
International Standard



2408

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Steel wire ropes for general purposes — Characteristics

Câbles en acier pour usages courants — Caractéristiques

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Descriptors : wire rope, steel wire, characteristics, dimensions, diameters, strands, breaking load.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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

ISO 2408 was first published in 1973. This second edition cancels and replaces the first edition, of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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. They are grouped by the number of strands and the number of outer wires in the strands.

In the absence of a precise indication by the purchaser, the choice of construction within a group is left to the discretion of the supplier.

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;
- ropes for fishing purposes.

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 actual breaking load.*

ISO 3178, *Steel wire ropes for general purposes — Terms of acceptance.*

ISO 3578, *Steel wire ropes — Standard designations.*

ISO 4345, *Steel wire ropes — Fibre main cores — Specifications.*

ISO 4346, *Steel wire ropes for general purposes — Lubricants — Basic requirements.*

3 Classification of wire ropes

3.1 Classification table

See table 1.

Table 1

1	2	3	4
Group	Class	Description ¹⁾	Diameter range mm
1	6 × 7	Up to 7 outer wires in a strand, one layer of wire over a king wire.	2 to 9
2	6 × 19	8 to 12 outer wires in a strand, two or three layers over a king wire. Wires equal laid.	8 to 52
3	6 × 37	14 to 18 outer wires in a strand, three or more layers of wire over a king wire. Wires equal laid.	9 to 60
4	8 × 19	8 to 12 outer wires in a strand, two or three layers over a king wire. Wires equal laid.	22 to 60
5	8 × 37	14 to 18 outer wires in a strand, three or more layers over a king wire. Wires equal laid.	22 to 60
6	17 × 7	17 or 18 strands in rope. Two layers of strand over fibre or steel core.	8 to 26
7	34 × 7	34 or 36 strands in rope. Three layers of strand over fibre or steel core.	16 to 40
8	6 × 24	12 to 15 outer wires in a strand. Two layers of wire over fibre strand core.	8 to 40

1) The main cores of 6 × 24 ropes shall be fibre only.

The cores of 17 × 7 and 34 × 7 ropes shall be fibre or steel at the discretion of the supplier.

The remainder shall be available with either a fibre or steel main core.

3.2 Lay directions

Ropes in groups 2, 3, 4, 5 can be manufactured in right and left hand, ordinary, or Langs lay.

Ropes in group 1 and 8 shall be manufactured in right hand ordinary lay only.

The lays of multistrand ropes (groups 6 and 7) shall be at the discretion of the manufacturer.

4 Materials

The materials used in the manufacture of these ropes are described below. Material requirements are part of the terms of acceptance of the rope : see ISO 3178 and ISO 2232.

4.1 Rope wire

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

The tensile grades and surface finish of the wires, excluding filler and king wires, shall be :

- 1 770 N/mm²¹⁾, bright or B-galvanized for all groups, except group 8;
- 1 570 N/mm²¹⁾, A-galvanized for group 8.

For groups 1 to 7, B-galvanizing of wires is normal. However, wires for shipping and inland waterway ropes may be A-galvanized by agreement between the purchaser and the manufacturer.

4.2 Cores

4.2.1 Fibre cores

These shall comply with ISO 4345.

4.2.2 Steel main cores

The steel core shall normally be an independent wire rope (IWR). Wire strand cores (IWS) may be used for ropes up to but not including 13 mm rope diameter, and also may be used in all multistrand ropes.

4.3 Lubricants

The lubricants for these wire ropes shall comply with ISO 4346.

5 Rope characteristics

5.1 Strand

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

5.1.2 In equal lay construction, all wires of the strand shall be stranded in one operation. When the king wire of the strand becomes so large that it is considered undesirable, it is permissible (at the manufacturer's discretion) to replace it with a multi-wire strand manufactured in a separate stranding operation.

5.1.3 King wires and fibre cores of strand 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 All strands in a given layer shall be of the same construction and lay. The length of lay of the strands in a rope shall not vary significantly.

5.2.3 The core shall be of a size to provide sufficient support to enable the covering strands to be evenly laid.

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 if necessary.

5.3 Rope lubrication

Wire ropes shall be appropriately lubricated.

5.4 Rope diameter

5.4.1 Nominal diameter, *d*

The nominal rope diameter, expressed in millimetres, 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 3178.

5.4.3 Tolerance

The actual rope diameter shall be within the tolerance of the nominal diameter specified in table 2.

1) 1 N/mm² = 1 MPa

Table 2

Nominal diameter <i>d</i> mm	Tolerance of the nominal diameter, %	
	Ropes with strands exclusively of wire	Ropes with fibre strand cores
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

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

- ≤ 400 m : ${}^{+5}_0$ %
- > 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 the purchaser and the manufacturer.

For the length of test pieces, see ISO 3108.

5.6 Mass, *M*

The approximate rope mass, expressed in kilograms per 100 m, is calculated as follows :

$$M = K d^2$$

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 kilograms per 100 metre square millimetres [kg/(100 m·mm²)].

The values for *K* shown in table 3 are for fully lubricated ropes. Ropes which are not fully lubricated may be lighter.

In table 3 :

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

K_{1p} is the factor for polypropylene fibre cored ropes;

K_2 is the factor for steel cored ropes.

In tables 4 to 9 :

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

M_2 is the approximate mass for steel cored ropes.

5.7 Minimum breaking force, F_0

The minimum breaking force, expressed in kilonewtons, is the force which shall be reached at least in the tensile test to destruction carried out in accordance with ISO 3108.

It is calculated as follows :

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

where

F_0 is the minimum breaking force, 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 force for a given rope construction.

The values of K' are given in table 3.

In table 3 :

K'_1 is the factor for fibre cored ropes;

K'_2 is the factor for steel cored ropes.

In tables 4 to 7 :

F_{01} is the minimum breaking force for fibre cored ropes;

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

The breaking force values 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.

NOTE — In cases where the tensile grade of wires in steel cores is different from that of the wires in the other strands, the minimum breaking force of the rope will need to be agreed between the manufacturer and the purchaser.

5.8 Numerical values of factors K and K' and minimum breaking force factor

Table 3

1 Group	2 Class	3 Rope mass factor			6 $\frac{K_2}{K_{1n}}$	7 $\frac{K_2}{K_{1p}}$	8 Minimum breaking force factor		10 $\frac{K'_2}{K'_1}$
		natural fibre core	Ropes with				fibre core	steel core	
			man-made fibre core	steel core					
		K_{1n}	K_{1p}^{**}	K_2			K'_1	K'_2	
kg/(100 m·mm ²)									
1	6 × 7	0,346	0,340	0,381	1,10	1,12	0,332	0,359	1,08
2 3*	6 × 19 and 6 × 37	0,361	0,352	0,398	1,10	1,13	0,330	0,356	1,08
4 5	8 × 19 and 8 × 37	0,347	0,339	0,417	1,20	1,23	0,293	0,346	1,18
6	17 × 7	0,390			—	—	0,328		—
7	34 × 7	0,390			—	—	0,318		—
8	6 × 24	0,308	0,295		—	—	0,280	—	—

* When ropes with strands of 19 wires or fewer are supplied in these groups, mass factors 3 % lower than those given in the tables shall be used.

** These factors are for polypropylene cored ropes.

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6 Physical properties

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6.1 Group 1

Table 4

1 Nominal diameter		2		3 Approximate mass of ropes		4		5 Minimum breaking force of ropes corresponding to nominal tensile grade R_0 of 1 770 N/mm ²		6	
d	tol.	Ropes with		Ropes with		fibre core		steel core			
		natural fibre core M_{1n}	steel core M_2	fibre core F_{01}	steel core F_{02}						
mm	%	kg/100m	kg/100m	kN	kN						
2	} +7 -1	1,38	1,52	2,35	2,54						
3		3,11	3,43	5,29	5,72						
4	} +6 -1	5,54	6,10	9,40	10,17						
5		8,65	9,53	14,69	15,89						
6	} +5 -1	12,46	13,72	21,16	22,88						
7		16,95	18,67	28,79	31,14						
8	} +4 -1	22,14	24,38	37,61	40,67						
9		28,03	30,86	47,60	51,47						

6.2 Groups 2 and 3

Table 5

1		2		3		4		5		6	
Nominal diameter		Approximate mass of ropes				Minimum breaking force of ropes corresponding to nominal tensile grade R_0 of 1 770 N/mm ²					
		Ropes with natural fibre core		Ropes with steel core		Ropes with fibre core			Ropes with steel core		
d	tol.	M_{1n}	M_2	F_{01}	F_{02}						
mm	%	kg/100m	kg/100m	kN	kN						
8*		23,1	25,5	37,4	40,3						
9		29,2	32,2	47,3	51,0						
10		36,1	39,8	58,4	63,0						
11		43,7	48,2	70,7	76,2						
12		52,0	57,3	84,1	90,7						
13		61,0	67,3	98,7	106,5						
14		70,8	78,0	114,5	123,5						
16		92,4	101,9	149,5	161,3						
18		117,0	129,0	189,2	204,2						
20		144,4	159,2	233,6	252,0						
22	+ 4	174,7	192,6	282,7	305,0						
24	- 1	207,9	229,2	336,4	362,9						
26		244,0	269,0	394,9	426,0						
28		283,0	312,0	457,9	494,0						
32		369,7	407,6	598,1	645,2						
36		467,9	515,8	757,0	816,6						
40		577,6	636,8	934,6	1 008,2						
44		698,9	770,5	1 130,8	1 219,2						
48		831,7	917,0	1 345,8	1 451,8						
52		976,1	1 076,2	1 579,4	1 703,8						
56**		1 132,1	1 248,1	1 831,7	1 976,1						
60**		1 299,6	1 432,8	2 102,8	2 268,4						

* 8 mm rope only available in group 2.

** 56 mm and 60 mm ropes only available in group 3.

6.3 Groups 4 and 5

Table 6

1		2		3		4		5		6	
Nominal diameter		Approximate mass of ropes				Minimum breaking force of ropes corresponding to nominal tensile grade R_0 of 1 770 N/mm ²					
		Ropes with natural fibre core		Ropes with steel core		Ropes with fibre core			Ropes with steel core		
d	tol.	M_{1n}	M_2	F_{01}	F_{02}						
mm	%	kg/100m	kg/100m	kN	kN						
22		167,9	201,8	251,0	296,4						
24		199,9	240,2	298,7	352,8						
26		234,6	281,9	350,6	414,0						
28		272,0	326,9	406,6	480,1						
32		355,3	427,0	531,1	627,1						
36	+ 4	449,7	540,4	672,1	793,7						
40	- 1	555,2	667,2	829,8	979,9						
44		671,8	807,3	1 004,0	1 185,6						
48		799,5	960,8	1 194,9	1 411,0						
52		938,3	1 127,6	1 402,3	1 656,0						
56		1 088,2	1 307,7	1 626,4	1 920,5						
60		1 249,9	1 501,2	1 867,0	2 204,7						

6.4 Group 6

Table 7

1	2	3	4
Nominal diameter		Approximate mass of ropes	Minimum breaking force of ropes corresponding to nominal tensile grade R_0 of 1 770 N/mm ²
d	tol.		
mm	%	M kg/100m	F_0 kN
8		25,0	37,2
9		31,6	47,0
10		39,0	58,1
11		47,2	70,2
12		56,2	83,6
13		65,9	98,1
14	+4	76,4	113,8
16	-1	99,8	148,6
18		126,4	188,1
20		156,0	232,2
22		188,8	281,0
24		224,6	334,4
26		263,6	392,5

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6.5 Group 7

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Table 8

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1	2	3	4
Nominal diameter		Approximate mass of ropes	Minimum breaking force of ropes corresponding to nominal tensile grade R_0 of 1 770 N/mm ²
d	tol.		
mm	%	M kg/100m	F_0 kN
16		99,8	144,1
18		126,4	182,4
20		156,0	225,1
22		188,8	272,4
24	+4	224,6	324,2
26	-1	263,6	380,5
28		305,8	441,3
32		399,4	576,4
36		505,4	729,5
40		624,0	900,6

6.6 Group 8

Table 9

1	2	3	4
Nominal diameter		Approximate mass of ropes with natural fibre core	Minimum breaking force of ropes corresponding to nominal tensile grade R_0 of 1 570 N/mm ²
	d tol.	M_{1n}	F_0
	mm	kg/100m	kN
8		19,7	28,1
9		24,9	35,6
10		30,8	44,0
11		37,3	53,2
12		44,4	63,3
13		52,1	74,3
14		60,4	86,2
16		78,8	112,5
18	+6	99,8	142,4
20	-1	123,2	175,8
22		149,1	212,8
24		177,4	253,2
26		208,2	297,2
28		241,5	344,6
32		315,4	450,2
36		399,2	569,7
40		492,8	703,4

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Annex

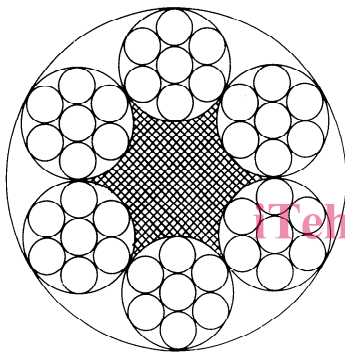
Typical rope constructions

This annex gives typical rope constructions for the respective wire rope groups and wire rope classes laid down in table 1, using standard designations according to ISO 3578.

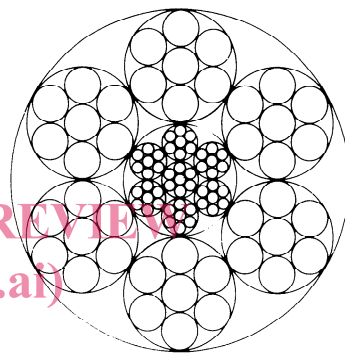
A.1 Group 1, class 6 × 7

A.1.1 Wire rope 6 × 7

Construction of the strand : 6 + 1



with fibre core (FC)



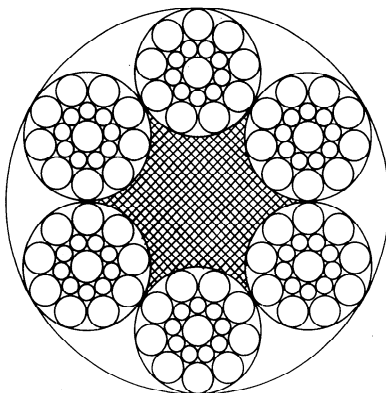
with steel core (IWR)

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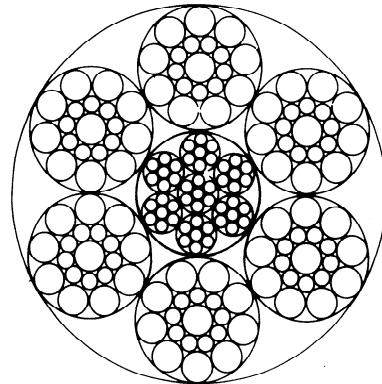
A.2 Group 2, class 6 × 19

A.2.1 Wire rope 6 × 19 Seale

Construction of the strand : 9 + 9 + 1



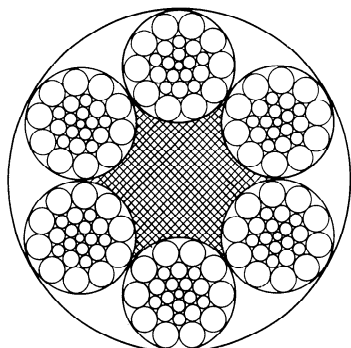
with fibre core (FC)



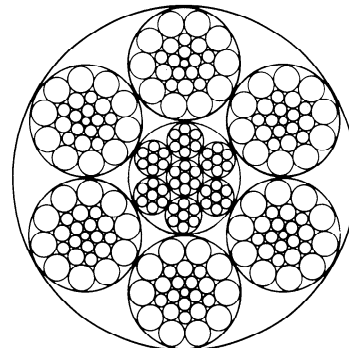
with steel core (IWR)

A.2.2 Wire rope 6 × 26 Warrington-Seale

Construction of the strand : 10 + 5/5 + 5 + 1



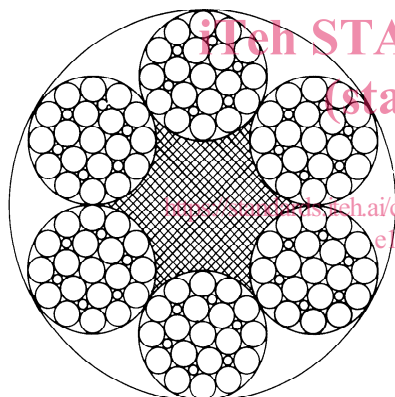
with fibre core (FC)



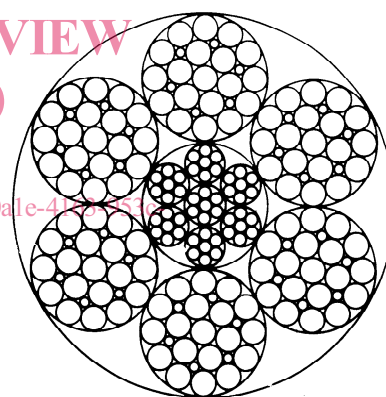
with steel core (IWR)

A.2.3 Wire rope 6 × 19 Filler

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



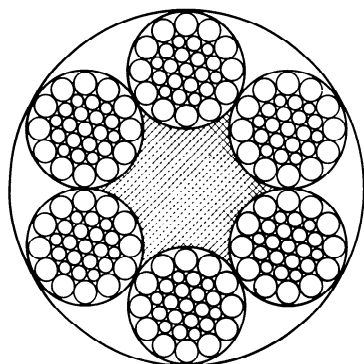
with fibre core (FC)



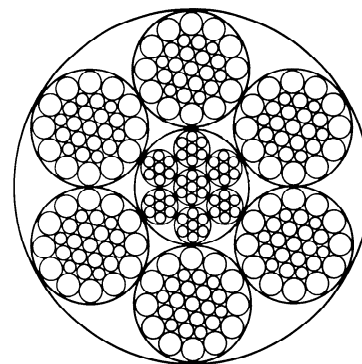
with steel core (IWR)

A.2.4 Wire rope 6 × 31 Warrington-Seale

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



with fibre core (FC)



with steel core (IWR)