

SPECIFICATION FOR
PATENTED
COLD DRAWN STEEL
SPRING WIRE

B.S. 1408 : 1964

Price 7/6 net

BRITISH STANDARDS INSTITUTION

INCORPORATED BY ROYAL CHARTER

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THIS BRITISH STANDARD, having been approved by the Iron and Steel Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 16th December, 1964.

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The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 4000, fully indexed and with a note of the contents of each, will be found in the British Standards Yearbook, price 15s. The B.S. Yearbook may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standard:

B.S. 18. Methods for tensile testing of metals.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following B.S.I. references relate to the work on this standard:
Committee references ISE/26, ISE/26/4
Draft for comment D63/13745

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CO-OPERATING ORGANIZATIONS

The Iron and Steel Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Alloy Steels Association
 *British Bolt, Nut, Screw and Rivet Federation
 British Cast Iron Research Association
 British Constructional Steelwork Association
 British Electrical and Allied Manufacturers' Association
 *British Iron and Steel Federation
 British Ironfounders' Association
 British Mechanical Engineering Federation
 British Railways Board
 British Steel Castings Research Association
 Council of Iron Producers
 Council of Ironfoundry Associations
 Crown Agents for Oversea Governments and Administrations
 Engineering Equipment Users' Association
 Federation of Civil Engineering Contractors
 Institute of British Foundrymen
 *Institute of Iron and Steel Wire Manufacturers
 Institute of Marine Engineers
 Institution of Civil Engineers
 Institution of Mechanical Engineers (Automobile Division)
 Institution of Production Engineers
 Institution of Structural Engineers
 Iron and Steel Board
 Iron and Steel Institute
 Joint Iron Council
 Lloyd's Register of Shipping
 Ministry of Aviation
 *Ministry of Defence, Army Department
 Ministry of Defence, Navy Department
 Ministry of Labour (H.M. Factory Inspectorate)
 Ministry of Transport
 National Association of Drop Forgers and Stampers
 National Ironfounding Employers' Federation
 National Physical Laboratory (D.S.I.R.)
 Oil Companies Materials Association
 Royal Institute of British Architects
 Shipbuilding Employers' Federation
 Society of British Aerospace Companies Ltd.
 *Society of Motor Manufacturers and Traders Ltd.

The Government department and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Federation of Wire Rope Manufacturers of Great Britain
 Fencing Contractors' Association
 Institution of Engineering Inspection
 Music Wire Export Association
 Patented Steel Wire Association
 Spring Manufacturers' Research Association

BRITISH STANDARD SPECIFICATION FOR
PATENTED COLD DRAWN STEEL
SPRING WIRE

FOREWORD

This British Standard, which has been revised under the authority of the Iron and Steel Industry Standards Committee, is now confined to patented cold drawn round steel spring wire, and no longer makes reference to B.S. 970, En 49, to define the quality of the wire, though the classifying letters B, C and D have been retained to maintain continuity with the 1947 edition of the standard.

The revised standard now also includes in Part 2 a specification, complete in itself, for high quality patented cold drawn steel spring wire, known as music wire, for which the classifying letter M has been given. For this wire the choice of two ranges of tensile strength are given as against the three ranges for the B, C and D qualities of wire.

The standard covers a very wide range of wire sizes and in the opinion of the Committee it is not generally practicable to perform all the specified tests on the whole range of wire sizes. Appropriate limits are given where necessary.

NOTE 1. Where metric equivalents are stated, the figures in British units are to be regarded as standard. The metric conversions are approximate. More accurate conversions should be based on the tables in B.S. 350, 'Conversion factors and tables'.

NOTE 2. In place of the customary, but incorrect use of the ton as a unit of force, the unit called a ton-force (abbreviation tonf) has been used in this standard. It is the force which, when acting on a body of mass 1 ton, gives it an acceleration equal to that of standard gravity. Similar considerations apply to kilogramme-force (abbreviation kgf).

PART 1

SECTION ONE: GENERAL CLAUSES

SCOPE

1. Three patented steel spring wire specifications are given in Part 1 of this standard, for cold drawn round wire between 0.01 in (0.25 mm) and 0.413 in (10.5 mm) diameter; these are:

B.S. 1408-B : Steel spring wire.

B.S. 1408-C : High duty underground steel spring wire.

B.S. 1408-D : High duty ground steel spring wire.

Section One specifies the general requirements and test methods for the three specifications, whilst Section Two gives the specific requirements for each of the three specifications. Each full specification therefore comprises the appropriate part of Section Two and the relevant clauses of Section One.

STEELMAKING PROCESS

2. The steel shall be made by the open hearth, electric or any of the oxygen processes*. In the case of the oxygen processes the nitrogen content of the steel shall not exceed 0.008 per cent.

CHEMICAL COMPOSITION

3. The chemical compositions of the steels specified in Section Two are based on cast analysis. On request, the wire manufacturer shall supply the cast analysis for the specified elements. Any subsequent analytical checks shall take into consideration the heterogeneity normal to the steel.

FREEDOM FROM DEFECTS

4. a. The ingots, blooms or billets shall be so prepared as to remove surface imperfections which might produce defects in the wire made from them.

b. The rod from which the wire is drawn and the finished wire shall be free from harmful surface defects, pipe and other flaws.

SURFACE FINISH

5. The wire shall be supplied in a smooth bright drawn condition, unless otherwise specified. When specified by the purchaser it may be supplied with a metallic or other coating. Galvanized wire shall comply with Clause 9.

* This term includes both top and bottom oxygen processes

SELECTION OF TEST SAMPLES

6 Test samples of sufficient length for the prescribed tests shall be cut from each end of each coil of wire. Apart from the test piece for the deep etch test, Sub-clause 8e, the test samples shall not be heat-treated.

Wire supplied in straight lengths shall be grouped in such a manner as to be clearly identified with the coil from which the lengths have been cut. Two test samples selected at random shall then be considered to be representative of each coil of wire.

TOLERANCES

7. a. *Diameter of wire.* The tolerance on the specified diameter shall be as given in Table 1.

TABLE 1. TOLERANCES

BRITISH UNITS				EQUIVALENT METRIC UNITS			
Nominal wire diameter		Plus and minus tolerance		Nominal wire diameter		Plus and minus tolerance	
Over	Up to and including	Wire in coils	Wire in straight lengths	Over	Up to and including	Wire in coils	Wire in straight lengths
in	in	in	in	mm	mm	mm	mm
0-009	0-014	0-0002	0-0007	0-23	0-36	0-005	0-018
0-014	0-022	0-0003	0-0008	0-36	0-56	0-009	0-020
0-022	0-072	0-0005	0-0010	0-56	1-83	0-013	0-025
0-072	0-128	0-0007	0-0012	1-83	3-25	0-018	0-030
0-128	0-192	0-0010	0-0015	3-25	4-88	0-025	0-038
0-192	0-413	0-0015	0-0020	4-88	10-5	0-038	0-051

b. *Circularity of wire.* The cross-section of round wire shall be circular to within half the diameter tolerance specified.

TESTS

8. a. *Tensile test.* The tensile test shall be carried out in accordance with the requirements of B.S. 18, 'Methods for tensile testing of metals', and the tensile strength shall be calculated on the nominal diameter of the wire. The three tensile strength ranges for the different sizes of wire are given in Table 2.

TABLE 2. TENSILE STRENGTH

BRITISH UNITS					EQUIVALENT METRIC UNITS				
Nominal wire diameter		Tensile strength			Nominal wire diameter		Tensile strength		
Over	Up to and including	Range 1	Range 2	Range 3	Over	Up to and including	Range 1	Range 2	Range 3
in	in	tonf/in ²	tonf/in ²	tonf/in ²	mm	mm	kgf/mm ²	kgf/mm ²	kgf/mm ²
0-0090	0-0155	140 min	150 min	160 min	0-23	0-39	220 min.	236 min	252 min
0-0155	0-022	130 min	140 min	150 min	0-39	0-56	205 min	220 min	236 min
0-022	0-033	120/130	130/140	140/150	0-56	0-84	190/205	205/220	220/236
0-033	0-051	110/120	120/130	130/140	0-84	1-30	173/190	190/205	205/220
0-051	0-085	100/110	110/120	120/130	1-30	2-16	157/173	173/190	190/205
0-085	0-135	90/100	100/110	110/120	2-16	3-43	142/157	157/173	173/190
0-135	0-201	80/90	90/100	100/110	3-43	5-10	125/142	142/157	157/173
0-201	0-263	70/80	80/90	90/100	5-10	6-68	110/125	125/142	142/157
0-263	0-413	70/80	80/90	80/90	6-68	10-5	—	110/125	125/142

NOTE. A tolerance of ± 5 tonf/in² (± 8 kgf/mm²) is allowed beyond the maximum tensile strength of the range specified, unless otherwise specified on the order.

b. *Torsion test.* The ends of the test piece shall be gripped in two vices, the distance apart of which may be varied to accommodate different lengths of test piece, and one of which shall be free to move longitudinally during the progress of the test.

The test piece shall be twisted by causing one of the vices to revolve until fracture occurs and the number of twists shall be indicated by a counter. The speed of twisting shall not exceed 60 turns per minute.

The test pieces, selected as specified in Clause 6, shall, without sign of failure, withstand being twisted uniformly the specified number of turns in one direction on a length normally equivalent to 100 diameters. The number of turns shall be as given in Table 3. If the length of the test piece is more or less than 100 diameters, the numbers of turns shall be altered proportionately.

TABLE 3. NUMBER OF TURNS

Nominal wire diameter	Number of turns for all tensile ranges
Under 0.086 in (2.2 mm)	20
0.086 in (2.2 mm) and over	15

The test shall be continued until fracture occurs, when the primary fracture shall be clean and perpendicular to the axis of the wire, any secondary helical fractures shall be ignored.

c. *Reverse bend test.* For wire of 0.086 in (2.2 mm) diameter and over.

The test piece selected as specified in Clause 6, shall, without sign of fracture, withstand repeated bending in opposite directions, each bend being over a support having a specified radius. One reverse bend consists of bending the test piece through an angle of 90° and then returning it to the original position. This is counted as one bend. The test piece is then bent through 90° in the opposite direction and back to the original position which counts as the second bend. The test is then repeated in opposite directions through 90° and back to the original position until fracture occurs. The bend in which fracture occurs shall not be counted.

Alternatively, if the bending machine is equipped with an automatic counter operating on the limiting stops, then the first bend down through 90° shall count as one bend. For the second bend the wire shall then be bent in the opposite direction through 180°. The process shall be repeated in opposite directions, one bend being counted for each 180° movement. By this method the bend in which fracture occurs shall not be counted under any circumstances.

The rate of testing shall not exceed one reverse bend per second. The number of bends and the radius of the support for different sizes of wire and tensile strengths are given in Table 4. For the purpose of deciding the minimum bend requirement, if the supplied tensile range differs from the nominal range given in Table 2, the latter shall be the criterion for fixing the bent value required.

d. *Wrapping test.* For wire under 0.086 in (2.2 mm) diameter down to and including 0.024 in (0.61 mm).

The test pieces, selected as specified in Clause 6, shall, without sign of failure, withstand being wrapped eight complete turns round a spindle equal to the diameter of the wire.

TABLE 4. NUMBER OF REVERSE BENDS

Nominal wire diameter British units		Radius of support	Number of reverse bends for wire of actual tensile strength		Nominal wire diameter in equivalent metric units	
Over	Up to and including		Up to but not including 100 tonf/in ² (157 kgf/mm ²)	100 tonf/in ² (157 kgf/mm ²) up to and includ- ing 120 tonf/in ² (190 kgf/mm ²)	Over	Up to and including
in	in	mm			mm	mm
0.086	0.091	5.0	6	5	2.2	2.3
0.091	0.098	7.5	11	9	2.3	2.5
0.098	0.110	7.5	8	7	2.5	2.8
0.110	0.118	7.5	7	6	2.8	3.0
0.118	0.122	10.0	11	9	3.0	3.1
0.122	0.135	10.0	9	8	3.1	3.4
0.135	0.138	10.0	8	—	3.4	3.5
0.138	0.146	15.0	10	—	3.5	3.7
0.146	0.157	15.0	9	—	3.7	4.0
0.157	0.173	15.0	8	—	4.0	4.4
0.173	0.189	15.0	6	—	4.4	4.8
0.189	0.201	15.0	5	—	4.8	5.1
0.201	0.220	15.0	4	—	5.1	5.6
0.220	0.256	15.0	3	—	5.6	6.5
0.256	0.276	15.0	2	—	6.5	7.0
0.276	0.295	20.0	5	—	7.0	7.5
0.295	0.315	20.0	4	—	7.5	8.0
0.315	0.335	20.0	3	—	8.0	8.5
0.335	0.374	20.0	2	—	8.5	9.0
0.374	0.394	20.0	1	—	9.5	10.0
0.394	0.413	20.0	1	—	10.0	10.5

e. Deep etch test. This test shall normally be limited to wire of 0.064 in (1.6 mm) diameter or over. If the test is required by the purchaser on smaller sizes of wire this shall be stated on the order.

The test pieces, selected as specified in Clause 6, shall be immersed in a boiling solution of 50 per cent of concentrated hydrochloric acid and 50 per cent of water for a period of time equivalent to two seconds for every 0.001 in (0.025 mm) of diameter, with a maximum of five minutes, after which, when examined macroscopically, they shall be free from seams or other defects likely to prejudice the performance of the finished spring.

It is necessary to heat the test pieces to a temperature of about 400°C, for the purpose of stress relief before carrying out this test.

f. Decarburization test. This test shall normally be limited to wire of 0.064 in (1.6 mm) diameter or over. If the test is required by the purchaser on smaller sizes of wire this shall be stated on the order.

A cross-section from each batch of not more than five coils of wire shall be prepared and mounted in a manner capable of suitably supporting the edge of the specimen for preparation of the section. Any metallic coating may be suitably removed.

After polishing and etching by an accepted method the section shall be examined at a magnification of 200 diameters.

g. Dead wire test. The wire shall be properly dressed during the process of wire drawing so that the wire shall lie flat in the coil without any corkscrew set.

GALVANIZING

9. Unless otherwise agreed between the purchaser and manufacturer the weight of coat shall be not less than 0.10 oz/ft² (30 gm/m²). This clause applies to 0.018 in (0.46 mm) diameter wire and thicker. For the smaller sizes, if necessary, the weight of coat shall be agreed between the purchaser and manufacturer.

RETESTS

10. Should any sample fail any of the tests, two additional test samples may be taken from the same end of the same coil and subjected to the test or tests in which the original sample failed. The manufacturer may discard part of the coil prior to removing the samples for retest.

Should both additional test samples pass the test or tests, the coil from which they were taken shall be deemed to comply with the requirements of this British Standard. Should either of them fail the coil shall be deemed not to comply.

PACKING AND IDENTIFICATION

11. The wire manufacturer shall ensure that each coil is securely tied, and shall attach to each coil a suitable label or labels on which shall be shown the number of this British Standard, the specification letter, the size of the wire, the tensile strength and such other markings as may be agreed between the purchaser and the manufacturer.

DESIGNATION FOR ORDERING PURPOSES

12. For ordering purposes the wire shall be designated by the number of this British Standard, the appropriate specification letter, the tensile strength range and the diameter of the wire in inches or millimetres.

For example:

(i) 8 SWG ground high duty patented cold drawn steel spring wire of tensile strength 90/100 tonf/in² shall be designated:

B.S. 1408 : D : 2; 0.160 in.

(ii) 1.0 mm diameter commercial quality patented cold drawn steel spring wire of tensile strength 205 kgf/mm² shall be designated:

B.S. 1408 : B : 3; 1.0 mm.

B.S. 1408-B
STEEL SPRING WIRE

GENERAL

13. This section of the specification states the specific requirements for cold drawn patented spring wire for general engineering purposes (replacing En 49B in the 1947 edition of B.S. 1408), and shall be used in conjunction with Section One: General Clauses. Three tensile ranges are specified, as given in Table 2.

CHEMICAL COMPOSITION

14. The chemical composition of the steel shall be within the following limits:

Element	Per cent	
	Min.	Max.
Carbon	0.45	0.85
Silicon	—	0.35
Manganese	0.40	1.00
Sulphur	—	0.050
Phosphorus	—	0.050

NOTE. In order to ensure a satisfactory quality of spring wire in the larger sizes it is necessary that the reduction of area by cold drawing should be as great as practicable. In the thicker sizes included in this standard it is not always possible to give as heavy a reduction by drawing as is desirable. In these cases casts of steel should be selected with suitable carbon and manganese contents, which will enable the tensile strength specified to be obtained on the specified sizes of wire with a reduction of area, by drawing from the heat-treated base, of not less than 60 per cent, wherever possible.

PROPERTIES

15. *a. Tensile strength.* The tensile strength of the test pieces selected and tested in accordance with Clauses 6 and 8a shall be shown in Table 2, corresponding to the specified tensile range.

b. Torsion test. The test pieces selected in accordance with Clause 6 shall withstand the torsion test specified in Subclause 8b.

c. Reverse bend test. The test pieces selected in accordance with Clause 6 shall withstand the reverse bend test specified in Subclause 8c.

d. Wrapping test. The test pieces, selected as specified in Clause 6, shall withstand the wrapping test specified in Subclause 8d.

e. Dead wire test. The wire shall satisfy the requirements of the dead wire test in Subclause 8g.

SECTION TWO: SPECIFIC CLAUSES FOR SPECIFICATIONS

B.S. 1408-B: Steel spring wire.

B.S. 1408-C: High duty unground steel spring wire.

B.S. 1408-D: High duty ground steel spring wire.

B.S. 1408-C

HIGH DUTY UNGROUND STEEL SPRING WIRE

GENERAL

13. This section of the specification states the specific requirements for high duty unground patented cold drawn steel spring wire (replacing En 49C in the 1947 edition of B.S. 1408) and shall be used in conjunction with Section One: General Clauses. Three tensile ranges are specified, as given in Table 2.

CHEMICAL COMPOSITION

14. The chemical composition of the steel shall be within the following limits:

Element	Per cent	
	Min.	Max.
Carbon	0.55	0.85
Silicon	—	0.35
Manganese	0.30	1.00
Sulphur	—	0.040
Phosphorus	—	0.040

NOTE. In order to ensure a satisfactory quality of spring wire in the larger sizes it is necessary that the reduction of area by cold drawing should be as great as practicable. In the thicker sizes included in this standard, it is not always possible to give as heavy a reduction by drawing as is desirable. In these cases casts of steel should be selected with narrower ranges of carbon and manganese contents, which will enable the tensile strength specified to be obtained on the specified sizes of wire with a reduction of area, by drawing from the heat-treated base, of not less than 60 per cent, wherever possible.

PROPERTIES

15. *a. Tensile strength.* The tensile strength of the test pieces, selected and tested in accordance with Clauses 6 and 8a shall be as in Table 2, corresponding to the specified tensile range.

b. Torsion test. The test pieces, selected in accordance with Clause 6, shall withstand the torsion test specified in Subclause 8f.

c. Reverse bend test. The test pieces, selected in accordance with Clause 6, shall withstand the reverse bend test specified in Subclause 8c.

d. Wrapping test. The test pieces, selected in accordance with Clause 6, shall withstand the wrapping test specified in Subclause 8d.

e. Deep etch test. The test pieces, selected in accordance with Clause 6, shall withstand the deep etch test specified in Subclause 8e.

f. Decarburization test. A cross-section from each batch of not more than five coils of wire shall be prepared and examined as specified in Subclause 8f.

The section shall show no totally decarburized zone. Partial decarburization as indicated by grain boundary ferrite shall not extend to a depth below the surface greater than a dimension equal to $1\frac{1}{2}$ per cent of the nominal diameter of the wire.

g. Dead wire test. The wire shall satisfy the requirements of the dead wire test specified in Subclause 8g.

B.S. 1408-D

HIGH DUTY GROUND STEEL SPRING WIRE

GENERAL

13. This section of the specification states the specific requirements for high duty ground patented cold drawn steel spring wire (replacing En 49D in the 1947 edition of B.S. 1408) and shall be used in conjunction with Section One; General Clauses. Wire to this specification shall be ground all over, preferably subsequent to the final patenting heat treatment, to remove surface defects and all decarburization. Three tensile ranges are specified as given in Table 2.

CHEMICAL COMPOSITION

14. The chemical composition of the steel shall be within the following limits:

Element	Per cent	
	Min.	Max.
Carbon	0.55	0.85
Silicon	—	0.35
Manganese	0.30	1.00
Sulphur	—	0.030
Phosphorus	—	0.030

NOTE. In order to ensure a satisfactory quality of spring wire in the larger sizes it is necessary that the reduction of area by cold drawing should be as great as practicable. In the thicker sizes included in this standard, it is not always possible to give as heavy a reduction by drawing as is desirable, but in these cases casts of steel should be selected with narrower ranges of carbon and manganese contents, which will enable the tensile strength specified to be obtained on the specified sizes of wire with a reduction of area, by drawing from the heat-treated base, of not less than 60 per cent, wherever possible.

PROPERTIES

15. *a. Tensile strength.* The tensile strength of the test pieces selected and tested in accordance with Clauses 6 and 8a shall be as shown in Table 2, corresponding to the specified tensile range.

b. Torsion test. The test pieces, selected in accordance with Clause 6, shall withstand the torsion test specified in Subclause 8b.

c. Reverse bend test. The test pieces, selected in accordance with Clause 6, shall withstand the reverse bend test specified in Subclause 8c.

d. Wrapping test. The test pieces, selected in accordance with Clause 6, shall withstand the wrapping test specified in Subclause 8d.

e. Deep etch test. The test pieces, selected in accordance with Clause 6, shall withstand the deep etch test specified in Subclause 8e.

f. Decarburization test. A cross-section from each batch of not more than five coils of wire shall be prepared and examined as specified in Subclause 8f.

The section shall be entirely free from decarburization.

g. Dead wire test. The wire shall satisfy the requirements of the dead wire test specified in Subclause 8g.

to these and other tests specified in the specification and shall be
 prepared in accordance with the requirements of the specification
 and shall be entirely free from decarburization.

The wire shall satisfy the requirements of the dead wire test
 specified in Subclause 8g.

and shall be entirely free from decarburization.

and shall be entirely free from decarburization.

and shall be entirely free from decarburization.

PART 2

B.S. 1408-M

SPECIFICATION FOR STEEL SPRING MUSIC WIRE

SCOPE

1. This Part 2 of the standard, for high quality patented round wire known as spring music wire, is independent of Part 1 and is for cold drawn wire, uniform in strength and hardness, intended especially for manufacture of springs. It covers wire between 0.009 in (0.23 mm) and 0.400 in (10.2 mm), with the choice of two tensile ranges.

STEELMAKING PROCESS

2. The steel shall be made by the open hearth, electric or any of the oxygen processes* In the case of the oxygen processes the nitrogen content of the steel shall not exceed 0.008 per cent

CHEMICAL COMPOSITION

3. The chemical composition, based on cast analysis, shall be within the following limits

Element	Per cent	
	Min.	Max.
Carbon	0.70	1.00
Silicon	—	0.35
Manganese	0.25	0.75
Sulphur	—	0.030
Phosphorus	—	0.030

On request, the wire manufacturer shall supply the cast analysis for the specified elements. Any subsequent analytical checks shall take into consideration the heterogeneity of the steel

FREEDOM FROM DEFECTS

4. *a.* The ingots, blooms or billets shall be so prepared as to remove surface imperfections which might produce defects in the wire made from them.

* This term includes both top and bottom oxygen processes.

b. The rod from which the wire is drawn and the finished wire shall be free from harmful surface defects, pipe and other flaws

SURFACE FINISH

5. The wire shall be supplied in a smooth bright drawn condition, unless otherwise specified. When specified by the purchaser it may be supplied with a metallic or other coating. All coated wire shall comply with all the requirements of this standard.

SELECTION OF TEST SAMPLES

6. Test samples shall be cut from each end of each coil of wire of sufficient length for the prescribed tests. The test samples shall not be heat-treated.

Wire supplied in straight lengths shall be grouped in such a manner as to be clearly identified with the coil from which the lengths have been cut. Test samples selected at random shall then be considered to be representative of each coil of wire.

TOLERANCES

7. *a.* *Diameter of wire* The tolerance on the specified diameter shall be as given in Table 5

TABLE 5. TOLERANCES

BRITISH UNITS				EQUIVALENT METRIC UNITS			
Nominal wire diameter		Plus and minus tolerance		Nominal wire diameter		Plus and minus tolerance	
Over	Up to and including	Wire in coils	Wire in straight lengths	Over	Up to and including	Wire in coils	Wire in straight lengths
in	in	in	in	mm	mm	mm	mm
0.009	0.014	0.0002	0.0003	0.23	0.36	0.005	0.008
0.014	0.022	0.0003	0.0005	0.36	0.56	0.008	0.013
0.022	0.072	0.0005	0.0008	0.56	1.83	0.013	0.020
0.072	0.128	0.0007	0.0011	1.83	3.25	0.018	0.028
0.128	0.400	0.0010	0.0015	3.25	10.2	0.025	0.038

b. *Circularity of wire* The cross-section of round wire shall be circular to within half the diameter tolerance specified

TESTS AND PROPERTIES

8. *a.* *Tensile test* The tensile test shall be carried out in accordance with the requirements of B.S. 18, 'Methods for tensile testing of metals', and the tensile

strength shall be calculated on the nominal diameter of the wire. The two tensile strength ranges for the different sizes of wire are given in Table 6.

TABLE 6. TENSILE STRENGTH

BRITISH UNITS				EQUIVALENT METRIC UNITS			
Nominal wire diameter		Tensile strength		Nominal wire diameter		Tensile strength	
Over	Up to and including	Range 1	Range 2	Over	Up to and including	Range 1	Range 2
in	in	tonf/in ²	tonf/in ²	mm	mm	kgf/mm ²	kgf/mm ²
0.009	0.015	165 min	175 min	0.23	0.38	260 min	276 min
0.015	0.018	155/170	165 min	0.38	0.46	244/268	260 min
0.018	0.022	150/165	160/175	0.46	0.56	236/260	252/276
0.022	0.025	145/155	155/170	0.56	0.64	228/244	244/268
0.025	0.033	140/150	150/165	0.64	0.84	220/236	236/260
0.033	0.043	135/145	145/155	0.84	1.09	213/228	228/244
0.043	0.051	130/140	140/150	1.09	1.30	205/220	220/236
0.051	0.067	125/135	135/145	1.30	1.70	197/213	213/228
0.067	0.085	120/130	130/140	1.70	2.16	190/205	205/220
0.085	0.109	115/125	125/135	2.16	2.77	181/197	197/213
0.109	0.135	110/120	120/130	2.77	3.43	173/190	190/205
0.135	0.167	105/115	115/125	3.43	4.24	165/181	181/197
0.167	0.201	100/110	110/120	4.24	5.10	157/173	173/190
0.201	0.263	95/105	105/115	5.10	6.68	150/165	165/181
0.263	0.400	85/95	95/106	6.68	10.2	134/150	150/165

NOTE. For wire supplied in straight lengths the minimum tensile strength shall be reduced by 5 per cent.

b. *Reverse bend test.* For wire of 0.086 in (2.2 mm) diameter and over.

The test piece selected as specified in Clause 6, shall, without sign of fracture, withstand repeated bending in opposite directions, each bend being over a support having a specified radius. One reverse bend consists of bending the test piece from the vertical through an angle of 90° and then returning it to the vertical position. This is counted as one bend. The test piece is then bent through 90° in the opposite direction and back to the vertical which counts as two bends. The test is then repeated in opposite directions through 90° and back to the vertical until fracture occurs. The bend in which fracture occurs shall not be counted.

The number of bends and the radius of the support for different sizes of wire are given in Table 7.

TABLE 7. NUMBER OF REVERSE BENDS

Nominal wire diameter British units		Radius of support	Number of reverse bends	Nominal wire diameter metric units		
Over	Up to and including			Over	Up to and including	
in	in	mm			mm	mm
0.085	0.091	7.5	5	2.2	2.3	
0.091	0.097	7.5	9	2.3	2.5	
0.097	0.109	7.5	7	2.5	2.8	
0.109	0.115	7.5	6	2.8	2.9	
0.115	0.121	10	9	2.9	3.1	
0.121	0.137	10	8	3.1	3.5	
0.137	0.143	15	9	3.5	3.6	
0.143	0.157	15	8	3.6	4.0	
0.157	0.171	15	7	4.0	4.3	
0.171	0.191	15	5	4.3	4.8	
0.191	0.221	15	4	4.8	5.6	
0.221	0.263	15	3	5.6	6.7	

c. *Wrapping test.* For wire under 0.086 in (2.2 mm) diameter down to and including 0.024 in (0.61 mm).

The test pieces, selected and specified in Clause 6, shall without sign of failure withstand being wrapped eight complete turns round a spindle equal to the diameter of the wire.

d. *Deep etch test.* This test shall normally be limited to wire of 0.064 in (1.6 mm) diameter or over. If the test is required by the purchaser on smaller sizes of wire this shall be stated on the order.

The test pieces, selected as specified in Clause 6, shall be immersed in a boiling solution of 50 per cent of concentrated hydrochloric acid and 50 per cent of water for a period of time equivalent to two seconds for every 0.001 in (0.025 mm) of diameter, with a maximum of five minutes, after which, when examined macroscopically, they shall be free from seams or other defects likely to prejudice the performance of the finished spring.

It is necessary to heat the test pieces to a temperature of about 400°C, for the purpose of stress relief before carrying out this test.

e. Decarburization test. This test shall normally be limited to wire of 0.064 in (1.6 mm) diameter or over. If the test is required by the purchaser on smaller sizes of wire this shall be stated on the order.

A cross-section from each batch of not more than five coils of wire shall be prepared and mounted in a manner capable of suitably supporting the edge of the specimen for preparation of the section. Any metallic coating may be suitably removed.

After polishing and etching by an accepted method the section shall be examined at a magnification of 200 diameters.

The section shall show no totally decarburized zone. Partial decarburization as indicated by grain boundary ferrite shall not extend to a depth below the surface greater than a dimension equal to 1½ per cent of the nominal diameter of the wire.

f. Coiling test. For wire of 0.097 in (2.5 mm) diameter and under.

A specimen length shall be wound on a mandrel of 3 to 3½ times the wire diameter and a 5 in length of the resultant coil stretched to three times its original length. The wire so tested shall give uniform pitch without split or fracture.

g. Dead wire test. The wire shall be properly dressed during the process of wire drawing so that the wire shall lie flat in the coil without any corkscrew set.

RETESTS

9. Should any sample fail any of the tests, two additional test samples may be taken from the same end of the same coil and subjected to the test or tests in which the original sample failed. The manufacturer may discard part of the coil prior to removing the samples for retest.

Should both additional test samples pass the test or tests, the coil from which they were taken shall be deemed to comply with the requirements of this British Standard. Should either of them fail the coil shall be deemed not to comply.

PACKING AND IDENTIFICATION

10. The wire manufacturer shall ensure that each coil is securely tied, and shall attach to each coil a suitable label or labels on which shall be shown the number of this British Standard, the specification letter, the size of the wire, the tensile strength and such other markings as may be agreed between the purchaser and the manufacturer.

DESIGNATION FOR ORDERING PURPOSES

11. For ordering purposes the wire shall be designated by the number of this British Standard, the specification letter 'M', the tensile range and the diameter of the wire in inches or millimetres.

For example:

a. 8 SWG steel music spring wire of tensile strength 115/125 tonf/in² shall be designated:

B.S. 1408 : M : 2; 0.160 in.

b. 1.0 mm diameter steel music spring wire of tensile strength 213 kgf/mm² shall be designated:

B.S. 1408 : M : 1; 1.0 mm.

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