	1670 - 1880	1670 - 1880	1890 - 2100	1890 - 2100
2.80	1420 - 1640	1650 - 1850	1650 - 1850	1860 - 2070	1860 - 2070
3.00	1410 - 1620	1630 - 1830	1630 - 1830	1840 - 2040	1840 - 2040
3.20	1390 - 1600	1610 - 1810	1610 - 1810	1820 - 2020	1820 - 2020
3.40	1370 - 1580	1590 - 1780	1590 - 1780	1790 - 1990	1790 - 1990
3.60	1350 - 1560	1570 - 1760	1570 - 1760	1770 - 1970	1770 - 1970
3.80	1340 - 1540	1550 - 1740	1550 - 1740	1750 - 1950	1750 - 1950
4.00	1320 - 1520	1530 - 1730	1530 - 1730	1740 - 1930	1740 - 1930
4.25	1310 - 1500	1510 - 1700	1510 - 1700	1710 - 1900	1710 - 1900
4.50	1290 - 1490	1500 - 1680	1500 - 1680	1690 - 1880	1690 - 1880
4.75	1270 - 1470	1480 - 1670	1480 - 1670	1680 - 1840	1680 - 1840
5.00	1260 - 1450	1460 - 1650	1460 - 1650	1660 - 1830	1660 - 1830
5.30	1240 - 1430	1440 - 1630	1440 - 1630	1640 - 1820	1640 - 1820
5.60	1230 - 1420	1430 - 1610	1430 - 1610	1620 - 1800	1620 - 1800
6.00	1210 - 1390	1400 - 1580	1400 - 1580	1590 - 1770	1590 - 1770
6.30	1190 - 1380	1390 - 1560	1390 - 1560	1570 - 1750	1570 - 1750
6.50	1180 - 1370	1380 - 1550	1380 - 1550	1560 - 1740	1560 - 1740
7.00	1160 - 1340	1350 - 1530	1350 - 1530	1540 - 1710	1540 - 1710
7.50	1140 - 1320	1330 - 1500	1330 - 1500	1510 - 1680	1510 - 1680
8.00	1120 - 1300	1310 - 1480	1310 - 1480	1490 - 1660	1490 - 1660
8.50	1110 - 1280	1290 - 1460	1290 - 1460	1470 - 1630	1470 - 1630
9.00	1090 - 1260	1270 - 1440	1270 - 1440	1450 - 1610	1450 - 1610
9.50	1070 - 1250	1260 - 1420	1260 - 1420	1430 - 1590	1430 - 1590
10.00	1060 - 1230	1240 - 1400	1240 - 1400	1410 - 1570	1410 - 1570
10.50	—	1220 - 1380	1220 - 1380	1390 - 1550	1390 - 1550
11.00	—	1210 - 1370	1210 - 1370	1380 - 1530	1380 - 1530

Table 5 (*Concluded*)

Nominal Diameter of Wire, mm	Tensile Strength for Grades, MPa				
	SL	SM	DM	SH	DH
(1)	(2)	(3)	(4)	(5)	(6)
12.00	—	1180 - 1340	1180 - 1340	1350 - 1500	1350 - 1500
12.50	—	1170 - 1320	1170 - 1320	1330 - 1480	1330 - 1480
13.00	—	1160 - 1310	1160 - 1310	1320 - 1470	1320 - 1470
14.00	—	1130 - 1280	1130 - 1280	1290 - 1440	1290 - 1440
15.00	—	1110 - 1260	1110 - 1260	1270 - 1410	1270 - 1410
16.00	—	1090 - 1230	1090 - 1230	1240 - 1390	1240 - 1390
17.00	—	1070 - 1210	1070 - 1210	1220 - 1360	1220 - 1360
18.00	—	1050 - 1190	1050 - 1190	1200 - 1340	1200 - 1340
19.00	—	1030 - 1170	1030 - 1170	1180 - 1320	1180 - 1320
20.00	—	1020 - 1150	1020 - 1150	1160 - 1300	1160 - 1300

NOTES

1 1 MPa = 1 N/mm² = 1 MN/m² = 0.1020 kgf/mm²

2 For DH grade in the size range 0.08 mm to 0.18 mm, a restricted tensile strength range of 300 MPa within the specified range may be mutually agreed to.

3 For intermediate values of the wire diameter, the values given for next larger diameter are applicable.

Table 6 Torsion Test Requirements

(*Clause* 10.3.3)

Nominal Diameter of Wire, mm		Minimum Number of Twists for Grades	
Over	Up to and Including	SL, SM and SH	DM and DH
(1)	(2)	(3)	(4)
0.69	1.40	20	25
1.40	2.00	18	22
2.00	3.50	16	20
3.50	6.00	14	18
6.00	8.00	7[1)]	9[1)]
8.00	10.00	5[1)]	7[1)]

[1)] For guidance only.

10.3.5 The result of test piece failed in the grip shall be ignored and fresh test piece shall be tested.

10.4 Bend Test

The bend test may be applied to wires with nominal diameter greater than 3.00 mm when mutually agreed between the manufacturer and the purchaser. The wires shall not show any sign of fracture, on visual examination, when bent through an angle of 180° to form a U around a mandrel of diameter equal to twice the wire diameter for sizes above 3.00 mm to 6.50 mm and equal to three times the wire diameter for sizes above 6.50 mm.

10.5 Coiling and Stretching Test

The coiling test may be applied to wires with nominal diameter not greater than 0.70 mm with mutual agreement between the manufacturer and the purchaser. A test piece approximately 500 mm in length is closely wound, under slight but reasonably uniform tension on a mandrel, three to three and half times the nominal diameter. The closed coil is then stretched so that after

releasing the stress, it sets to approximately three times its original length. The surface condition of the wire and the regularity of the spring pitch (and individual windings) shall be inspected with the test piece in this condition.

10.6 Cast of the Wire

The wire shall be uniformly cast. When a ring of wire is cut from the package and allowed to fall on the surface, the wire shall lie flat and not show a spiral cast.

10.6.1 By mutual agreement between the manufacturer and the purchaser, for sizes up to 5.00 mm, the cast requirements may be considered as being fulfilled if the following condition is satisfied:

An individual ring taken from the coil and freely hung on a hook may show an axial displacement 'f' at the ends of the ring (*see* Fig. 1). This displacement 'f' shall not exceed a value given by the following inequality:

$$f \leq \frac{(0.2\ D)}{\sqrt[4]{d}}$$

where

f = Axial displacement in mm,

D = Diameter of a free ring in mm, and

d = Nominal diameter of the wire in mm.

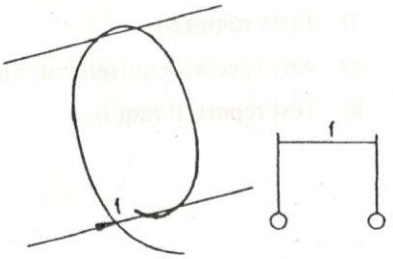

FIG. 1 CAST OF THE WIRE

10.7 Deep Etch Test

Deep etch test shall be carried out only for grades DM and DH. This test shall normally be limited to wire of 1.0 mm diameter and above. If the test is required by the purchaser on smaller sizes of wire, this shall be agreed upon at the time of enquiry and order.

10.7.1 The cold test pieces shall be immersed in a solution of 50 percent of concentrated hydrochloric acid and 50 percent of water at a temperature of 75° C minimum. The etching shall be finalized after a reduction in diameter of about 1 percent. for a period of time equivalent to two seconds for every 0.025 mm of diameter, with a maximum of five minutes, after which, when examined microscopically, the radial depth of the seam or other surface defects shall not be greater than 1 percent of the nominal diameter of the wire.

10.7.1.1 It is necessary to heat the test pieces to a temperature of about 550°C for the purpose of stress relief before carrying out this test.

10.8 Decarburization Test

Decarburization test shall be carried out only for grades DM and DH as specified in IS 6396.

10.8.1 The wires of grades DM and DH shall show no completely decarburized layer. Partial decarburization, as indicated by grain boundary ferrite of an amount in excess of that present in the main portion or core of the section, shall not have a radial depth greater than 1.5 percent of the nominal diameter of the wire or 0.05 mm, whichever is the lowest.

11 COATING AND SURFACE FINISH

The spring wire may be lime, borax or phosphate coated either by dry drawing or by wet drawing. A metallic coating, where required, shall be commonly of copper, zinc or zinc/aluminium alloy. Surface finish and mass of coating and their methods of test shall be as per the mutual agreement between the purchaser and the manufacturer.

11.1 Other coatings may be agreed between the manufacturer and the purchaser.

11.2 The wire can additionally be ordered with an oiled surface for all surface finishes.

11.3 If no specific finish is specified, the type of finish shall be at the manufacturer's discretion.

12 SAMPLING

Unless otherwise agreed to, the method of drawing representative samples of the material and the criteria for conformity shall be as prescribed in Annex C.

13 CONDITION OF DELIVERY

13.1 The coil of wire shall consist of one single length of wire originating from one heat only. Welds prior to the last patenting operation are allowed; all other welds shall be removed or, if so agreed between the purchaser and the manufacturer, properly marked. The wires shall not be kinked and wavy.

13.2 The wire may be supplied in lime coated or borax coated or phosphate coated and/or oiled condition. These may also be supplied with metallic coating of copper, zinc or zinc/aluminium alloy if mutually agreed between the manufacturer and the purchaser.

13.3 The weight of the coils, the eye dimensions and other forms of supply shall be mutually agreed to between the purchaser and the manufacturer.

14 PACKING

The packing of the material shall be done in such a way that corrosion does not attack the material during transit. There shall not be any damage during normal handling in transit. The suitable mode of packing shall be mutually agreed to between the purchaser and the manufacturer.

15 MARKING

15.1 Each coil of wire and bundle of straightened and cut lengths shall be legibly marked with the following information:

a) Name of the supplier,
b) Wire grade,
c) Wire diameter,
d) Surface finish,
e) Weight of the coil/bundle,
f) Coating,
g) Cast or batch number, and
h) Date of supply.

15.1.1 The material may also be marked with the Standard Mark.

15.1.2 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 the 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

While placing order for spring steel wires covered by this standard, the purchaser should specify the following:

a) The desired quantity;
b) The wire grade;
c) Nominal wire diameter;
d) Surface finish and coating where relevant;
e) The form and condition of delivery;
f) Tests required;
g) Any special requirement; and
h) Test report, if required.

ANNEX B

(*Foreword*)

EXAMPLES OF APPLICATION OF COLD DRAWN UNALLOYED STEEL WIRE

B-1 FIELD OF APPLICATION

The broad fields of application for the 5 grades of spring steel wire are given for general guidance of the designers in **B-1.1.1** to **B-1.1.5**.

B-1.1.1 Grade SL is used for tension, compression or torsion springs, which are subjected to low static stresses.

B-1.1.2 Grade SM is used for tension, compression or torsion springs intended for medium high duty mainly static or almost not dynamic.

B-1.1.3 Grade DM is used for tension, compression or torsion springs, which are subjected to medium high tensile levels of a dynamic nature. Also for wire forms which require severe bending.

B-1.1.4 Grade SH is used for tension, compression or torsion springs intended for stress conditions requiring high tensile levels, and mainly from static nature or slightly dynamic.

B-1.1.5 Grade DH is used for tension, compression or torsion springs or wire forms which are subjected to medium high stresses or medium level dynamic applications.

ANNEX C

(*Clause* 12)

SAMPLING AND CRITERIA FOR CONFORMITY

C-1 LOT

In any consignment, all the coils of wire of the same grade and diameter manufactured under essentially similar conditions of manufacture shall be grouped together to constitute a lot.

C-1.1 Sample shall be taken from each lot and tested for conformity to the standard.

C-2 SAMPLING

The number of coils to be taken from a lot shall be according to col 1 and 2 of Table 7. These samples shall be taken at random by using random number tables (*see* IS 4905).

C-3 PREPARATION OF SAMPLES AND NUMBER OF TESTS

C-3.1 Tests for Physical Requirements

From the coils selected from col 1 and 2 of Table 7, adequate length of test piece shall be cut from each end and subjected to physical tests, namely, size, surface condition, tensile, bend, wrapping and coating tests.

A test piece failing to meet any one of the requirements, shall be called a defective. If the number of defectives found is less than or equal to the permissible number of defectives specified in col 3 of Table 7, the lot shall be considered to have conformed to physical requirements.

C-3.2 Tests for Chemical Requirements

Unless otherwise agreed, the following procedure shall be followed for chemical requirements:

From these test pieces which have conformed to physical requirements further test pieces shall be selected at random according to col 4 of Table 7. These samples shall be tested for all the chemical requirements. If a test piece fails to meet the respective chemical requirement, it shall be called a defective. The lot shall be considered to have conformed to the chemical requirements if all the individual test pieces tested for chemical requirements pass the test.

C-4 CRITERIA FOR CONFORMITY

A lot shall be considered to have conformed to the requirements of the specification if **C-3.1** and **C-3.2** are satisfied.

Table 7 Scale of Sampling and Permissible Number of Defectives

(*Clauses* C-2, C-3.1 *and* C-3.2)

No. of Coils in the Lot	No. of Coils for Physical Requirements	Permissible Number of Defectives (s)	No. of Tests for Chemical Requirements
(1)	(2)	(3)	(4)
Up to 25	2	0	1
26 to 50	3	0	1
51 to 150	5	0	2
151 to 300	8	1	2
301 and above	13	1	2

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FOREWORD

This Indian Standard (Part 1) (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 1967 and subsequently revised in 1975 and 1981. While reviewing the standard in the light of experience gained during these years, the Committee decided to revise it to bring it in line with the present practices being followed by the Indian industry.

In this revision following changes have been made:

a) Grade designation has been modified,
b) Chemical composition and tensile strength values have been modified,
c) Dimensional tolerances have been modified,
d) Provision of wrapping test, torsion test and decarburization test have been modified, and
e) Coating and surface finish requirements have been modified.

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

The properties governing the application of steels for springs may be considerably influenced by their chemical composition as well as the modes of mechanical treatment and heat treatment applied. It is for these reasons that a very large variety of steels may be employed in the manufacture of steel springs. This variety is further increased owing to the fact that in certain cases these springs have to exhibit considerable resistance against corrosive influences and withstand elevated temperature and that the mechanical stress is imposed on them vary considerably. In order to facilitate clear survey, the steels are classified into three categories.

This part is one of the series of Indian Standards on steel wire for mechanical springs. Other parts in the series are:

Part 2 Oil hardened and tempered steel wire
Part 4 Stainless steel wire

Examples of application for cold drawn unalloyed steel wire have been given in Annex B.

In the preparation of this standard, assistance has been derived from the following standards:

a) ISO/CD 8458-1 Steel wire for mechanical springs : Part 1General requirements (Aug 98)
b) ISO/CD 8458-2 Steel wire for mechanical springs : Part 2 Patented and cold-drawn unalloyed steel wire (Aug 98)
c) prEN 10270-1 Steel wire for mechanical springs : Part 1 Patented and cold-drawn unalloyed steel wire (June 96)

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.