INTERNATIONAL STANDARD ISO 2408

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Steel wire ropes for general purposes — Characteristics

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2408 was drawn up by Technical Committee ISO/TC 105, *Steel wire ropes.*

It was approved in December 1971 by the Member Bodies of the following countries :

Austria	Ireland	Spain
Belgium	Israel	Sweden
Chile	Italy	Switzerland
Denmark	Netherlands	Thailand
Egypt, Arab Rep. of	Norway	United Kingdom
France	Pakistan	U.S.S.R.
Germany	Portugal	
India	South Africa, Rep. of	

The Member Body of the following country expressed disapproval of the document on technical grounds :

New Zealand

Printed in Switzerland

Steel wire ropes for general purposes — Characteristics

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the most commonly used wire ropes for general purposes, selected from a great number of possible rope constructions.

The following types of wire ropes are not covered by this International Standard :

- ropes for mining purposes;
- ropes for aircraft controls;
- ropes for deep drilling equipment;
- ropes for aerial ropeways and funiculars;
- ropes for lifts and elevators;
- ropes for prestressed concrete.

2 REFERENCES

ISO 2232, *Drawn wire for general purpose non-alloy steel wire ropes — Specifications.*

ISO 3108, *Steel wire ropes for general purposes — Determination of breaking load.* (At present at the stage of draft.)

ISO . . ., *Steel wire ropes for general purposes — Terms of acceptance.* (At present at the stage of draft proposal.)

3 TYPES OF CONSTRUCTION AND DIAMETER RANGES — ROUND STRAND

TABLE 1

Rope designation	Rope construction	Type of main core	Available diameter range mm
3.1 6-Stranded ropes			
6 X 7	6 (6 + 1)	fibre or steel	2 to 36
6 X 19	6 (12 + 6 + 1)	fibre steel	3 to 44 8 to 48
6 X 37	6 (18 + 12 + 6 + 1)	fibre	6 to 56
6 X 19 Seale	6 (9 + 9 + 1)	fibre or steel	8 to 36
6 X 19 Filler	6 (12 + 6F + 6 + 1)	fibre or steel	8 to 36
6 X 26 Warrington-Seale	6 (10 + 5/5 + 5 + 1)	fibre or steel	9 to 40
6 X 31 Warrington-Seale	6 (12 + 6/6 + 6 + 1)	fibre or steel	11 to 40
6 X 36 Warrington-Seale	6 (14 + 7/7 + 7 + 1)	fibre or steel	13 to 56
6 X 41 Warrington-Seale	6 (16 + 8/8 + 8 + 1)	fibre or steel	16 to 60
6 X 12	6 (12 + FC)	fibre	8 to 32
6 X 24	6 (15 + 9 + FC)	fibre	8 to 40
3.2 8-Stranded ropes			
8 X 19 Seale	8 (9 + 9 + 1)	fibre or steel	8 to 36
8 X 19 Filler	8 (12 + 6F + 6 + 1)	fibre or steel	8 to 36
3.3 Multi-strand ropes			
17 X 7 18 X 7	11 (6 + 1) + 6 (6 + 1) 12 (6 + 1) + 6 (6 + 1)	fibre or steel	8 to 28
34 X 7 36 X 7	17 (6 + 1) + 11 (6 + 1) + 6 (6 + 1) 18 (6 + 1) + 12 (6 + 1) + 6 (6 + 1)	fibre or steel	12 to 40

3.4 Increments of diameters

The increments of diameters referred to in this International Standard were arrived at by giving due consideration to the practical requirements of the users.

4 MATERIALS

The materials used in the manufacture of these ropes are described in the following clauses : the information is given for general interest only. Materials requirements are part of the terms of acceptance of the rope and will be the subject of a separate International Standard.

4.1 Rope wire

The wire used for the manufacture of these ropes shall comply with the requirements of ISO 2232.

4.1.1 *Tensile grade of wire*

The wire tensile grades shall be

1 570 N/mm² (160 kgf/mm²)

1 770 N/mm² (180 kgf/mm²)

For shipping, fishing and inland waterway rope requirements, the 1 420 N/mm² (145 kgf/mm²) tensile grade of wire may also be used.

4.1.2 *Surface finish of wire*

The wire shall be either bright or galvanized. If galvanized it shall be B quality.

For shipping, fishing and inland waterway rope requirements, the galvanizing may be quality A or AB.

TABLE 2

Surface finish of wire	Tensile grades N/mm²			Remarks
bright		1 570	1 770	
galvanized quality B		1 570	1 770	
galvanized quality AB	1 420	1 570	1 770	Only for shipping, fishing and inland waterway ropes
galvanized quality A	1 420	1 570		

4.2 Cores

4.2.1 *Fibre cores (FC)*

Main and strand cores shall be manufactured from the following materials :

— natural hard fibre (NF) (e.g. manila, sisal);

— natural soft fibre (NF) (e.g. hemp, jute, cotton);

— man-made fibre (SF) (e.g. polyamide, polyethylene, polypropylene).

4.2.2 *Steel main core*

The steel core shall normally be an independent wire rope (WR).

Wire strand cores (WS) may be used for certain constructions of rope up to, but not including, 13 mm diameter, as well as for 6 X 7 and 6 X 19 ropes for shipping purposes and for multi-strand ropes.

The wires in a steel core shall normally be of similar tensile strength to that of the main strand. Lower tensile strength wires are permitted.

4.3 Rope lubricant

The lubricants for these wire ropes shall be selected to reduce the friction in the rope, to provide protection of the steel wires against corrosion and to protect the fibre core against deterioration.

The lubricant shall be free from acid or marked alkali and shall have no injurious effect on the steel wire or on the fibres in the rope.

5 ROPE CHARACTERISTICS

5.1 Strand

5.1.1 The strand shall be uniformly made and be free from slack wires.

5.1.2 The length of lay of the individual layers of like wires in a strand shall not vary significantly.

5.1.3 All wires of a strand made in equal lay construction shall be stranded in one operation.

5.1.4 King wires and fibre cores of strands shall be of a size to provide sufficient support to enable the covering wires to be evenly laid.

5.2 Rope

5.2.1 The rope shall be uniformly made and the strands shall lie tightly on the core or the underlying strands. When uncoiled and under no load the rope shall not be wavy.

5.2.2 The length of lay of the individual layers of like strands in a rope shall not vary significantly.

5.2.3 In a new rope, clearances between the strands are recommended as a general rule.

5.2.4 In galvanized ropes, all the wires shall be galvanized, including those of the steel core, where applicable.

5.2.5 Wires over 0,4 mm diameter shall be joined by brazing or welding. Wires up to and including 0,4 mm diameter may be joined by brazing, welding, or twisting.

5.2.6 The free ends of all wire ropes shall be secured against untwisting.

5.3 Rope lubrication

Wire ropes shall be thoroughly lubricated, unless otherwise specified by the purchaser.

5.4 Rope diameter

5.4.1 *Nominal diameter d (expressed in millimetres)*

The nominal rope diameter shall be that by which the rope is designated.

5.4.2 *Measured (actual) diameter*

The measured (actual) rope diameter shall be that obtained by measuring the rope by the method described in ISO . . ..

5.4.3 *Tolerance*

The actual rope diameter shall be within the tolerances of the nominal diameter specified in Table 3.

TABLE 3

Nominal diameter d	Tolerance of the nominal diameter	
	ropes with strands exclusively of wire	ropes with fibre strand cores
mm	%	%
2 and 3	$^{+7}_{-1}$	–
4 and 5	$^{+6}_{-1}$	$^{+8}_{-1}$
6 and 7	$^{+5}_{-1}$	$^{+7}_{-1}$
8 and more	$^{+4}_{-1}$	$^{+6}_{-1}$

For ropes with diameters from 2 to 5 mm the permitted tolerance shall be rounded up to the nearest 0,05 mm.

5.5 Length (expressed in metres)

The length of rope supplied shall be that given on the order subject to the following tolerances :

up to and including 400 m : $^{+5}_{0}$ %

over 400 m : $^{+20}_{0}$ m for each 1 000 m or part thereof.

The rope length shall be measured under no load.

Ropes required with smaller tolerance, for example ropes fitted with a terminal at each end, shall be the subject of special agreement between purchaser and manufacturer.

For the length of test pieces see ISO 3108.

5.6 Mass M (expressed in kilograms per 100 m)

The approximate rope mass is calculated as follows :

$$M = Kd^2$$

where

M is the approximate mass per unit length of the rope, in kilograms per 100 m;

d is the nominal diameter of the rope, in millimetres;

K is the empirical factor for the mass per unit length for a given rope construction, in kg/(100 m·mm^2).

The values for K shown in Table 4 are for fully lubricated ropes. Ropes which are not fully lubricated may be lighter.

In Table 4 :

K_{1n} is the factor for natural fibre cored ropes,

K_{1p} the factor for polypropylene fibre cored ropes, and

K_2 the factor for steel cored ropes.

In Tables 5 to 16 :

M_{1n} is the approximate mass for natural fibre cored ropes, and

M_2 the approximate mass for steel cored ropes.

5.7 Minimum breaking load F_0 (expressed in kilonewtons)

The minimum breaking load is the load which shall be reached at least in the tensile test to destruction according to ISO 3108.

It is calculated as follows :

$$F_0 = \frac{K'd^2R_0}{1\,000}$$

where

F_0 is the minimum breaking load, in kilonewtons;

d is the nominal diameter of the rope, in millimetres;

R_0 is the tensile grade of wire, in newtons per square millimetre;

K' is the empirical factor for the minimum breaking load for a given rope construction.

The values of K' are given in Table 4.

In Table 4 :

K'_1 is the factor for fibre cores ropes, and

K'_2 the factor for steel cored ropes.

In Tables 5 to 16 :

F_{01} is the minimum breaking load for fibre cored ropes, and

F_{02} the minimum breaking load for steel cored ropes.

The breaking load figures for ropes with steel cores shown in the tables are calculated on the assumption that the steel core has a tensile strength similar to that of the wires of the other strands.

In the case where the tensile grade of the steel cores is different from that of the wires in the other strands, the minimum breaking load shall be agreed by the manufacturer and purchaser.

5.8 Numerical values of factors K and K'

TABLE 4

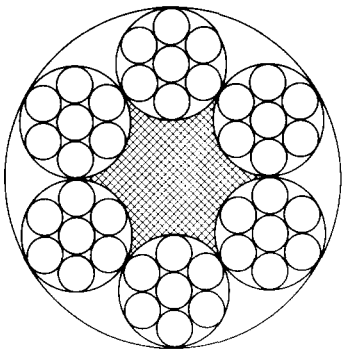
1	2	3	4	5	6	7	8	9
Rope designation	**Rope mass factor**			$\frac{K_2}{K_{1n}}$	$\frac{K_2}{K_{1p}}$	**Minimum breaking load factor**		$\frac{K'_2}{K'_1}$
	natural fibre cored ropes	polypropylene fibre cored ropes[1]	steel cored ropes			fibre cored ropes	steel cored ropes	
	K_{1n}	K_{1p}	K_2			K'_1	K'_2	
	kg/(100 m·mm²)					–		
6 X 7	0,357 4	0,348 5	0,393 1	1,10	1,135	0,332 2	0,358 8	1,08
6 X 19 6 X 37	0,346 0	0,337 4	0,380 6 –	1,10	1,135	0,307 3 0,294 8	0,331 9 –	1,08 –
6 X 19 Seale 6 X 19 Filler	0,372 6 0,380 2	0,363 3 0,370 7	0,409 9 0,418 2	1,10 1,10	1,135 1,135	0,330 9 0,337 7	0,357 4 0,364 7	1,08 1,08
6 X 26 Warrington-Seale 6 X 31 Warrington-Seale 6 X 36 Warrington-Seale 6 X 41 Warrington-Seale	0,380 2	0,370 7	0,418 2	1,10	1,135	0,329 9	0,356 3	1,08
6 X 12 6 X 24	0,250 6 0,318 4	0,230 6 0,304 1	– –	– –	– –	0,208 6 0,280 2	– –	– –
8 X 19 Seale 8 X 19 Filler	0,348 4 0,356 5	0,336 2 0,344 0	0,425 2 0,434 9	1,22 1,22	1,28 1,28	0,287 0 0,293 6	0,338 6 0,346 4	1,18 1,18
17 X 7 and 18 X 7 34 X 7 and 36 X 7	0,382 8 0,390 2	0,379 0 0,386 3	0,401 9 0,401 9	1,05 1,03	1,06 1,035	0,318 6 0,312 2	0,328 1 0,318 4	1,03 1,02

1) The practice of using man-made fibre cores is developing. Experience to date exists only with polypropylene.

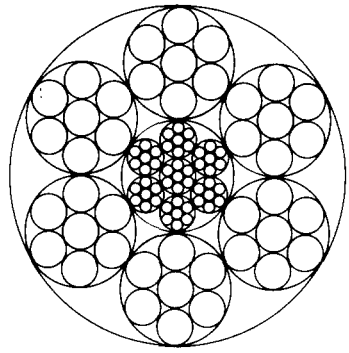
6 TABLES OF PHYSICAL PROPERTIES

6.1 Wire rope 6 X 7

Construction of the strand : 6 + 1



with fibre core (FC)



with steel core (WR)

TABLE 5

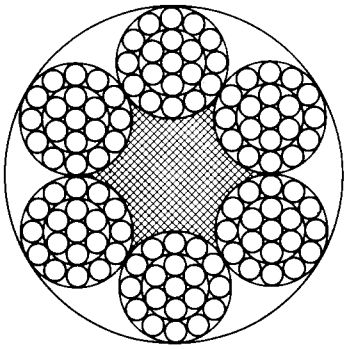
1	2	3	4	5	6	7	8	9	10
Nominal diameter		Approximate mass		Minimum breaking load of the rope, corresponding to a tensile grade R_0 of the wires of					
				1 420 N/mm²*		1 570 N/mm²		1 770 N/mm²	
		natural fibre cored ropes	steel cored ropes	fibre cored ropes	steel cored ropes	fibre cored ropes	steel cored ropes	fibre cored ropes	steel cored ropes
d	Tol.	M_{1n}	M_2	F_{01}	F_{02}	F_{01}	F_{02}	F_{01}	F_{02}
mm	%	kg/100 m	kg/100 m	kN	kN	kN	kN	kN	kN
2	$^{+7}_{-1}$	1,43	1,57	–	–	–	–	2,35	2,54
3		3,22	3,54	–	–	–	–	5,29	5,72
4	$^{+6}_{-1}$	5,72	6,29	–	–	–	–	9,41	10,2
5		8,94	9,83	–	–	–	–	14,7	15,9
6	$^{+5}_{-1}$	12,9	14,2	–	–	–	–	21,2	22,9
7		17,5	19,3	–	–	–	–	28,8	31,1
8		22,9	25,2	30,2	32,6	33,4	36,1	37,6	40,6
9		28,9	31,8	38,2	41,3	42,2	45,6	47,6	51,4
10		35,7	39,3	47,2	50,9	52,2	56,3	58,8	63,5
11		43,2	47,5	57,1	61,6	63,1	68,2	71,1	76,8
12		51,5	56,7	67,9	73,4	75,1	81,1	84,7	91,5
13		60,4	66,4	79,7	86,1	88,1	95,2	99,4	107
14		70,1	77,1	92,5	99,9	102	110	115	124
16	$^{+4}_{-1}$	91,5	101	121	130	134	144	151	163
18		116	128	153	165	169	183	191	206
20		143	157	189	204	209	225	235	254
22		173	190	228	247	252	273	285	307
24		206	227	272	293	300	324	339	366
26		242	266	319	344	353	381	397	429
28		280	308	370	399	409	442	461	498
32		366	403	483	522	534	577	602	650
36		463	509	611	660	676	730	762	823

Surface finish of the wires : see 4.1.2.

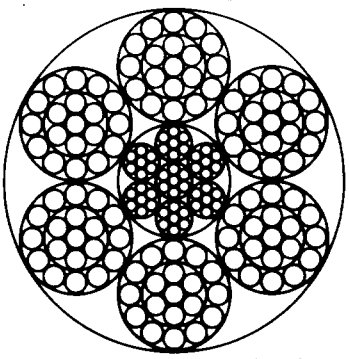
* Grade 1 420 N/mm² is only to be used for certain shipping, fishing and inland waterway requirements (see 4.1.1).

6.2 Wire rope 6 × 19

Construction of the strand : 12 + 6 + 1



with fibre core (FC)



with steel core (WR)

TABLE 6

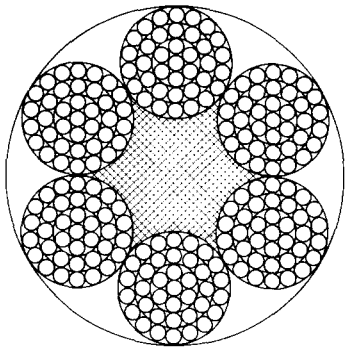
1	2	3	4	5	6	7	8	9
Nominal diameter		Approximate mass		Minimum breaking load of the rope, corresponding to a tensile grade R_0 of the wires of				
				1 420 N/mm²*		1 570 N/mm²		1 770 N/mm²
		natural fibre cored ropes	steel cored ropes	fibre cored ropes	steel cored ropes	fibre cored ropes	steel cored ropes	fibre cored ropes
d	Tol.	M_{1n}	M_2	F_{01}	F_{02}	F_{01}	F_{02}	F_{01}
mm	%	kg/100 m	kg/100 m	kN	kN	kN	kN	kN
3	$^{+7}_{-1}$	3,11	–	–	–	–	–	4,90
4	$^{+6}_{-1}$	5,54	–	–	–	–	–	8,70
5		8,65						13,6
6	$^{+5}_{-1}$	12,5	–	–	–	–	–	19,6
7		17,0	–	–	–	–	–	26,7
8		22,1	24,4	27,9	30,2	30,9	33,3	34,8
9		28,0	30,8	35,3	38,2	39,1	42,2	44,1
10		34,6	38,1	43,6	47,1	48,2	52,1	54,4
11		41,9	46,1	52,8	57,0	58,4	63,1	65,8
12		49,8	54,8	62,8	67,9	69,5	75,0	78,3
13		58,5	64,3	73,7	79,6	81,5	88,1	91,9
14		67,8	74,6	85,5	92,4	94,6	102	107
16		88,6	97,4	112	121	124	133	139
18		112	123	141	153	156	169	176
20	$^{+4}_{-1}$	138	152	175	189	193	208	218
22		167	184	211	228	234	252	263
24		199	219	251	271	278	300	313
26		234	257	295	319	326	352	368
28		271	298	342	369	378	409	426
32		354	390	447	483	494	534	557
36		448	493	566	611	625	675	705
40		554	609	698	754	772	834	870
44		670	737	845	912	934	1 010	1 050
48		–	877	–	1 090	–	1 200	–

Surface finish of the wires : see 4.1.2.

* Grade 1 420 N/mm² is only to be used for certain shipping, fishing and inland waterway requirements (see 4.1.1).

6.3 Wire rope 6 X 37

Construction of the strand : 18 + 12 + 6 + 1



with fibre core (FC)

TABLE 7

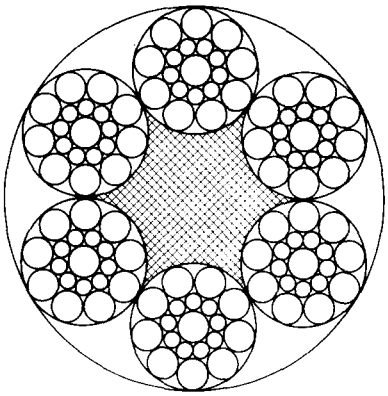
1	2	3	4	5	6
Nominal diameter		**Approximate mass**	***Minimum breaking load of the rope, corresponding to a tensile grade R_0 of the wires of***		
		natural fibre cored ropes	1 420 N/mm²*	1 570 N/mm²	1 770 N/mm²
d	Tol.	M_{1n}	F_{01}	F_{01}	F_{01}
mm	%	kg/100 m	kN	kN	kN
6	$^{+5}_{-1}$	12,5	–	–	18,8
7		17,0	–	–	25,6
8		22,1	26,8	29,6	33,4
9		28,0	33,9	37,5	42,3
10		34,6	41,9	46,3	52,2
11		41,9	50,7	56,0	63,1
12		49,8	60,3	66,6	75,1
13		58,5	70,7	78,2	88,2
14		67,8	82,0	90,7	102
16		88,6	107	118	134
18		112	136	150	169
20	$^{+4}_{-1}$	138	167	185	209
22		167	203	224	253
24		199	241	267	301
26		234	283	313	353
28		271	328	363	409
32		354	429	474	534
36		448	543	600	676
40		554	670	741	835
44		670	810	896	1 010
48		797	964	1 070	1 200
52		936	1 130	1 250	1 410
56		1 090	1 310	1 450	1 640

Surface finish of the wires : see 4.1.2.

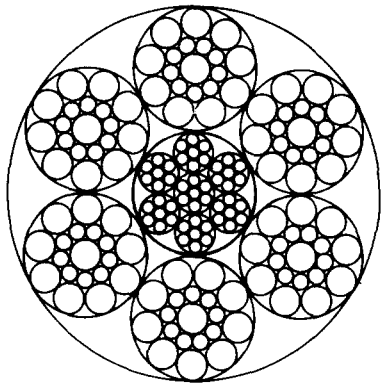
* Grade 1 420 N/mm² is only to be used for certain shipping, fishing and inland waterway requirements (see 4.1.1).

6.4 Wire rope 6 × 19 Seale

Construction of the strand : 9 + 9 + 1



with fibre core (FC)



with steel core (WR)

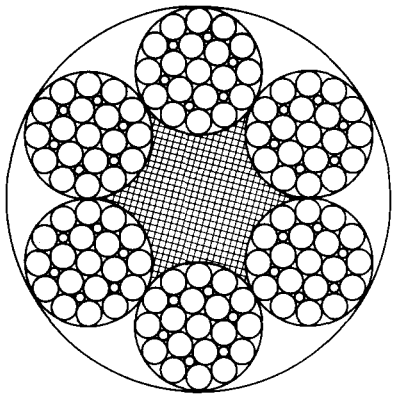
TABLE 8

1	2	3	4	5	6	7	8
Nominal diameter		Approximate mass		Minimum breaking load of the rope, corresponding to a tensile grade R_0 of the wires of			
				1 570 N/mm²		1 770 N/mm²	
		natural fibre cored ropes	steel cored ropes	fibre cored ropes	steel cored ropes	fibre cored ropes	steel cored ropes
d	Tol.	M_{1n}	M_2	F_{01}	F_{02}	F_{01}	F_{02}
mm	%	kg/100 m	kg/100 m	kN	kN	kN	kN
8	$+4$ -1	23,8	26,2	33,2	35,9	37,5	40,5
9		30,2	33,2	42,1	45,5	47,4	51,2
10		37,3	41,0	52,0	56,1	58,6	63,3
11		45,1	49,6	62,9	67,9	70,9	76,5
12		53,7	59,0	74,8	80,8	84,3	91,1
13		63,0	69,3	87,8	94,8	99,0	107
14		73,0	80,3	102	110	115	124
16		95,4	105	133	144	150	162
18		121	133	168	182	190	205
20		149	164	208	224	234	253
22		180	198	251	272	283	306
24		215	237	299	323	337	364
26		252	277	351	379	396	428
28		292	321	407	440	459	496
32		382	420	532	575	600	648
36		483	531	673	727	759	820

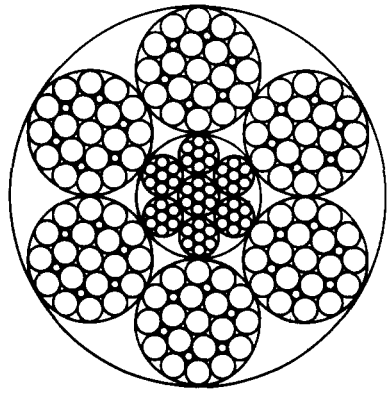
Surface finish of the wires : see 4.1.2.

6.5 Wire rope 6 X 19 Filler

Construction of the strand : 12 + 6F + 6 + 1



with fibre core (FC)



with steel core (WR)

TABLE 9

1	2	3	4	5	6	7	8
Nominal diameter		Approximate mass		Minimum breaking load of the rope, corresponding to a tensile grade R_0 of the wires of			
				1 570 N/mm²		1 770 N/mm²	
		natural fibre cored ropes	steel cored ropes	fibre cored ropes	steel cored ropes	fibre cored ropes	steel cored ropes
d	Tol.	M_{1n}	M_2	F_{01}	F_{02}	F_{01}	F_{02}
mm	%	kg/100 m	kg/100 m	kN	kN	kN	kN
8	+ 4 − 1	24,3	26,7	33,9	36,6	38,3	41,3
9		30,8	33,9	42,9	46,4	48,4	52,3
10		38,0	41,8	53,0	57,3	59,8	64,6
11		46,0	50,6	64,2	69,3	72,3	78,1
12		54,7	60,2	76,3	82,5	86,1	93,0
13		64,3	70,7	89,6	96,8	101	109
14		74,5	82,0	104	112	117	127
16		97,3	107	136	147	153	165
18		123	135	172	186	194	209
20		152	167	212	229	239	258
22		184	202	257	277	289	312
24		219	241	305	330	344	372
26		257	283	358	387	404	436
28		298	328	416	449	469	506
32		389	428	543	586	612	661
36		493	542	687	742	775	837

Surface finish of the wires : see 4.1.2.