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Specification for

Preformed zinc coated carbon steel wire rope (metric and inch series)

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Aerospace Standards Policy Committee (ACE/-) to Technical Committee ACE/14, upon which the following bodies were represented:

British Independent Steel Producers' Association
Civil Aviation Authority (Airworthiness Division)
Federation of Wire Rope Manufacturers of Great Britain
Ministry of Defence
Society of British Aerospace Companies Limited
Stainless Steel Wire Export Group

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Contents

Foreword

This British Standard, prepared under the direction of the Aerospace Standards Policy Committee, is a revision of BS W12:1968, which is withdrawn, and it supersedes BS 2W 9:1965, which is also withdrawn.

This British Standard specifies requirements for carbon steel wire used in the manufacture of wire ropes, and requirements for preformed zinc coated wire rope for aerospace applications. It complies with ISO 2020 published by the International Organization for Standardization (ISO) in respect of wire rope diameters and strengths in metric units, and also specifies the requirements for preformed "P" series zinc coated wire rope in imperial units that do not comply with ISO 2020.

In order to meet the severe conditions in which wire rope operates in the control systems of modern aircraft, some requirements are more fully specified than in earlier standards. The composition of the wire, examination for decarburization and compliance with certain requirements of BS 2763 are now specified, together with dimensional tolerances and an elongation test to establish that the elongation is within limits at stated increments of force.

This standard is in three sections, the first covering scope and definitions, the second specifies the properties of the wire from which the rope is manufactured, whilst the third specifies the requirements for the wire rope.

Tests to be performed on both the wire and the rope are given, together with information on construction, storage and handling of wire ropes.

NOTE Manufacturers of wire rope to this standard will be expected to operate a quality control system at least equivalent to BS 5750-2.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This British Standard specifies the material properties, mechanical properties and test requirements for zinc coated carbon steel wire used in the manufacture of wire ropes (section 2) and the construction, mechanical properties and test requirements for preformed zinc coated carbon steel wire ropes (metric and inch series) (section 3).

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1
wire

a single continuous length of steel, cold drawn from rod

2.2
strand

an assembly of wires spun helically, in one or more layers, around a core

2.3
wire rope

an assembly of strands spun helically, in one or more layers, around a core

2.4
preformed wire rope

a wire rope in which the finished strands are formed into the helical shape they will assume in the finished rope, thus lying naturally in their true position without constraint

2.5
nominal diameter

the value by which the diameter of the wire or rope is designated

2.6
actual diameter

the measured diameter of the wire or rope

2.7
lay

the designation of the direction in which the wires are spun in the strand and the strands are spun in the rope. It will be either right-hand (RH) or left-hand (LH)

2.8
lay length

that distance in a strand or rope, measured parallel to the longitudinal axis, in which the wire in the strand or the strand in the rope makes one complete turn (or helix) about the axis of the strand or rope

2.9
king wire (core wire)

a single wire forming the core of a strand

2.10
core

the central member of a strand or rope

2.11
elongation

that length by which the rope extends between defined upper and lower limits of force (i.e. between first and second reading), expressed as a percentage of the gauge length measured at the lower limit

Section 2. Zinc coated carbon steel wire used in the manufacture of wire rope

3 Material

3.1 Grade

The wire used in the manufacture of wire ropes shall comply with section 1 and section 3 of BS 2763:1982 except for wire diameters.

3.2 Cast analysis

The cast analysis of the wire shall comply with Table 1.

Table 1 — Cast analysis

Element(s)	Min.	Max.
	%	%
Carbon	0.5	0.85
Silicon	—	0.35
Manganese	0.4	0.9
Phosphorus	—	0.030
Sulphur	—	0.035

3.3 Zinc coating

3.3.1 The wire shall be uniformly zinc coated by either the hot dip process or the electrolytic process. If the hot dip process is used the purity of the slab zinc shall be not less than 98.5 %.

3.3.2 The weight of the zinc coating shall be determined by one of the methods given in section 2 of BS 443:1982, and shall comply with class Z requirements of BS 2763.

3.3.3 The adhesion of the zinc coating shall comply with BS 443.

4 Manufacture

4.1 The wire shall be manufactured to circular section within the range of diameters shown in Table 2 by cold drawing from rod complying with **3.1** and **3.2**, and which is free from surface defects when tested in accordance with Appendix A. The wire shall be supplied in the zinc coated condition complying with **3.3**.

NOTE The decarburization test (see **6.4**) should be carried out before the zinc coating is applied.

4.2 The finished wire shall be free from harmful defects.

5 Dimensional tolerances on diameter

5.1 The finished wire shall comply with the tolerances shown in Table 2. Individual measurements shall lie within the tolerance given in Table 2.

5.2 The diameter shall be taken as the mean of two measurements made at right angles to each other on a straight piece of wire.

Table 2 — Tolerances on diameter

Nominal wire diameter		Tolerance	
From	Up to but excluding	Plus	Minus
mm	mm	mm	mm
0.20	0.40	0.01	0.01
0.40	0.80	0.015	0.015

6 Performance requirements

6.1 Selection of test pieces

Samples for all tests shall be cut from each end of each coil of finished wire as drawn.

6.2 Tensile strength test

6.2.1 When tested in accordance with BS 4545 the tensile strength of the wire, calculated on the nominal diameter, shall meet the requirements of grade 1860 or 1960 of BS 2763.

6.2.2 The tensile strength of the wire shall be specified by the rope maker.

6.2.3 The tensile strength of any wire shall meet the limits shown in Table 3 for the appropriate tensile grade numbers and nominal wire diameters.

Table 3 — Tensile strength limits

Nominal wire diameter		Plus tolerance
From	Up to but excluding	
mm	mm	N/mm^2
0.20	0.25	340
0.25	0.40	300
0.40	0.80	260

6.3 Torsional test

When tested in accordance with BS 4545 the test piece shall withstand the number of twists shown in Table 4. When failure occurs, the primary fracture shall be perpendicular to the longitudinal axis of the wire.

Table 4 — Torsional limits

Tensile grade: average tensile strength	Number of twists
N/mm^2 (minimum)	
1 860	$\frac{L}{100\,d} \times 25$
1 960	$\frac{L}{100\,d} \times 22$
where L is the free length between grips (in mm); d is the nominal diameter of wire (in mm).	

6.4 Decarburization test

When tested in accordance with BS 6617-1 the wire shall show a radial depth of decarburization (total and partial) not greater than 1.5 % of the diameter.

6.5 Ductility wrap test

6.5.1 When tested in accordance with the wrap test given in BS 4545 the wire shall not fracture.

6.5.2 The test piece shall be wrapped for eight complete close turns around a mandrel of the same diameter as the wire under test, and shall then be unwrapped for seven complete turns.

6.6 Retests

Should any test piece fail to meet the requirements of **6.2** to **6.5**, two further test pieces in respect of each failure shall, if the wire manufacturer so desires, be cut from the same end of the coil of wire from which the failed test piece was cut, and shall be subjected to repeat tests in **6.2** to **6.5**. If both additional test pieces meet the requirements, the coil shall be accepted. If either fails, the coil shall be deemed not to comply with this standard.

7 Marking

Each coil of wire shall have attached securely to it a durable tally or label, which bears the following information:

a) the number of this British Standard, i.e. BS 2W 12[1)];

b) the manufacturer's name or identification mark;

c) the inspector's stamp;

d) the coil number and steel cast identity;

e) the nominal size and specified tensile grade of the wire.

[1)] Marking BS 2W 12 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Section 3. Preformed zinc coated carbon steel wire rope

8 Designation

The designation of a preformed wire rope shall be in terms of its nominal diameter for a metric series rope, or its "P" number for an inch series rope as listed in Table 5.

9 Material

Preformed wire ropes shall be manufactured from zinc coated carbon steel wire complying with section 2.

10 Dimensions

The actual diameter of a preformed wire rope, when measured in accordance with Appendix B, shall be between the maximum and minimum dimensions given in Table 5.

11 Mass

The maximum mass per unit length of preformed wire rope, for a designated size, shall not exceed the figure given in Table 5.

12 Manufacture

12.1 Construction

Preformed wire ropes shall be manufactured to the construction shown in Table 5.

NOTE 1 For ropes designated 2.4 mm diameter two types of construction are permitted. The purchaser should state in his contract and order which type of construction is required.
NOTE 2 The types of construction are described in Appendix C.

12.2 Core strand

The core strand of a preformed wire rope shall be of sufficient diameter to give full support to the outer strands.

12.3 King wire

The king wire of each strand shall be of sufficient diameter to give full support to the outer wires.

NOTE The king wire of a strand may be of different tensile grade from the outer wires.

12.4 Length of lay

The length of lay of the strands shall be between six and eight times the diameter of the rope, for both limits of size given in Table 5. The strands shall be in right-hand ordinary lay.

12.5 Preforming

The strands shall be preformed during manufacture in such a manner that the finished wire rope satisfies the test specified in **13.6**.

12.6 Joints

When it is necessary to introduce new lengths of wire, joints in different wires shall be distributed as far apart as possible. The ends shall be tucked in, and in no case shall more than one joint occur in 6 m of strand. For wire of 0.20 mm diameter and larger, joints shall be made by welding or brazing.

12.7 Defects

Each length of finished rope shall be of uniform lay and shall be free from irregularities, including kinks and open and unequally tensioned strands.

12.8 Lubrication

12.8.1 The purchaser shall state in his contract and order if a lubricated rope is required.

12.8.2 Where a lubricated wire rope has been specified a lubricant shall be applied during stranding and wiped well back.

12.8.3 The lubricant shall have good lubrication properties in the temperature range – 54 °C to + 121 °C and shall be resistant to oxidation. It shall not induce corrosion.

NOTE Lubricant XG 284 is accepted as being suitable and the properties specified for this material should be taken as a basic requirements for this application. (See Def Stan 01-5.)[2)]

13 Performance requirements

13.1 General

The tests given in **13.3** to **13.8** shall be undertaken on all preformed wire ropes manufactured to this British Standard by the rope manufacturer to the satisfaction of the inspecting authority.

13.2 Selection of test pieces

Samples for all tests shall be cut from each end of each length of preformed wire rope produced.

13.3 Minimum breaking force test

13.3.1 When tested to destruction in accordance with ISO 3108 a test piece, selected as in **13.2**, shall withstand a breaking force not less than that specified in Table 5. The reference to ISO 2408 in ISO 3108 shall be read as Table 5 of this British Standard for this test.

13.3.2 If the test piece breaks at the jaws of the test machine the result shall be rejected and the test repeated.

[2)] Available from Ministry of Defence, Directorate of Standardisation, Kentigern House, 65 Brown Street, Glasgow, G2 8EX.

Table 5 — Principal properties of preformed wire rope

	Designation of wire rope		Construction	Diameter				Minimum breaking force		Approximate mass		Maximum increase in diameter after preforming test	
				Maximum		Minimum							
	mm	"P"		mm	in	mm	in	kN	lbf	kg/100 m	lb/100 ft	mm	in
		1	4 × 7		0.065		0.055		336		0.63		0.009
[a]	1.6		7 × 7	1.8		1.6		2.15		1.2		0.23	
		2	4 × 7		0.080		0.071		560		1.00		0.009
		4	7 × 7		0.080		0.071		560		1.11		0.009
			7 × 7	2.7		2.4		4.10		2.4		0.25	
[a]	2.4		7 × 19	2.7		2.4		4.45		2.6		0.25	
		5	7 × 14		0.118		0.106		1 120		2.22		0.016
[a]	3.2		7 × 19	3.5		3.2		8.90		4.3		0.28	
		6	7 × 19		0.150		0.138		1 680		3.75		0.016
		3	7 × 19		0.160		0.142		2 240		4.50		0.016
[a]	4.0		7 × 19	4.4		4.0		12.45		6.7		0.43	
		51	7 × 19		0.180		0.165		2 800		5.40		0.017
[a]	4.8		7 × 19	5.2		4.8		18.60		9.7		0.48	
		52	7 × 19		0.210		0.193		3 920		7.00		0.019
[a]	5.6	53	7 × 19	6.0	0.237	5.6	0.220	24.9		12.8		0.51	0.020
[a]	6.4		7 × 19	6.8		6.4		31.2		16.4		0.53	
		54	7 × 19		0.270		0.256		6 720		11.9		0.021
		55	7 × 19		0.280		0.264		7 840		13.2		0.022
		56	7 × 19		0.310		0.295		8 960		16.4		0.023
		57	7 × 19		0.340		0.323		11 200		19.8		0.025
		58	7 × 37		0.400		0.382		13 440		26.2		0.027
		59	7 × 37		0.42		0.406		15 680		29.2		0.028
		60	7 × 37		0.44		0.425		17 920		32.5		0.029
		61	7 × 37		0.49		0.472		20 160		36.8		0.030
		62	7 × 37		0.51		0.496		22 400		40.3		0.031
[a]	8.0		7 × 19	8.6		8.0		43.6		25.8		0.61	
[a]	9.5		7 × 19	10.2		9.5		64.1		36.2		0.69	

[a] Denotes compliance with ISO 2020.

13.4 Elongation test

When tested in accordance with Appendix D the change in gauge length shall not exceed 1.5 %.

NOTE The same test piece and test machine should be used for the proof test in **13.5**.

13.5 Proof test

When tested in accordance with Appendix E the test piece shall achieve 80 % of the minimum breaking force without failure of any constituent wire.

13.6 Preforming test

When tested in accordance with Appendix F the increase in diameter of the reassembled preformed wire rope shall not exceed the values given in Table 5.

13.7 Endurance test (metric series lubricated wire ropes only)

13.7.1 An endurance test shall be undertaken on each batch of lubricated preformed wire ropes of metric designation.

13.7.2 When tested in accordance with Appendix G the breaking force shall be equal to or greater than the values given in Table 7.

13.8 Lubrication test (lubricated preformed wire ropes only)

Pass a white cloth once over a 300 mm length of the wire rope using light finger pressure only. A noticeable dis-coloration of the white cloth shall be observed.

13.9 Retests

Should any test piece fail to meet any of the requirements of **13.3** to **13.7**, two further test pieces cut from the same length of rope shall be subjected to a repeat of the failed test if the rope manufacturer so desires. If both test pieces meet the requirements of the repeat test the rope length shall be accepted. If either fails, the rope length shall be deemed not to comply with this standard.

14 Protective treatment

When specified in the contract and order, ropes shall be protected before despatch with a coat of protective compound compatible with the lubricant used during manufacture (see **12.8**).

NOTE The purchaser should state in his contract and order if a protective coating is required.

15 Winding reels

15.1 Reels used for winding preformed wire rope for handling, storage or despatch shall be constructed from materials that will not corrode or damage the rope. Oak, Sweet Chestnut, French Maritime Pine or Western Red Cedar timber shall not be used. The face of the reel barrel and the inside of the reel flanges shall be lined with inert waterproof material.

15.2 The diameter of the barrel shall be not less than 40 times the nominal diameter of the rope.

NOTE More than one piece of wire rope may be wound on to a reel if all the pieces on the reel are of identical diameter, construction and lubrication condition, and of the same batch. The lengths of the pieces so wound need not be equal.

15.3 The ends of the ropes shall be whipped or wrapped. The inner-most end of each piece shall be passed through an opening in the side of the reel and left exposed.

15.4 Precautions shall be taken to protect the rope from ingress of grit and moisture, and from damage in transit. The surface of any material in contact with the rope shall be waterproof and inert.

NOTE Precautions for the handling of wire ropes off the reel are given in Appendix H.

16 Marking

16.1 Each length of preformed wire rope shall be identified by a metal tally or seal, which bears the following information:

a) the number of this British Standard, i.e. BS 2W 12[3)];

b) the wire designation and construction type;

c) the length;

d) the manufacturer's name or identification mark;

e) the batch or run number;

f) the test number;

g) the stamp of the inspector.

16.2 Each piece shall have the tally attached to the inner-most end, and left exposed as described in **15.3**.

[3)] Marking BS 2W 12 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Appendix A Surface defect test for rod

A.1 Apparatus and reagent

A.1.1 *Rod test piece*, not less than 200 mm long from which wire is to be drawn.

A.1.2 *Heat source*

A.1.3 *Concentrated hydrochloric acid*, SG 1.16 to 1.18).

A.2 Procedure

A.2.1 Prepare a solution of equal volumes of concentrated hydrochloric acid and water and maintain at a temperature of not less than 85 °C.

A.2.2 Immerse each test piece, from each rod from which the wire is to be drawn, in the hydrochloric acid solution for a period of 10 min, or for sufficient time to reduce the diameter by 1 %.

A.2.3 Remove each test piece from the solution, wash in water and examine for detrimental surface defects.

Appendix B Measurement of actual diameter of preformed wire rope

B.1 Apparatus

Measuring caliper, with jaws sufficiently wide to span at least two adjacent strands.

B.2 Procedure

B.2.1 Lay the length of rope straight and ensure that it is not under tension.

B.2.2 Measure the diameter at each end of the rope, and at three other positions spaced at least 10 m apart. At each of the five positions take two measurements of the diameter at right angles to each other. Record each measurement.

B.2.3 Check that each measurement lies between the maximum and minimum values for the rope given in Table 5.

Appendix C Types of construction

C.1 4 × 7 construction

Rope of 4 × 7 construction consists of four strands of seven wires of right-hand lay. Each strand consists of a king wire around which a layer of six wires is wound in left-hand lay.

C.2 7 × 7 construction

C.2.1 Rope of 7 × 7 construction consists of six strands of seven wires of right-hand lay around a core strand of seven wires.

C.2.2 The core strand consists of a king wire around which a layer of six wires is wound in right-hand lay, having a length of lay not exceeding 60 % of the length of lay of the complete rope (see **12.4**).

C.2.3 The six outer strands are wound as for the core strand but in left-hand lay, having a length of lay not exceeding 60 % of the length of lay of the complete rope (see **12.4**).

C.3 7 × 14 construction

C.3.1 Rope of 7 × 14 construction consists of six strands of 14 wires in right-hand lay around a core strand of 14 wires.

C.3.2 The core strand consists of four wires in either left- or right-hand lay, around which is wound a layer of 10 wires in right-hand lay.

C.3.3 The six outer strands each consist of four wires in either left- or right-hand lay, around which is wound a layer of 10 wires in left-hand lay.

C.4 7 × 19 construction

C.4.1 Rope of 7 × 19 construction consists of six strands of 19 wires wound in right-hand lay around a core strand of 19 wires.

C.4.2 The core strand consists of a king wire around which a first layer of six wires is wound in right-hand lay, and a second layer of 12 wires is wound also in right-hand lay.

C.4.3 The six outer strands are wound as for the core strand but in left-hand lay.

C.4.4 The length of lay of the core strand and of the outer strands of metric series ropes is as follows:

a) the inner layer of six wires has a length of lay of less than 60 % of the length of lay of the outer layer;

b) the outer layer of 12 wires has a length of lay of less than 50 % of the length of lay of the rope;

c) the six outer strands are closed around the core strand with a length of lay of between six and eight times the nominal diameter of the rope.

NOTE Not applicable to “P” series ropes.

C.5 7 × 37 construction

C.5.1 Rope of 7 × 37 construction consists of six strands of 37 wires wound in right-hand lay around a core strand of 37 wires.

C.5.2 The core strand consists of a king wire around which a first layer of six wires is wound in left- or right-hand lay. Around this a second layer of 12 wires is wound in left- or right-hand lay, and a third layer of 18 wires is wound in right-hand lay.

C.5.3 The six outer strands are wound as for the core but in left-hand lay.

Appendix D Elongation test

D.1 Apparatus

D.1.1 *Elongation test machine*, capable of achieving between 1 % and 80 % of rope minimum breaking force.

D.1.2 *Rope test piece,* of sufficient length to give 500 mm test length between test machine jaws.

D.2 Procedure

D.2.1 Mount the test piece in the test machine to give 500 mm unobstructed length between the jaws.

D.2.2 Prestretch the test piece by applying a force equal to 63 % of the minimum breaking force for not less than 2 min. Release the force carefully to give a residual tension of not more than 1 % of the minimum breaking force.

D.2.3 Immediately, measure accurately and mark on the test piece a minimum gauge length of 500 mm. Progressively increase the force until 60 % of the minimum breaking force is reached and maintain this force for a period of not less than 1 min. Measure accurately the distance between the previously marked points. Retain the test piece in the machine for undertaking the proof test (see Appendix E).

Determine the elongation, in millimetres, and express this as a percentage of the original gauge length.

Appendix E Proof test

E.1 Apparatus

E.1.1 *Elongation test machine* (from Appendix D).

E.1.2 *Rope test piece*, retained in the machine from the elongation test in Appendix D.

E.2 Procedure

E.2.1 Using the test piece retained in the machine from the elongation test in Appendix D, progressively increase the force until a minimum of 80 % of the minimum breaking force is achieved, and maintain this force for not less than 5 s. Release the force and remove the test length.

E.2.2 Separate the test length into its constituent wires and examine each wire. If any wires are broken the production length of rope represented by the test length shall be rejected.

Appendix F Preforming test

F.1 Apparatus

F.1.1 *Rope test piece*

F.1.2 *Mechanical shears*

F.2 Procedure

F.2.1 Cut a length 200 × the rope diameter from one end of the test piece.

F.2.2 Select two diametrically opposite strands on the test piece and unlay them for a distance of ten rope diameters or 50 mm (whichever is the greater) from the cut face. Relay the strands into position.

F.2.3 Measure the diameter at a distance of six rope diameters or 25 mm (whichever is the greater) from the cut face, and check that any increase in diameter does not exceed the values given in Table 5.

Appendix G Endurance test (metric series lubricated wire ropes only)

G.1 Apparatus

G.1.1 *Test apparatus*, conforming to Figure 1.

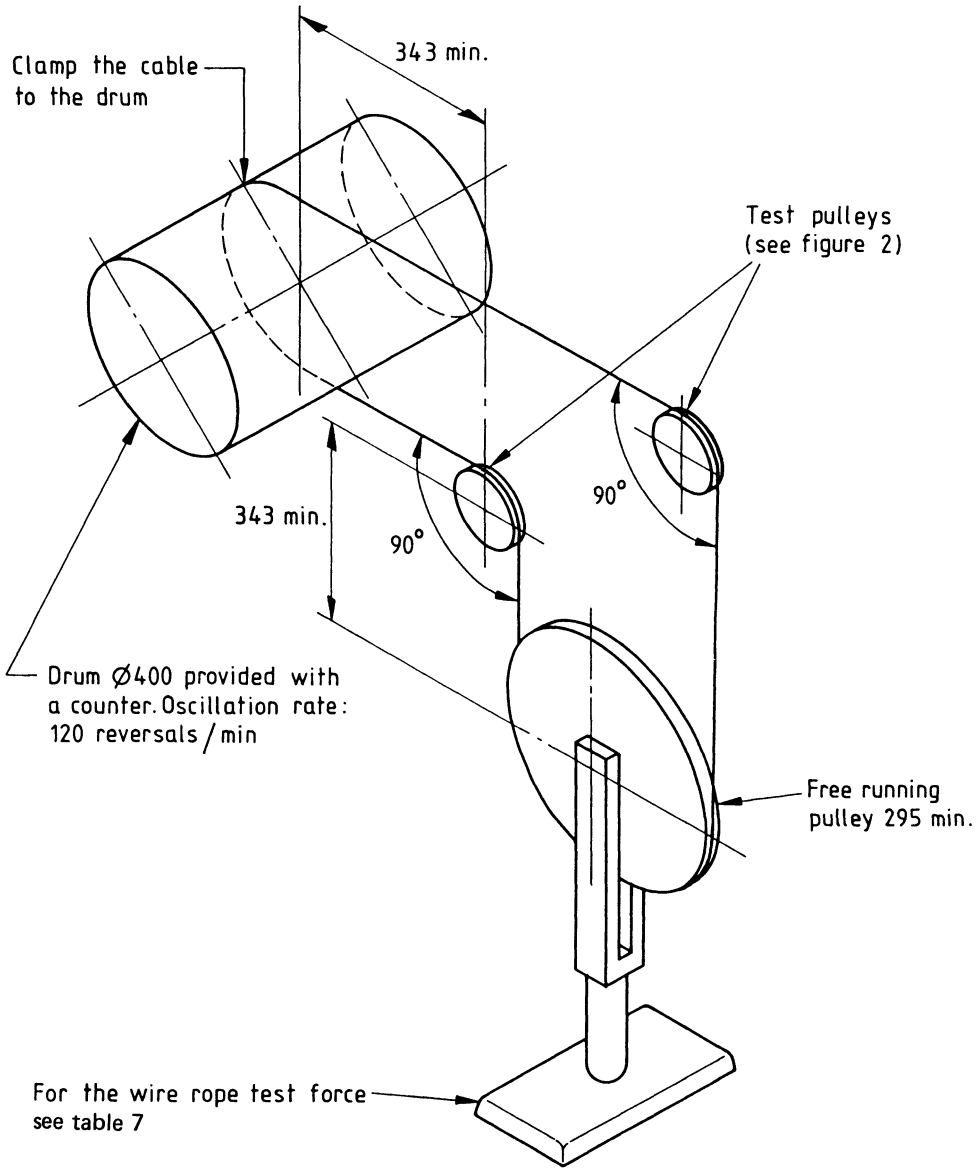
G.1.2 *Steel pulleys*, conforming to Figure 2 and Table 6.

G.1.3 *Rope test piece*

G.2 Procedure

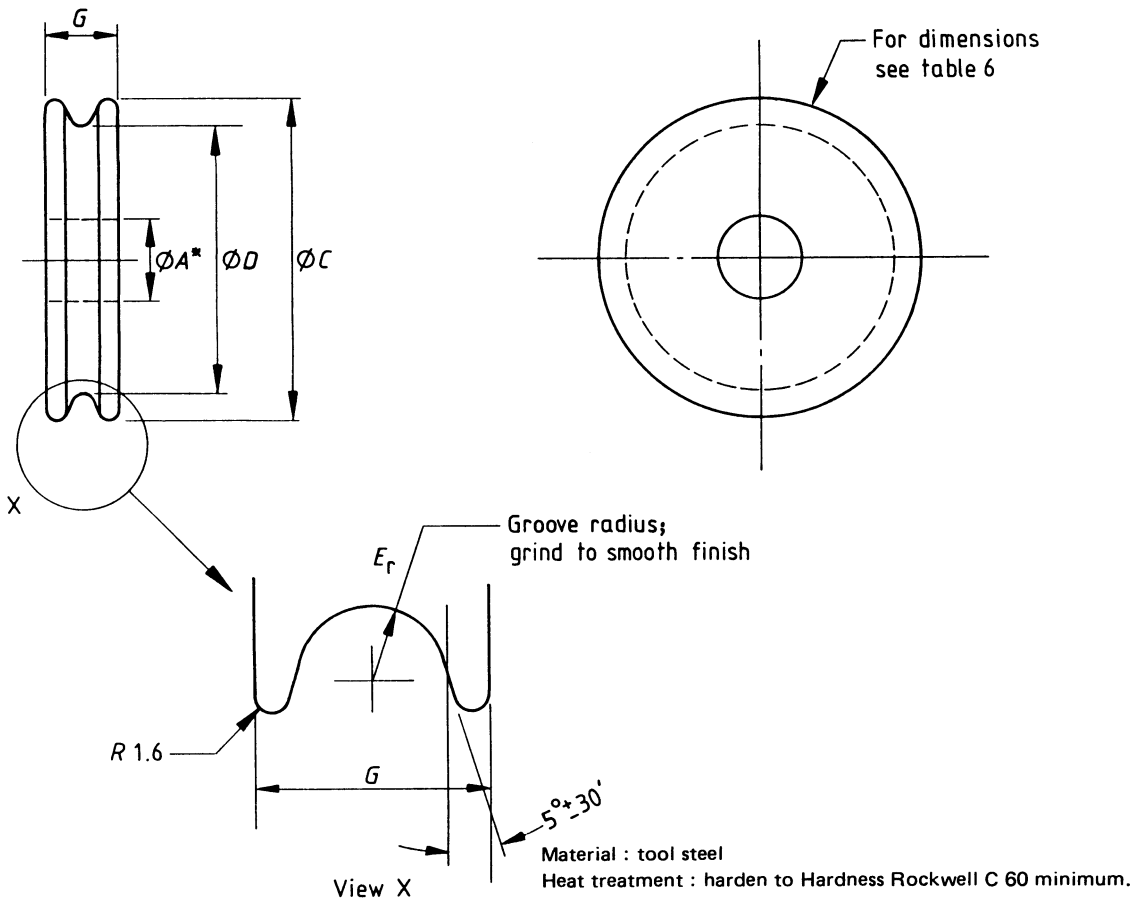
G.2.1 Fit the test piece to the test machine to form a continuous loop by clamping the ends of the rope to the drum. Adjust the free running pulley to give the force shown in Table 7 for the rope under test. Do not apply additional lubricant to the test piece either before or during the test. Operate the test machine to give the number of reversals of force shown in Table 7 for the rope under test. Mark the sections of the rope that pass over the test pulleys during the test.

G.2.2 Remove the test piece from the machine and cut out the previously marked sections. Carry out a breaking force test in accordance with **13.3** on one of these sections and check that the breaking force is equal to or greater than the value shown in Table 7 for the rope under test.



Dimensions are in millimetres.
NOTE This is a typical application and the dimensions of the test pulleys and the magnitude of the test forces are not intended as design criteria.

Figure 1 — Schematic diagram for endurance test equipment and test conditions



*Diameter *A*: pulley support on suitable ball or roller bearing, or shaft, extensions supported on suitable ball or roller bearings. Dimensions are given in Table 6.

Figure 2 — Test pulleys for use in endurance test

Table 6 — Dimensions of pulleys used in endurance test

Nominal diameter of rope	Construction	Ratio of pulley diameter to rope diameter[a]	C^{bc}	D	E_r	G
mm			mm	mm	mm	mm
1.6	7 × 7	12.0	24	19.2	0.90	10
	7 × 7	12.0	36	28.8	1.35	10
2.4	7 × 19	7.0	24	16.8	1.35	10
3.2	7 × 19	7.0	32	22.4	1.75	10
4.0	7 × 19	9.5	50	38.0	2.20	10
4.8	7 × 19	9.5	60	45.6	2.60	13
5.6	7 × 19	9.5	70	53.2	2.80	13
6.4	7 × 19	9.5	80	60.8	3.20	13

[a] Ratio between pulley diameter D and diameter of wire rope d.
[b] Reference values, not a mandatory dimension.
[c] $C = D + 3d$.

Table 7 — Breaking strength after endurance test

Designation of rope	Nominal diameter of wire rope	Construction	Minimum test force[a]	Number of reversals[b]	Minimum breaking force[c]
mm	mm		N		kN
1.6	1.6	7 × 7	22	70 000	1.07
2.4	2.4	7 × 7	40	70 000	2.05
		7 × 19	40	70 000	2.25
3.2	3.2	7 × 19	80	70 000	4.45
4.0	4.0	7 × 19	107	130 000	6.25
4.8	4.8	7 × 19	165	130 000	9.30
5.6	5.6	7 × 19	225	130 000	12.45
6.4	6.4	7 × 19	285	130 000	15.60

[a] The wire rope test force is equal to one half the weight that includes idler pulley and hanger.
[b] 1 cycle = 2 reversals.
[c] Minimum breaking force equal to 50 % of the original minimum breaking force, prior to the endurance test.

Appendix H Handling precautions with wire ropes

H.1 General

Preformed wire ropes need careful handling to ensure that the lays as manufactured are not disturbed, and to further ensure that the rope is not allowed to form a loop in itself which, if pulled tight, will produce a kink. In this class of rope a kink is shown by the core leaving the rope's centre and either lying between the outer strands, or protruding from the rope in the form of a small loop.

H.2 Unwinding a rope

When unwinding a rope the reel should be mounted in a stand, with an axle shaft through the centre hole of the reel, to enable the rope to be pulled off in a straight line. It is not advisable to pay-off rope from a reel to make flat coils on the floor and then to pull out the end for cutting to lengths; this practice usually causes core protrusion.

H.3 Hand coiling

When lengths have been cut from the rope it is frequently necessary to coil up the cut lengths by hand coiling. In such cases the hand coil should be of large diameter, not less than 50 diameters of the rope involved, with a minimum of 150 mm diameter. When a hand-made coil is run out, it should be done by the "wheeling" method, or by rotating the coil so that the rope is paid out in a straight line. If, when handling a length of rope, it forms a loop on itself this indicates a localization of turn. It is essential that this be eliminated by taking the turn out and not by pulling the rope tight; the latter action will produce permanent malformation and core protrusion.

H.4 Lubricated ropes

Ropes treated with a lubricant will tend to retain dust and grit. During handling, therefore, precautions should be taken to minimize such contamination.

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Publications referred to

BS 443, *Specification for testing zinc coatings on steel wire and for quality requirements.*

BS 2763, *Specification for round carbon steel wire for wire ropes.*

BS 4545, *Methods for mechanical testing of steel wire.*

BS 5750, *Quality systems.*

BS 5750-2, *Specification for manufacture and installation*[4)].

BS 6617, *Determination of decarburization in steel.*

BS 6617-1, *Methods for determining decarburization by microscopic and micro-hardness techniques.*

ISO 2020, *Aerospace — mechanical system parts — preformed flexible steel wire rope for aircraft controls — technical specification*[4)].

ISO 2408, *Steel wire ropes for general purposes — characteristics.*

ISO 3108, *Steel wire ropes for general purposes — determination of actual breaking load.*

Def Stan 01-5, *Fuels, lubricants and associated products.*

[4)] Referred to in foreword only.

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