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British Standard

Stranded steel wire ropes

Part 6. Specification for ropes for mine hoisting

Câbles toronnés en acier
Partie 6. Câbles d'extraction — Spécifications

Litzenseile aus Stahldrähten
Teil 6. Seile für den Bergbau

British Standards Institution

Foreword

This Part of BS 302 has been prepared under the direction of the Mechanical Handling Standards Committee. It is one Part of a combined revision of BS 302 : 1968, BS 236 : 1968, BS 329 : 1968, BS 330 : 1968, BS 365 : 1968 and BS 3530 : 1968, which are withdrawn. BS 302 is now published in six Parts and takes account of both national and international developments since 1968.

This Part (Part 6) specifies requirements for mine hoisting ropes additional to the general requirements in Part 1. Other Parts specify the additional requirements for other particular uses of ropes:

- Part 2 Specification for ropes for general purposes
- Part 3 Specification for zinc coated ropes for ships
- Part 4 Specification for ropes for lifts
- Part 5 Specification for ropes for hauling purposes

Two further Parts are in preparation, covering larger diameter ropes (64 mm to 205 mm diameter) and higher strength ropes and will be Parts 7 and 8 respectively.

In line with the principles of international standard ISO 2408, published by the International Organization for Standardization (ISO), the constructions are grouped according to the number of outer wires in the strands. The general requirements of BS 302 : Part 1 and the methods used for calculating breaking loads and approximate masses comply with ISO 2408. In respect of individual usages the ropes in Parts 2 and 3 are fully in accordance with ISO 2408 and those in section two of Part 4 are in accordance with ISO 4344. In each of these Parts however, certain additional ropes still in common use in the UK have been included.

In line with current international practice, the term 'zinc coated' has been adopted in this standard in place of 'galvanized'. The terms are synonymous.

Purchasers ordering to BS 302 are advised to specify in their purchasing contract that the manufacturer operate a quality system in compliance with the appropriate Part of BS 5750, or suitable equivalent, to ensure themselves that products claimed to comply with BS 302 consistently achieve the required level of quality.

Wire rope users will find valuable information in the companion publication BS 6570 'Code of practice for the selection, care and maintenance of steel wire ropes'.

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

Contents

	Page
Foreword	Inside front cover
Committees responsible	Back cover
Specification	
1 Scope	2
2 Definitions	2
3 Compliance	2
4 Wire rope constructions and sizes	2
5 Material	2
6 Direction of lay	2
7 Lubrication	3
8 Minimum breaking load	3
Appendix	
A Information to be supplied by the purchaser with the enquiry and order	7
Tables	
1 Wire rope constructions and sizes	2
2 6 x 7 construction group: round strand fibre core	3
3 6 x 19 construction group: round strand fibre core	4
4 6 x 8 TS construction group: triangular strand fibre core	5
5 6 x 22 TS and 6 x 25 TS construction group: triangular strand fibre core	6
6 Enquiry or order form for winding rope round strand or flattened strand only	9

Specification

1 Scope

This Part of BS 302 specifies the requirements for round and triangular strand steel wire ropes for mine hoisting (winding) purposes and is for use in conjunction with BS 302 : Part 1.

NOTE 1. Information to be given by the purchaser on the enquiry and order is given in appendix A.

NOTE 2. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 302, the definitions given in BS 302 : Part 1 apply.

3 Compliance

Ropes in accordance with BS 302 : Part 6 shall comply with this Part and with BS 302 : Part 1.

4 Wire rope constructions and sizes

Constructions and size ranges shall be as given in table 1.

NOTE. In the absence of a precise indication by the purchaser on the enquiry and order, the choice of construction within a group is at the discretion of the supplier.

5 Material

5.1 Wire

5.1.1 General. The wire used for the manufacture of wire ropes in accordance with this standard, excluding the wire used in triangular strand cores (see 5.1.3), shall comply with sections one and three (high duty wire) of BS 2763 : 1982. The mechanical tests shall include reverse bend requirements.

5.1.2 Wire finish. The wire shall be class Z zinc coated or bright. The zinc coating shall comply with BS 2763.

5.1.3 Tensile grades of wire. All wires except filler wires, wires comprising the triangular strand core, and king wires shall be of 1570 N/mm²* or 1770 N/mm² tensile grade.

For round strand ropes the king wires shall all be of one tensile grade selected from BS 2763. The filler wires shall all be one of the tensile grades specified in BS 2763.

For triangular strand ropes the strand core wires shall have a minimum tensile strength of 770 N/mm² in cores comprised of solid triangular wires or three round wires, and a minimum tensile strength of 1270 N/mm² in cores built up from more than three round wires.

NOTE. In order to achieve a required triangular shape, some low carbon steel wires may be added.

5.2 Rope main core

The rope main core shall be of hard or man-made fibre and shall comply with 3.2 of BS 302 : Part 1 : 1987.

Table 1. Wire rope constructions and sizes

Rope group	Description	Size range (diameter)	Typical construction
6 x 7	Up to seven outer wires in a strand, one layer of wire over a king wire.	mm 19 to 32	6 x 7 (6/1) FC
6 x 19	7 to 12 outer wires in a strand two or three layers over a king wire. Wires equal laid.	20 to 48	6 x 15 (7/7/1) FC 6 x 17 (8/8/1) FC 6 x 19 (9/9/1) FC 6 x 19 (12/6+6F/1) FC 6 x 16 (10/5+5F/1) FC
6 x 8 TS	7 to 8 outer wires in a strand. One layer of wire over a single triangular wire or a multi-wire triangular core.	19 to 32	6 x 8 (7/V) FC 6 x 9 (8/V) FC
6 x 22 TS 6 x 25 TS	9 to 18 outer wires in a strand. Two layers of wire over a single triangular wire or a multi-wire triangular core.	26 to 35 26 to 41 26 to 48 32 to 54 38 to 64	6 x 22 (9/12/V) 6 x 23 (10/12/V) 6 x 25 (12/12/V) 6 x 28 (15/12/V) 6 x 31 (18/12/V)

*1 N/mm² = 1 MPa.

6 Direction of lay

Ropes shall be of right-hand lay or left-hand lay.

NOTE. It will need to be stated by the purchaser on his enquiry and order if left-hand lay is required, otherwise right-hand lay will be supplied.

Round strand ropes shall be ordinary or Lang's lay.

Triangular strand ropes shall be Lang's lay.

7 Lubrication

All cores except those of man-made fibre shall be suitably

treated. The wires of the rope shall be coated with a lubricant complying with 3.3 of BS 302 : Part 1 : 1987.

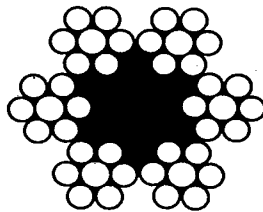
NOTE. The degree and type of lubrication should be agreed between the purchaser and the supplier.

8 Minimum breaking load

The minimum breaking loads shall be as given in tables 2 to 5.

NOTE. For guidance, these tables also give approximate masses of ropes, calculated as in C.2 of BS 302 : Part 1 : 1987.

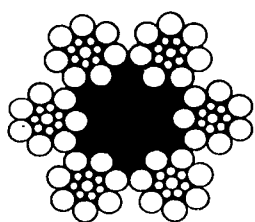
Table 2. 6 × 7 construction group: round strand fibre core



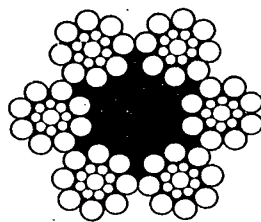
6 × 7 (6/1) FC

Nominal diameter	Minimum breaking force		Minimum breaking load		Approximate mass of rope
	1570 N/mm ² tensile grade	1770 N/mm ² tensile grade	1570 N/mm ² tensile grade	1770 N/mm ² tensile grade	
mm	kN	kN	t	t	kg/100 m
19	188	212	19.2	21.6	125
20	208	235	21.2	24.0	138
21	230	259	23.4	26.4	153
22	252	284	25.7	29.0	167
24	300	338	30.6	34.5	199
26	352	397	35.9	40.5	234
28	409	461	41.7	47.0	271
29	438	494	44.6	50.4	291
32	534	602	54.4	61.4	354

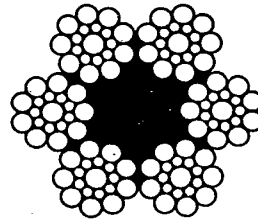
Table 3. 6 x 19 construction group: round strand fibre core



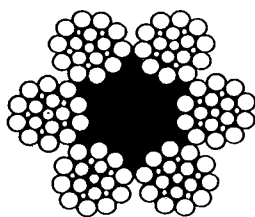
6 x 15 (7/7/1) FC



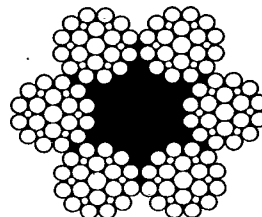
6 x 17 (8/8/1) FC



6 x 19 (9/9/1) FC



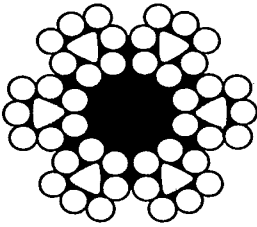
6 x 16 (10/5 + 5F/1) FC



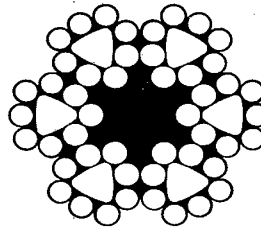
6 x 19 (12/6 + 6F/1) FC

Nominal diameter	Minimum breaking force		Minimum breaking load		Approximate mass of rope
	1570 N/mm ² tensile grade	1770 N/mm ² tensile grade	1570 N/mm ² tensile grade	1770 N/mm ² tensile grade	
mm	kN	kN	t	t	kg/100 m
20	207	234	21.1	23.9	144
21	228	258	23.2	26.3	159
22	251	283	25.6	28.8	175
24	298	336	30.4	34.3	208
26	350	395	35.7	40.3	244
28	406	458	41.4	46.7	283
29	436	491	44.4	50.1	304
32	531	598	54.1	61.0	370
35	635	716	64.7	73.0	442
36	671	757	68.4	77.2	468
38	748	843	76.2	85.9	521
40	829	935	84.5	95.3	578
41	871	982	88.8	100	607
44	1003	1131	102	115	699
48	1194	1346	122	137	832

Table 4. 6 x 8 TS construction group: triangular strand fibre core



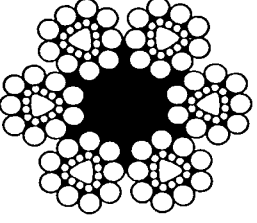
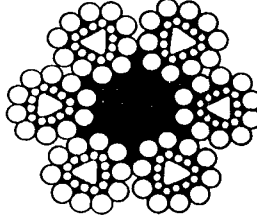
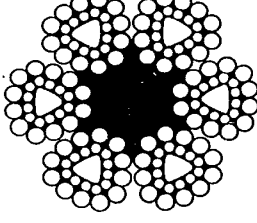
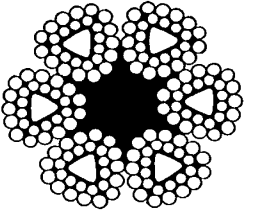
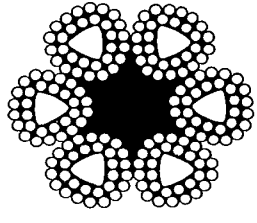
6 x 8 (7/V) FC



6 x 9 (8/V) FC

Nominal diameter	Minimum breaking force		Minimum breaking load		Approximate mass of rope
	1570 N/mm ² tensile grade	1770 N/mm ² tensile grade	1570 N/mm ² tensile grade	1770 N/mm ² tensile grade	
mm	kN	kN	t	t	kg/100 m
19	205	231	20.9	23.5	148
20	227	256	23.1	26.1	164
21	251	283	25.6	28.8	181
22	275	310	28.0	31.6	198
24	327	369	33.3	37.6	236
26	384	433	39.1	44.1	277
28	446	502	45.5	51.2	321
29	478	539	48.7	54.9	345
32	582	656	59.3	66.9	420

Table 5. 6 x 22 TS and 6 x 25 TS construction group: triangular strand fibre core

 6 x 22 (9/12/V) FC  6 x 23 (10/12/V) FC  6 x 25 (12/12/V) FC  6 x 28 (15/12/V) FC  6 x 31 (18/12/V) FC					
Nominal diameter	Minimum breaking force		Minimum breaking load		Approximate mass of rope
	1570 N/mm ² tensile grade	1770 N/mm ² tensile grade	1570 N/mm ² tensile grade	1770 N/mm ² tensile grade	
mm	kN	kN	t	t	kg/100 m
26	373	420	38.0	42.8	277
28	432	487	44.0	49.6	321
29	463	522	47.2	53.2	345
32	564	636	57.5	64.8	420
35	675	761	68.8	77.6	502
36	714	805	72.8	82.1	531
38	796	897	81.1	91.4	592
40	882	994	89.9	101	656
44	1067	1203	109	123	794
48	1270	1431	129	146	945
52	1490	1680	152	171	1109
56	1728	1948	176	199	1286
60	1984	2237	202	228	1476
64	2257	2545	230	259	1679

Appendix

Appendix A. Information to be supplied by the purchaser with the enquiry and order

The information to be supplied is listed in (a) to (k).

A suitable tabular form for the presentation of this information is given in table 6.

(a) Particulars of shaft:

- (1) depth, from lowest working level in shaft to bank, vertical distance from bank to centre of head pulley;
- (2) whether upcast, downcast or both;
- (3) whether wet or dry, and approximate range of temperature variation;
- (4) whether shaft water is known to be of an injurious nature, its pH value and chloride content if available;
- (5) whether steam is exhausted into the shaft, and whether there are any other special circumstances, likely to affect the rope.

(b) Particulars of winding engine drum:

- (1) type of drum:
 - (i) if parallel type, the diameter and width, and distance of first and last live turns from centre line of drum;
 - (ii) if conical type, the minimum and maximum diameters and width and distance of first and last working turns from centre line of drum;
 - (iii) if cylindro-conical type, the maximum and minimum diameters, distance of first and last live turns from centre line of drum, number of working turns on the minimum diameter, number of turns on the scroll, width of drum and width of scroll and width of parallel portion of drum;
- (2) nature and arrangement of drum lagging and cladding material and particulars of any grooving;
- (3) whether rope is wound on itself, if so number of layers.

(c) Particulars of driving sheave:

- (1) diameter;
- (2) rope groove lining.

(d) Particulars of pithead pulleys and position with respect to the winding engine:

- (1) horizontal and vertical distance between centres of pithead pulleys and whether the vertical centre line of or between the pulleys coincides with the centre line of the drum or sheave;
- (2) diameter of pithead pulley at bottom of groove;
- (3) diameter of any guide sheave and its position with respect to the pithead pulley or driving sheave;
- (4) height of centre of head pulley above centre of drum or ground type driving sheave;
- (5) horizontal distance between centre of drum or ground type driving sheave and rope hanging in shaft;
- (6) inside and outside fleet angles.

(e) Maximum winding speed in m/s.

(f) Maximum acceleration in m/s^2 of rope when raising full load.

(g) Maximum load and normal load suspended from the winding rope capping including the weight of any balance rope and its attachments.

(h) Type of cage guides.

(i) Particulars of rope required or proposed:

- (1) number of this British Standard, i.e. BS 302 : Part 6;
- (2) length;
- (3) nominal diameter;
- (4) construction;
- (5) minimum breaking load;
- (6) round strand or triangular strand, Lang's lay or ordinary lay, right-hand or left-hand;
- (7) nominal tensile grade of wire;
- (8) whether the wire is to be zinc coated.

(j) Particulars of inspection and testing required.

(k) Any limiting dimensions for reels.

Table 6. Enquiry or order form for winding rope round strand or flattened strand only				
Mine		Engine		
1. Shaft data				
Depth: lowest working level to bank (m)		Upcast or downcast		
		Wet or dry		
Type of guides		Approximate working temperature range (°C)		
Any special circumstances in shaft (e.g. exhaust steam)		Approximate analysis of shaft water if injurious	pH value	
			Chlorides (as Cl ₂) parts per million	
2. Rope loading				
Maximum working load, excluding rope, but including cage, balance rope, etc. (t)		Maximum winding speed (m/s)		
		Maximum acceleration or retardation under full load conditions (m/s ²)		
3. Data of rope required or proposed				
Length (m)		Construction		Material and construction of main core
Diameter (mm)		Tensile strength of wire (N/mm ²)		
Lay (Lang's or ordinary, RH or LH)		Minimum breaking load (t)		To be delivered on reel, limiting dimensions if any
		Whether zinc coated		
Details of special tests and inspection				

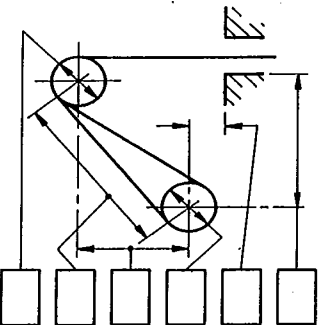
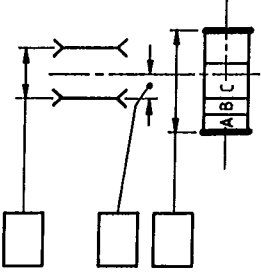
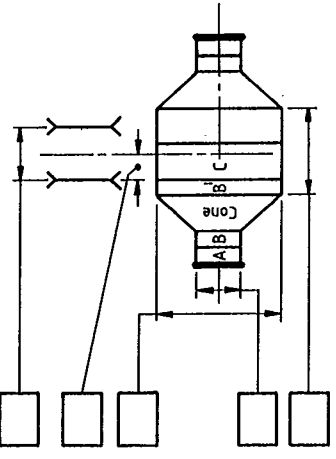
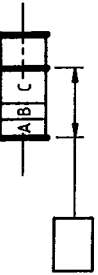
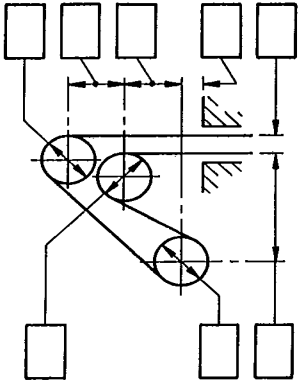
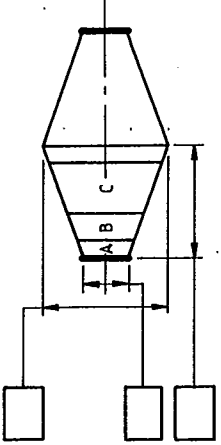
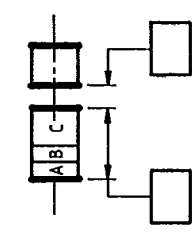
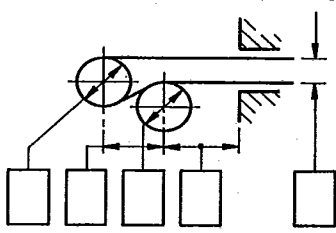
Table 6. (continued)	4. Drum and headgear. Type of drum or driving sheave		
	 Single parallel drum — one layer	 Bi-Cylindro — conical drum	 Single parallel drum with partition and layers
	 Conical drum		

Table 6. (concluded)							No. of turns	Width mm	Fleet angle
Lagging material ... Grooving: Type Radius (mm) Depth (mm) Pitch (mm)			Dead turns	A					
			Outside lead	B				Total	1:
				Cone*					
				B'*					
			Inside lead	C					1:
*B.C.C drums only.									

Publications referred to

- BS 525 Fibre cores for wire ropes
- BS 2763 Specification for round carbon steel wire for wire ropes
- BS 5750* Quality systems
Part 2 Specification for manufacture and installation
- BS 6570* Code of practice for the selection, care and maintenance of steel wire ropes
- ISO 2408* Steel wire ropes for general purposes — Characteristics
- ISO 4344* Steel wire ropes for lifts

*Referred to in the foreword only.

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Mechanical Handling Standards Committee (MHE/-) to Technical Committee MHE/2, upon which the following bodies were represented:

Associated Offices Technical Committee

Association of Supervisory and Executive Engineers

British Coal

British Ports Association and the National Association of Ports Employers

British Railways Board

British Steel Industry (Wire Section)

Bureau Veritas

Chain Testers Association of Great Britain

Department of the Environment (Property Services Agency)

Federation of Manufacturers of Construction Equipment and Cranes

Federation of Wire Rope Manufacturers of Great Britain

Health and Safety Executive

Institution of Mechanical Engineers

Institution of Mining Engineers

Institution of Mining and Metallurgy

Ministry of Defence

National Association of Lift Makers

Zinc Development Association

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