BS EN 12385-4:2002

Steel wire ropes — Safety —

Part 4: Stranded ropes for general lifting applications

The European Standard EN 12385-4:2002 has the status of a British Standard

ICS 77.140.65



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The UK participation in its preparation was entrusted to Technical Committee MHE/2, Wire ropes, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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This British Standard, having been prepared under the direction of the Engineering Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 30 October 2002

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Foreword

This document (EN 12385-4:2002) has been prepared by Technical Committee CEN/TC 168, "Chains, ropes, webbing, slings and accessories – Safety", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2003, and conflicting national standards shall be withdrawn at the latest by April 2003.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EC Directive(s).

For relationship with EC Directive(s), see informative annex ZA, which is an integral Part of this document.

The other Parts of EN 12385 are:

- Part 1: General requirements
- Part 2: Definitions, designation and classification
- Part 3: Information for use and maintenance
- Part 5: Stranded ropes for lifts
- Part 6: Stranded ropes for mine shafts
- Part 7: Locked coil ropes for mine shafts
- Part 8: Stranded hauling and carrying-hauling ropes for cableway installations designed to carry persons
- Part 9: Locked coil carrying ropes for cableway installations designed to carry persons
- Part 10: Spiral ropes for general structural applications

Part 1 provides the general requirements of Parts 4 to 10.

This is the first edition of this Part.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This Part of this European Standard has been prepared to be a harmonized standard to provide one means of complying with the essential safety requirements of the Machinery Directive.

This Part of this European Standard is a type C standard as stated in EN 292.

For the purposes of the Certificate referred to in clause 7, this Part assumes a working load limit based on a safety factor of 5. The safety factor and the required minimum breaking force of the rope for a given application is the responsibility of the manufacturer of the machine of which the rope forms a part.

During the preparation of this standard, it was assumed that a negotiation would take place between the purchaser and the manufacturer concerning the intended purpose of the rope.

Although tables of breaking forces and masses are provided for a number of the more common classes, diameters and rope grades, this Part of this standard is not limited to those given, providing all of the other requirements are met.

Specifiers, purchasers and users should recognise that some ropes are specially designed by the manufacturer to meet particular lifting machinery requirements.

1 Scope

This Part of this European Standard specifies the particular materials, manufacturing and testing requirements for ropes for general lifting applications.

The particular hazards covered by this Part are identified in Clause 4.

This Part of this European Standard does not establish requirements for information for use other than those given in clause 7 of Part 1. Neither does it cover the requirements for ropes fitted with terminations.

Minimum breaking force values for the more common classes, sizes and grades of rope are provided in tables 5 to 17.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 10264-2, Steel wire and wire products – Steel wire for ropes – Part 2: Cold drawn non-alloyed steel wire for ropes for general applications.

EN 12385-1:2002, Steel wire ropes – Safety – Part 1: General requirements.

EN 12385-2:2002, Steel wire ropes – Safety – Part 2: Definitions, designation and classification.

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

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions in EN 12385-2 apply.

4 Hazards

In addition to the general hazards identified in clause 4 of Part 1, Table 1 contains all the particular hazards which require action to reduce risk as being specific and significant for steel wire ropes for general lifting applications.

Table 1- Hazards and associated requirements

Hazard	s identified in annex A of EN 1050:1996	Relevant clause of annex A of EN 292- 2:1991/A1:1995	Relevant clause of this standard
27.4	Mechanical hazard from insufficient strength of parts	4.1.2.3	5 and 6
27.6	Mechanical hazard from inadequate selection of ropes and their inadequate integration into the machine	4.3.1	7

NOTE For the purposes of this Part of EN 12385, insufficient strength of parts means failure to achieve the minimum breaking force of the rope.

5 Safety requirements and/or measures

5.1 General

In addition to the requirements given 5.2 to 5.5, the requirements shall also conform to those given in EN 12385-1.

5.2 Materials

5.2.1 Wire

Wires, before ropemaking, shall conform to EN 10264-2.

For those ropes where a rope grade is applicable, e.g. Tables 5 to 16, the tensile strength grades of the wires shall be subject to the limits given in Table 2.

For those ropes where a rope grade is not applicable, e.g. large diameter ropes, the tensile strength grades of the wires shall be one or a combination of those given in EN 10264-2.

Table 2 — Wire tensile strength grades excluding centre and filler wires for given rope grades
--

Rope	Wire tensile strength grades N/mm ²							
Grade	Minimum	Maximum						
1770	1570	1960						
1960	1770	2160						
2160	1960	2160						

5.2.2 Core

The core shall be one of the following types:

- a) fibre;
- b) steel, as an independent wire rope (IWRC) or wire strand (WSC);
- c) composite (e.g. steel and fibre or steel and solid polymer);
- d) cushion core; or
- e) solid polymer.

5.2.3 Lubricant

The lubricant shall comply with ISO 4346.

5.3 Rope manufacture

5.3.1 Lubrication

At least the strands shall be lubricated.

5.3.2 Construction

The rope construction shall be either:

- a) one of those covered by Tables 5 to 17; or
- b) another single layer or parallel-closed or rotation-resistant rope construction as specified by the manufacturer and covered by the respective classes in EN 12385-2.

5.3.3 Rope grade

For rope sizes up to and including 60 mm diameter, the rope grade shall be 1770, 1960 or 2160 or an intermediate grade as specified by the manufacturer, but not exceeding 2160.

NOTE Ropes larger than 60mm diameter may not have a rope grade.

5.4 Diameter

5.4.1 Tolerances

When measured in accordance with 6.3.1 of EN 12385-1:2002, the measured diameter shall not vary from the nominal diameter by more than the values given in Table 3. For ropes with diameters from 2 mm to 5 mm inclusive, the tolerance shall be rounded up to the nearest 0,05 mm.

Nominal rope diameter	Tolerance as percentage of nominal rope diameter
mm	
From 2 to < 4	+8
	Ō
From 4 to < 6	+7
	0
From 6 to < 8	+6
	ŏ
8 and greater	+5
,	Ő

Table 3 — Tolerances on rope diameter

5.4.2 Differences between diameter measurements

The difference between any two of the four measurements taken in accordance with 6.3.1 of EN 12385-1:2002 and expressed as a percentage of the nominal rope diameter, shall not exceed the values given in Table 4.

Nominal rope	Difference between measurements as percentage of nominal rope diameter							
diameter	Rope with strands that are	Ropes with strands that						
	exclusively of wire or incorporate solid	incorporate						
mm	polymer	fibre centres						
From 2 to < 4	7	-						
From 4 to < 6	6	8						
From 6 to < 8	5	7						
8 and greater	4	6						

NOTE The values in the table apply irrespective of the type of core in the rope.

5.5 Breaking force

The breaking force shall be specified only as minimum breaking force.

The values of minimum breaking force for the more common classes and grades of ropes shall be not less than those given in Tables 5 to 16. For intermediate rope diameters, the values shall be not less than those obtained using the formula in annex A with the factors given in annex B.

The values of minimum breaking force for large diameter ropes are given in Table 17. For intermediate rope diameters, the values shall be not less than those obtained using the formula in annex A.

NOTE Refer to the definitions given in EN 12385-2 for derivation of the formula for calculation of minimum breaking force.

5.6 Designation and classification

Rope designation and classification shall conform to EN 12385-2.

6 Verification of safety requirements and/or measures

6.1 General

Verification of safety requirements and/or measures shall be in accordance with that given in clause 6 of EN 12385-1 and the additional verification given in 6.2 to 6.5 below.

6.2 Lubricant

Compliance with the lubricant requirements shall be through a visual verification of the inspection documents supplied with the lubricant.

6.3 Lubrication

Compliance with the lubrication requirements shall be through a visual verification.

6.4 Construction

Compliance with the construction requirements shall be through a visual verification.

6.5 Rope grade

Compliance with the rope grade requirements shall be through a visual verification of the inspection documents supplied with the wire in relation to the minimum breaking force value of the rope.

7 Information for use

In addition to conforming to clause 7 of Part 1, the Certificate (see 7.2.1 of Part 1) shall also include either an example of the maximum working load to which the rope shall be subjected in service at a given factor of safety or the working load limit when the intended use is known.

Construction cross section example	Construction	of rope		Construction of strand				
- Co	Item		Quantity	Item		Quantity		
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Strands		6	Wires		5 to 9		
		r strands	6	Outer wires	4 to 8			
		s of strands		Layers of wire	25	1		
APR AP	Wires in rope		30 to 54	Layore or with	•			
ଁ ପୂଟି ଁ	(excluding m							
6x7-FC	Typical exam			No. of outer wires				
0,7-1 0		ipie			VII 63	Outer wire factor ¹⁾		
	Rope		Strand	Total	per strand			
	6×7		1-6	36	6	0,106		
	Min. breaking	a force factor		$K_1 = 0,332$	$K_2 = 0,359$	<i>K</i> ₃ = 0,388		
	Nominal leng	th mass fact	or ¹⁾ :		$W_2 = 0,384$	0 -)		
	Nominal met			$C_1 = 0,369$				
	factor ¹⁾				-2 -,			
Nominal rope	Approximate	nominal		Minimum br	eaking force			
diameter	length mass ¹	ⁱ⁾ kg/100 m			N			
	Fibre core	Steel	Rope grade	1770	Rope grade	9 1960		
		core						
mm			Fibre core	Steel core	Fibre core	Steel core		
1	2	3	4	5 ²⁾	6	7 ²⁾		
2	1,38	1,54	2,35	2,54	2,60	2,81		
3	3,11	3,46	5,29	5,72	5,86	6,33		
4	5,52	6,14	9,40	10,2	10,40	11,3		
5	8,63	9,60	14,7	15,9	16,3	17,6		
6	12,4	13,8	21,2	22,9	23,4	25,3		
7	16,9	18,8	28,8	31,1	31,9	34,5		
8	22,1	24,6	37,6	40,7	41,6	45,0		
9	27,9	31,1	47,6	51,5	52,7	57,0		
10	34,5	38,4	58,8	63,5	65,1	70,4		
11	41,7	46,5	71,1	76,9	78,7	85,1		
12	49,7	55,3	84,6	91,5	93,7	101		
13	58,3	64,9	99,3	107	110	119		
14	67,6	75,3	115	125	128	138		
16	88,3	98,3	150	163	167	180		
18	112	124	190	206	211	228		
20	138	154	235	254	260	281		
22	167	186	284	308	315	341		
24	199	221	338	366	375	405		
26	233	260	397	430	440	476		
28	270	301	461	498	510	552		
32	353	393	602	651	666	721		
36	447	498	762	824	843	912		
40	552	614	940	1 020	1 040	1 130		
¹⁾ Informative only								

#### Table 5 — Class 6×7

" Informative only

²⁾ For small diameter ropes (2 mm to 7 mm) with wire strand core (WSC),  $K_3$  may be used for the calculation of breaking forces. The values given in columns 5 and 7 are based on ropes with independent wire rope cores (IWRC).

#### Table 6 — Class 8x7

Construction cross section example	Construction	of rope		Construction				
	Item		Quantity	ltem	Quantity			
	Strands		8	Wires		5 to 9		
82868		strands	8	Outer wires	4 to 8			
		s of strands	1	Layers of wire	1			
	Wires in rope		40 to 72	Layoro or Wirt	•			
8788	(excluding st		10 10 72					
405	、 <b>3</b>	,						
8x7-FC	Typical exam	ple		No. of outer v	vires	Outer wire factor ¹⁾		
	Rope		Strand	Total	per strand			
	8×7		1-6	48	6	0,087		
	Min. breaking	force factor		$K_1 = 0,291$	$K_2 = 0,359$	<i>K</i> ₃ = 0,404		
	Nominal leng	th mass fact	or ¹⁾ :		$\bar{W_2} = 0,391$			
	Nominal met			$C_1 = 0,335$				
	factor ¹⁾				- /	<b>u</b> ,		
Nominal rope	Approximate			Minimum br	eaking force			
diameter	length mass ¹	⁾ kg/100 m		k	kN			
[	Fibre core	Steel	Rope grade	1770	Rope grade	ade 1960		
		core	_					
mm			Fibre core	Steel core	Fibre core	Steel core		
1	2	3	4	5 ²⁾	6	7 ²⁾		
2	1,31	1,56	2,06	2,54	2,28	2,81		
3	2,94	3,52	4,64	5,72	5,13	6,33		
4	5,23	6,26	8,24	10,2	9,13	11,3		
5	8,18	9,78	12,9	15,9	14,3	17,6		
6	11,8	14,1	18,5	22,9	20,5	25,3		
7	16,0	19,2	25,5	31,1	27,9	34,5		
8	20,9	25,0	33,0	40,7	38,6	45,0		
9	26,5	31,7	41,7	51,5	57,0			
10	32,7	39,1	51,5	63,5	57,0	70,4		
11	39,6	47,3	62,3	76,9	69,0	85,1		
12	47,1 56,3					404		
			74,2	91,5	82,1	101		
13	55,3	66,1	87,0	107	96,4	119		
14	55,3 64,1	66,1 76,6	87,0 101	107 125	96,4 112	119 138		
14 16	55,3 64,1 83,7	66,1 76,6 100	87,0 101 132	107 125 163	96,4 112 146	119 138 180		
14	55,3 64,1	66,1 76,6	87,0 101	107 125	96,4 112	119 138		
14 16 18 20	55,3 64,1 83,7 106 131	66,1 76,6 100 127 156	87,0 101 132 167 206	107 125 163 206 254	96,4 112 146 185 228	119 138 180 228 281		
14 16 18 20 22	55,3 64,1 83,7 106 131 158	66,1 76,6 100 127 156 189	87,0 101 132 167 206 249	107 125 163 206 254 308	96,4 112 146 185 228 276	119 138 180 228 281 341		
14 16 18 20 22 24	55,3 64,1 83,7 106 131 158 188	66,1 76,6 100 127 156 189 225	87,0 101 132 167 206	107 125 163 206 254 308 366	96,4 112 146 185 228 276 329	119 138 180 228 281 341 405		
14 16 18 20 22 24 26	55,3 64,1 83,7 106 131 158 188 221	66,1 76,6 100 127 156 189 225 264	87,0 101 132 167 206 249 297 348	107 125 163 206 254 308 366 430	96,4 112 146 185 228 276 329 386	119 138 180 228 281 341 405 476		
14 16 18 20 22 24 26 28	55,3 64,1 83,7 106 131 158 188 221 256	66,1 76,6 100 127 156 189 225 264 307	87,0 101 132 167 206 249 297 348 404	107 125 163 206 254 308 366 430 498	96,4 112 146 185 228 276 329 386 447	119 138 180 228 281 341 405 476 552		
14 16 18 20 22 24 26 28 32	55,3 64,1 83,7 106 131 158 188 221 256 335	66,1 76,6 100 127 156 189 225 264 307 400	87,0 101 132 167 206 249 297 348 404 527	107 125 163 206 254 308 366 430 498 651	96,4 112 146 185 228 276 329 386 447 584	119 138 180 228 281 341 405 476 552 721		
14 16 18 20 22 24 26 28	55,3 64,1 83,7 106 131 158 188 221 256	66,1 76,6 100 127 156 189 225 264 307	87,0 101 132 167 206 249 297 348 404	107 125 163 206 254 308 366 430 498	96,4 112 146 185 228 276 329 386 447	119 138 180 228 281 341 405 476 552		

¹⁾ Informative only

²⁾ For small diameter ropes (2 mm to 7 mm) with wire strand core (WSC),  $K_3$  may be used for the calculation of breaking forces. The values given in columns 5 and 7 are based on ropes with independent wire rope cores (IWRC).

Construction cross section		Constru	ction of rope		Construction of strand								
examples													
i m		Item			Quantity	/	Item				Quantity		
	ກ່	Strands		6			Wires				15 to 26		
	83		outer strands	6		Outer wi				7 to 12			
			layers of strar	nds	1	-	Layers o	t wir	es		2 to 3		
645646	\$P	Wires in			90 to 15	6							
- 7867 -		(excludi	ng steel core)										
6×19S-F0	2	Typical example					No. of ou	uter	wires		Outer wir	e factor ¹⁾	
-999		Rope			Strand		Total		per str	and			
	82	6×19S			1-9-9		54		9		0,080		
	₩ A	6×25F			1-6-6F-1	2	72		12		0,064		
	₿ ₂	6×19W			1-6-6+6		72		12	6	0,073		
63355556	82									6	0,055		
1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 19		6×26W\$	S		1-5-5+5-	10	60		10		0,074		
		Min. bre	aking force fa	ctor:			$K_1 = 0.33$		$K_2 = 0,3$				
6×25F-FC	>	Nomina	I length mass	facto			$W_1 = 0.35$	59	$\bar{W}_2 = 0,$				
			I metallic cros	s-sec	tional are	а	$C_1 = 0,38$	84	$C_2 = 0,4$	449			
		factor ¹⁾ :											
Nominal	A	pproxima	te nominal				Mini	mun	n breaki	ng fo	orce		
rope		length							kN				
diameter		kg/10	00 m				Rope Grade				•		
mm						70		1960			2160		
		e core	Steel core		re core		el core		re core		Steel core	Steel core	
1	2		3	4		5		6		7		8	
6		2,9	14,4		21,0		22,7	23,3			25,1	27,7	
7		7,6	19,6		28,6		30,9	31,7			34,2	37,7	
8		3,0	25,6		37,4		40,3	41,4			44,7	49,2	
9		9,1	32,4		47,3		51,0	52,4			56,5	62,3	
10		5,9	40,0		58,4		63,0 70 0	64,7 79.2			69,8	76,9	
11   12		3,3 1,7	48,4 57,6		70,7 84,1		76,2 90,7		78,3 93,1		84,4 100	93,0 111	
13		0,7	67,6		98,7		90,7 106		109		118	130	
14		0,7	78,4		90,7 14		24	109			137	151	
16		1,9	102		50		61		66		179	197	
18	11		130		89		204	210			226	249	
20	14		160		34		252		259		279	308	
22	17		194		83		805		13		338	372	
24	20		230		36		63		373		402	443	
26	24	3	270	39	95	4	26	4	37		472	520	
28	28		314		58		94		507		547	603	
32	36		410		98		645		62		715	787	
36	46		518		57		817		38		904	997	
40	57		640		35		10		40		120	1 230	
44	69		774				20		250		350	1 490	
48	82		922				50		90		610	1 770	
52	97		1 080	15			00		750 Nao		890	2 080	
56	113		1 250	18			80		)30		2 190	2 410	
60	1 29	U	1 440	2 1	00	22	.70	23	30		2 510	2 770	
¹⁾ Informative	only												

Table 7 — Class: 6x19

#### Table 8 — Class 8x19

Construction Construction of rope								ictior	of strand	b		
cross section	1											
examples		ltana			Quantit		lite and				Quantitu	
	04	Item			Quantity Item					Quantity		
ACCERTS ACC	82	Strands		8			Wires				15 to 26	
- 449-344542.	260 -		outer strands	. da	8		Outer w				7 to 12	
- 영상 관광하는	BO -		layers of strar	us	1 120 to 2	00	Layers	OF WI	res		2 to 3	
- 4339999	Wires in rope 120 to 208 (excluding metallic core)											
- afte -	4.00	(excludi	ng metallic co	ie)								
8x19S-IWF	SC		example				No. of c	outer	wires		Outer wire	e factor ¹⁾
- da figha	b.	Rope			Strand		Total		per			
	æ –								strand			
- 253.3433		8×19S			1-9-9		72		9		0,065 5	
	for -	8×25F			1-6-6F-		96		12		0,052 5	
	98 - I	8×19W			1-6-6+6		96		12	6	0,060 6	
nen för at	2.7									6	0,045 0	
		8×26W			1-5-5+5		80		10		0,060 0	
8×25F-IWF	SC		aking force fa		1)		$K_1 = 0,29$		$K_2 = 0,35$			
			l length mass						$W_2 = 0.40$			
			I metallic cros	s-sec	tional are	а	$C_1 = 0,34$	9	$C_2 = 0.45$	57		
		factor ¹⁾										
Nominal	A	pproxima	te nominal		Minimum breaking force							
rope		length			kN							
diameter		kg/10	00 m		Rope Grac							
mm					1770						2160	
4	2	e core	Steel core	4	e core	5	teel core		Fibre core		teel core	Steel core
1						-		6		7		8
8		21,8	26,0		3,2		10,3	36,8			44,7	49,2
9		27,5	33,0		2,0				46,5		56,5	62,3
10		84,0	40,7		1,9	63,0 76 2		57,4			69,8	76,9
11 12		1,1	49,2		2,8		76,2		69,5 82,7		84,4	93,0 111
12		9,0	58,6 68,8		4,7 7.6		90,7 106		97,1		100 118	130
13		57,5 66,6	00,0 79,8		7,6 )2	12					137	151
16		50,0 57,0	104		33	16			47		179	197
18	11		132		55 58		204		186		226	249
20	13		163		)7	25			30		279	308
22	16		197	2		30			78		338	372
24	19		234		99	36			31		402	443
26	23		275		51	42			88		472	520
28	26		319		)7	49			50		547	603
32	34		417		31	64			88		715	787
36	44		527		72	8		7	44		904	997
40	54		651	83	30	101			19		120	1 230
44	65		788	1 0		1 22		1 1			350	1 490
48	78		938	1 20		1 45		1 3			610	1 770
52	91		1 100	1 4(		17(		15			890	2 080
56	1 07		1 280	16		1 98		18			190	2 410
60	1 22	20	1 470	1 87	70	2 27	70	20	70	2	510	2 770
¹⁾ Informative	only											

Coss sector         Item         Quantity         Item         Quantity           Strands         6         Wires         29 to 57           outer strands         1         Cuantity         20 to 57           outer strands         1         Layers of strands         1         20 to 57           outer strands         1         174 to 342         Outer wires         12 to 18           6x36WS-WRC         Trypical example         No. of outer wires         Outer wire factor ¹¹ No. of outer wires         Outer wire factor ¹¹ 6x36WS-WRC         Rope         Strand         Total         per         strand         Outer wire factor ¹¹ 6x36WS         1-6-6+6-12         72         12         0.064         0.050         6.441WS         1-7-7-7-7.14         84         14         0.056         6.441WS         1-8-8+8-16         96         16         0.050         6.441WS         1-8-8+8-16         96         16         0.050         16.4010S         1.5-17-16         16         0.050         16.7400         16.7400         16.7400         16.7400         16.7400         16.7400         16.7400         16.7400         16.7400         16.7400         16.7400         16.7400         16.7400         16.74	Construction cross sectior		Constru	ction of rope				Co	nstructio	on of s	tranc	1	
$\begin{tabular}{ c c c c c c c } \hline team & cluantity & team & cluantity & clu$		1											
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$\begin{tabular}{ c c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		<b>`</b>					,						
$ \begin{array}{ c c c c c c } \hline \begin{tabular}{ c c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		<u></u> Ş				-				5			
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		, 2			nds		-						
		ğ	Wires ir			174 to 3	342		, 				
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	6×36WS-IW	/RC	Typical		I				r wires	6	Outer w	ire factor ¹⁾	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			Rope			Strand		Tot	tal	•	4		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		<u>}</u>	6.04M/	<u> </u>		166+6	12	72			u	0.064	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		₿ B										,	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		<u>8</u>											
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		ÿ	1										
Min. breaking force factor: $K_1 = 0,330$ $K_2 = 0,356$ Nominal length mass factor ¹¹ $W_1 = 0,367$ $W_2 = 0,409$ Nominal metallic cross-sectional area factor ¹¹ $W_1 = 0,393$ $C_2 = 0,460$ factor ¹¹ Approximate nominal length mass ¹¹ Minimum breaking force           Idiameter         kg/100 m         Rope Grade           mm         1770         1960         2160           1         2         3         4         5         6         7         8           23,5         26,2         37,4         40,3         41,4         44,7         49,2           9         29,7         33,1         47,3         51,0         52,4         56,5         62,3           10         36,7         40,9         58,4         63,0         64,7         69,8         76,9           11         44,4         49,5         70,7         76,2         78,3         84,4         93,0           12         52,8         58,9         84,1         90,7         93,1         100         111           13         62,0         69,1         98,7         106         109         118         130	3899 (											· ·	
Nominal length mass factor $^{1)}$ Nominal metallic cross-sectional area $W_1 = 0.367$ $C_1 = 0.393$ $W_2 = 0.409$ $C_2 = 0.409$ Nominal rope diameter mmApproximate nominal length mass 10 kg/100 mMinimum breaking force kNNominal length mass 10 kg/100 mMinimum breaking force steel coreSteel core12345678823,526,2 26,237,440,3 41,441,444,749,2929,733,147,3 47,351,0 52,452,4 	6x41WS-IW	RC			-4	1-9-9+9						0,045 5	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$			I WIIN. Dre	eaking force fa	ctor:	1)							
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$			Nomina	l length mass	racto	r tional ara							
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$				i metallic cros	s-sec	tional are	$a = c_1 - c_2$	J,39.	$5 C_2$	- 0,400	)		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Nominal	A	pproxima	ite nominal			Ν	Minir	num bre	aking	force	Э	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$			length	mass ¹⁾	-				k١	N			
Fibre coreSteel coreFibre coreSteel coreSteel coreSteel coreSteel coreSteel coreSteel core12345678823,526,237,440,341,444,749,2929,733,147,351,052,456,562,31036,740,958,463,064,769,876,91144,449,570,776,278,384,493,01252,858,984,190,793,11001111362,069,198,71061091181301471,980,21141241271371511694,01051501611661791971811913318920421022624920147164234252259279308221781982833053133383722421123633636337340244326248276395426437472520282883214584945075476033237641959864566271578736476530757817838904997405876549351010 <td< td=""><td></td><td></td><td>kg/10</td><td>00 m</td><td></td><td></td><td></td><td colspan="3"></td><td></td><td></td><td></td></td<>			kg/10	00 m									
12345678823,526,237,440,341,444,749,2929,733,147,351,052,456,562,31036,740,958,463,064,769,876,91144,449,570,776,278,384,493,01252,858,984,190,793,11001111362,069,198,71061091181301471,980,21141241271371511694,0105150161166179197181191331892042102262492014716423425225927930822178198283305313338372242112363363633734024432624827639542643747252028288321458494507547603323764195986456627157873647653075781783890499740587654935101010401120123044711792130122012501350149048846	mm						1						
a $23,5$ $26,2$ $37,4$ $40,3$ $41,4$ $44,7$ $49,2$ 9 $29,7$ $33,1$ $47,3$ $51,0$ $52,4$ $56,5$ $62,3$ 10 $36,7$ $40,9$ $58,4$ $63,0$ $64,7$ $69,8$ $76,9$ 11 $44,4$ $49,5$ $70,7$ $76,2$ $78,3$ $84,4$ $93,0$ 12 $52,8$ $58,9$ $84,1$ $90,7$ $93,1$ $100$ $111$ 13 $62,0$ $69,1$ $98,7$ $106$ $109$ $118$ $130$ 14 $71,9$ $80,2$ $114$ $124$ $127$ $137$ $151$ 16 $94,0$ $105$ $150$ $161$ $166$ $179$ $197$ 18 $119$ $133$ $189$ $204$ $210$ $226$ $249$ 20 $147$ $164$ $234$ $252$ $259$ $279$ $308$ 22 $178$ $198$ $263$ $305$ $313$ $338$ $372$ 24 $211$ $236$ $336$ $363$ $373$ $402$ $443$ 26 $248$ $276$ $395$ $426$ $437$ $472$ $520$ 28 $288$ $321$ $458$ $494$ $507$ $547$ $603$ 32 $376$ $419$ $598$ $645$ $662$ $715$ $787$ $36$ $476$ $530$ $757$ $817$ $838$ $904$ $997$ $40$ $587$ $654$ $935$ $1010$ $1040$ $1120$	-		e core			e core		e		ore		el core	
929,733,147,351,052,456,562,310 $36,7$ $40,9$ $58,4$ $63,0$ $64,7$ $69,8$ $76,9$ 11 $44,4$ $49,5$ $70,7$ $76,2$ $78,3$ $84,4$ $93,0$ 12 $52,8$ $58,9$ $84,1$ $90,7$ $93,1$ $100$ $111$ 13 $62,0$ $69,1$ $98,7$ $106$ $109$ $118$ $130$ 14 $71,9$ $80,2$ $114$ $124$ $127$ $137$ $151$ 16 $94,0$ $105$ $150$ $161$ $166$ $179$ $197$ 18 $119$ $133$ $189$ $204$ $210$ $226$ $249$ 20 $147$ $164$ $234$ $252$ $259$ $279$ $308$ 22 $178$ $198$ $283$ $305$ $313$ $338$ $372$ 24 $211$ $236$ $336$ $363$ $373$ $402$ $443$ 26 $248$ $276$ $395$ $426$ $437$ $472$ $520$ 28 $288$ $321$ $458$ $494$ $507$ $547$ $603$ 32 $376$ $419$ $598$ $645$ $662$ $715$ $787$ $36$ $476$ $530$ $757$ $817$ $838$ $904$ $997$ $40$ $587$ $654$ $935$ $1010$ $1040$ $1120$ $1230$ $44$ $711$ $792$ $1350$ $1450$ $1490$ $1610$ $1770$ <td></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td>-</td> <td></td> <td><u> </u></td> <td></td> <td></td> <td></td> <td>•</td>				-			-		<u> </u>				•
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16 $94,0$ $105$ $150$ $161$ $166$ $179$ $197$ $18$ $119$ $133$ $189$ $204$ $210$ $226$ $249$ $20$ $147$ $164$ $234$ $252$ $259$ $279$ $308$ $22$ $178$ $198$ $283$ $305$ $313$ $338$ $372$ $24$ $211$ $236$ $336$ $363$ $373$ $402$ $443$ $26$ $248$ $276$ $395$ $426$ $437$ $472$ $520$ $28$ $288$ $321$ $458$ $494$ $507$ $547$ $603$ $32$ $376$ $419$ $598$ $645$ $662$ $715$ $787$ $36$ $476$ $530$ $757$ $817$ $838$ $904$ $997$ $40$ $587$ $654$ $935$ $1010$ $1040$ $1120$ $1230$ $44$ $711$ $792$ $1130$ $1220$ $1250$ $1350$ $1490$ $48$ $846$ $942$ $1350$ $1450$ $1490$ $1610$ $1770$ $52$ $992$ $1110$ $1580$ $1700$ $1750$ $1890$ $2080$ $56$ $1150$ $1280$ $1830$ $1980$ $2030$ $2190$ $2410$ $60$ $1320$ $1470$ $2100$ $2270$ $2330$ $2510$ $2770$													
18 $119$ $133$ $189$ $204$ $210$ $226$ $249$ $20$ $147$ $164$ $234$ $252$ $259$ $279$ $308$ $22$ $178$ $198$ $283$ $305$ $313$ $338$ $372$ $24$ $211$ $236$ $336$ $363$ $373$ $402$ $443$ $26$ $248$ $276$ $395$ $426$ $437$ $472$ $520$ $28$ $288$ $321$ $458$ $494$ $507$ $547$ $603$ $32$ $376$ $419$ $598$ $645$ $662$ $715$ $787$ $36$ $476$ $530$ $757$ $817$ $838$ $904$ $997$ $40$ $587$ $654$ $935$ $1010$ $1040$ $1120$ $1230$ $44$ $711$ $792$ $1130$ $1220$ $1250$ $1350$ $1490$ $48$ $846$ $942$ $1350$ $1450$ $1490$ $1610$ $1770$ $52$ $992$ $1110$ $1580$ $1700$ $1750$ $1890$ $2080$ $56$ $1150$ $1280$ $1830$ $1980$ $2030$ $2190$ $2410$ $60$ $1320$ $1470$ $2100$ $2270$ $2330$ $2510$ $2770$													
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282883214584945075476033237641959864566271578736476530757817838904997405876549351 0101 0401 1201 230447117921 1301 2201 2501 3501 490488469421 3501 4501 4901 6101 770529921 1101 5801 7001 7501 8902 080561 1501 2801 8301 9802 0302 1902 410601 3201 4702 1002 2702 3302 5102 770													
364765307578178389049974058765493510101040112012304471179211301220125013501490488469421350145014901610177052992111015801700175018902080561150128018301980203021902410601320147021002270233025102770									507				603
405876549351 0101 0401 1201 230447117921 1301 2201 2501 3501 490488469421 3501 4501 4901 6101 770529921 1101 5801 7001 7501 8902 080561 1501 2801 8301 9802 0302 1902 410601 3201 4702 1002 2702 3302 5102 770													
447117921 1301 2201 2501 3501 490488469421 3501 4501 4901 6101 770529921 1101 5801 7001 7501 8902 080561 1501 2801 8301 9802 0302 1902 410601 3201 4702 1002 2702 3302 5102 770													
488469421 3501 4501 4901 6101 770529921 1101 5801 7001 7501 8902 080561 1501 2801 8301 9802 0302 1902 410601 3201 4702 1002 2702 3302 5102 770													
529921 1101 5801 7001 7501 8902 080561 1501 2801 8301 9802 0302 1902 410601 3201 4702 1002 2702 3302 5102 770													
561 1501 2801 8301 9802 0302 1902 410601 3201 4702 1002 2702 3302 5102 770													
60         1 320         1 470         2 100         2 270         2 330         2 510         2 770													
informative only				14/0		0	2210	1	2 330		20	10	2110
	⁷ Informative	e only											

#### Table 9 — Class 6x36

Construction cross sectior		Constru	Construction of rope					Construction of strand					
example	I												
- champie		Item			Quantity	/	lte	m			Quantity	/	
	<u>}</u>	Strands			8			ires			29 to 57		
	80 880.		outer strands		8		Οι	uter wire	s		12 to 18	1	
			layers of strar	nds	1		La	yers of v	vires		3 to 4		
		Wires ir			232 to 4	56							
	0	(excludi	ing steel core)										
8×36WS-IW	WS-IWRC Typical example						o. of oute	er wire	s	Outer w	ire factor ¹⁾		
		Rope			Strand		То	otal	per stran	h			
		8×31W	\$		1-6-6+6	-12	96		12		0,052 5		
		8×36W			1-7-7+7		11		14		0,046 0		
		8×41W			1-8-8+8		12		16		0,041 0		
		8×49W			1-8-8-8-		12		16		0,041 0		
		8×46W			1-9-9+9		14		18		0,037 3		
			aking force fa	ctor.		$K_1 = ($			= 0,35	6	2,007 0		
		Nomina	I length mass	facto	1)			48 W ₂					
		Nomina	I metallic cros	s-sec	tional are				= 0,46				
		factor ¹⁾					-,	- 2	-,	-			
Nominal	A		ite nominal			ľ	Mini	imum bre	eaking	forc	e		
rope		length	mass ¹⁾					kl	N				
diameter		kg/1	00 m				Rope Grade						
mm						70				960		2160	
		e core	Steel core		e core	Steel core	e	Fibre c	ore		el core	Steel core	
1	2		3	4		5		6		7		8	
8		22,3	26,7		33,2	40,3		36,8			44,7	49,2	
9		28,2	33,8		12,0	51,0		46,			56,5	62,3	
10		34,8	41,7		51,9	63,0		57,4			69,8	76,9	
11		42,1	50,5		52,8	76,2		69,5			84,4	93,0	
12		50,1	60,0		74,7	90,7		82,7			00	111	
13 14		58,8	70,5		37,6 )2	106 124		97, [,] 113	I		18 37	130 151	
14		58,2 39,1	81,7 107		)2 33	124		147			37 79	197	
18		13	135		55 58	204		147			79 26	249	
20		39	167		)7	252		230			20 79	308	
22		58	202	2		305		278			38	372	
24		00	240		99	363		331			02	443	
26		35	282	3		426		388			72	520	
28		73	327		)7	494		450			47	603	
32	35	56	427	53	31	645		588		7	15	787	
36	4		540		72	817		744			04	997	
40		57	667		30	1 010		919		1 1:		1 230	
44		74	807	1 00		1 220		1 110		13		1 490	
48		)2	961	1 20		1 450		1 320		16		1 770	
52	94		1 130	14(		1 700		1 550		18		2 080	
56	1 09		1 310	163		1 980		1 800		21		2 410	
60	1 2		1 500	1 87	0	2 270		2 070		25	10	2 770	
¹⁾ Informative	only												

## Table 10 — Class 8x36

Construction cross section	Construction	of rope		Construction	n of strand		
example							
-000-	Item		Quantity	Item		Quantity	
an 2888 an	Strands		6	Wires		28 to 48	
	oute	r strands	6	Outer wires		12 to 18	
	lave	rs of strands	1	Layers of wi	3		
	Wires in rope		168 to 288	,			
- 38998889388	(excluding st						
4886	(	,					
6×35NW-FC	Typical exan	nple	•	No. of outer	wires	Outer wire factor ¹⁾	
	Rope		Strand	Total	per strand		
	6×28NW		1-5-5+5/12	72	12	0,064	
	6×33NW		1-6-6+6/14	84	14	0,056	
	6×34NW		1-6-6+6/15	90	15	0,053	
	6×35NW		1-6-6+6/16	96	16	0,050	
		q force factor:			$K_2 = 0,345$	0,000	
		g force factor.			$W_2 = 0,343$ $W_2 = 0,392$		
		allic cross-sec			$V_2 = 0,392$ $C_2 = 0,441$		
	factor ¹⁾ :	and cross-sed	alonal area	$C_1 = 0,377$	$C_2 = 0,441$		
Nominal rope	Approximate	nominal	1	Minimum bre	aking force		
diameter	length mass	$\frac{1}{10}$ kg/100 m		kN			
ulameter	Fibre core	Steel core	Rope grade ²		Rope grade	1060	
mm		Steel core	Fibre core	Steel core	Fibre	Steel core	
				Oleencore	core		
1	2	3	4	5	6	7	
8	22,5	25,1	35,9	39,1	39,8	43,3	
9	28,5	31,8	45,4	49,5	50,3	54,8	
10	36,2	39,2	56,1	61,1	62,1	67,6	
11	42,6	47,4	67,9	73,9	75,2	81,8	
12	50,7	56,4	80,8	87,9	89,5	97,4	
13	59,5	66,2	94,8	103	105	114	
14	69,0	76,8	110	120	122	133	
16	90,1	100	144	156	159	173	
18	114	127	182	198	201	219	
20	141	157	224	244	249	270	
22	170	190	272	296	301	327	
24	203	226	323	352	358	389	
26	238	265	379	413	420	457	
28	276	307	440	479	487	530	
32	360	401	575	625	636	692	
36	456	508	727	791	805	876	
40	563	626	898	977	994	1 080	
44	681	759	1 090	1 180	1 200	1 310	
48	811	903	1 290	1 410	1 4 3 0	1 560	
52	952	1 060	1 520	1 650	1 680	1 830	
56	1 100	1 230	1 760	1 920	1 950	2 120	
60	1 270	1 410	2 020	2 200	2 240	2 430	
¹⁾ Informative only		1 1 1 0	00	00	1 10	_ 100	

#### Table 11 — Class 6x35N

Construction cross section example	Construction	of rope		Construction	n of strand			
	Item		Quantity	Item		Quantity		
· m	Strands		6	Wires		12 to 19		
-m888.m	oute	r strands	6	Outer wires		9 to 12		
	lave	rs of strands	1	Layers of wi	2			
	Wires in rope		72 to 114					
	(excluding st	eel core)						
6×19M-WSC	Typical exan	nple		No. of outer	wires	Outer wire factor ¹⁾		
	Rope		Strand	Total	per	1		
					strand			
	6x19M		1-6/12	72	12	0,064 0		
		g force factor	$K_1 = 0,307$ $K_3 = 0,362$					
	Nominal leng	oth mass facto						
	Nominal met factor ¹⁾	allic cross-sec	tional area	<i>C</i> ₁ = 0,357	<i>C</i> ₃ = 0,418	= 0,418		
Nominal rope	Approximate	nominal		Minimum bre	eaking force			
diameter	length mass	¹⁾ kg/100 m		kî.				
	Fibre core	Steel core	Rope grade		Rope grade	e 1960		
mm			Fibre core	Steel core	Fibre	Steel core		
				-	core			
1	2	3	4	5	6	7		
3	3,11	3,43	4,89	5,77	5,42	6,39		
4	5,54	6,10	8,69 13,6	10,3 16,0	9,63	11,4		
5 6	8,65 12,5	9,53 13,7	13,6	23,1	15,0 21,7	17,7 25,5		
7	12,5	18,7	26,6	31,4	29,5	34,8		
¹⁾ Informative only	,	10,7	20,0	ד,דס ן	1 20,0	101,0		

#### Table 12 — Class 6x19M

Construction cross section example	Construction	of rope		Constructio	n of strand		
allo	Item		Quantity	Item		Quantity	
	Strands		6	Wires	27 to 37		
	oute	r strands	6	Outer wires	Outer wires		
	laye	rs of strands	1	Layers of w	Layers of wires		
	Wires in rop		162 to 222				
2000 C	(excluding st	teel core)				-	
6×37M-FC	Typical exar	nple		No. of outer	wires	Outer wire factor ¹⁾	
	Rope		Strand	Total	per strand		
	6x37M		1-6/12/18	108	18	0,0455	
	Min. breakin	g force factor		<i>K</i> ₁ = 0,295	$K_2 = 0,319$	K ₃ = 0,346	
	Nominal leng	oth mass facto	<b>r</b> ¹⁾	$W_1 = 0,346$	<i>W</i> ₂ = 0,381	W ₃ = 0,381	
	Nominal met	tallic cross-sec	ctional area	$C_1 = 0,357$	<i>C</i> ₂ = 0,418	<i>C</i> ₃ = 0,418	
Nominal rope	Approximate	nominal		Minimum bre	eaking force		
diameter	length mass	¹⁾ kg/100 m		kN			
	Fibre core	Steel core	Rope grade	Rope grade	rade 1960		
mm			Fibre core	Steel core	Fibre	Steel core	
					core		
						(-2)	
1	2	3	4	5 ²⁾	6	<b>7</b> ²⁾	
5	8,65	3 9,53	13,1	15,3	14,5	17,0	
5 6	8,65 12,5	9,53 13,7	13,1 18,8	15,3 22,0	14,5 20,8	17,0 24,4	
5 6 7	8,65 12,5 17,0	9,53 13,7 18,7	13,1 18,8 25,6	15,3 22,0 30,0	14,5 20,8 28,3	17,0 24,4 33,2	
5 6 7 8	8,65 12,5 17,0 22,1	9,53 13,7 18,7 24,4	13,1 18,8 25,6 33,4	15,3 22,0 30,0 39,2	14,5 20,8 28,3 37,0	17,0 24,4 33,2 43,4	
5 6 7 8 9	8,65 12,5 17,0 22,1 28,0	9,53 13,7 18,7 24,4 30,9	13,1 18,8 25,6 33,4 42,3	15,3 22,0 30,0 39,2 49,6	14,5 20,8 28,3 37,0 46,8	17,0 24,4 33,2 43,4 54,9	
5 6 7 8 9 10	8,65 12,5 17,0 22,1 28,0 34,6	9,53 13,7 18,7 24,4 30,9 38,1	13,1 18,8 25,6 33,4 42,3 52,2	15,3 22,0 30,0 39,2 49,6 61,2	14,5 20,8 28,3 37,0 46,8 57,8	17,0 24,4 33,2 43,4 54,9 67,8	
5 6 7 8 9	8,65 12,5 17,0 22,1 28,0	9,53 13,7 18,7 24,4 30,9	13,1 18,8 25,6 33,4 42,3	15,3 22,0 30,0 39,2 49,6	14,5 20,8 28,3 37,0 46,8	17,0 24,4 33,2 43,4 54,9	

#### Table 13 — Class 6x37M

²⁾ The values shown in columns 5 and 7 are for ropes with wire strand cores (WSC) and based on minimum breaking force factor  $K_3$ . The minimum breaking force for ropes with independent wire rope cores (IWRC) shall be based on factor  $K_2$ .

#### Table 14 — Class 18x7

Construction cross section example	Construction	of rope		Construct	ion of strand		
o 99 -	Item		Quantity	Item		Quantity	
	Strands		17 to 18	Wires		5 to 9	
		r strands	10 to 12		Outer wires		
		rs of strands	2		Layers of wires		
<u></u>	Wires in rope		85 to 162	Layoro or			
and the second s	(excluding w						
	centre)						
17×7-FC	Typical exan	nple		No. of out	er wires	Outer wire	
1///10						factor ¹⁾	
-0.0	Rope		Strand	Total	per		
<b>~~~</b> ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			- Circina	, otal	strand		
	17×7		1-6	66	6	0,070	
	18x7		1-6	72	6	0,063 2	
				12		0,000 2	
666666666							
6460							
18×7-FC	Min breakin	g force factor;		$K_1 = 0,328$	$K_3 = 0,328$		
10×7-FC		gth mass facto		$W_1 = 0,320$ $W_1 = 0,382$			
		allic cross-sec		$vv_1 = 0,302$	$C_3 = 0,40$ $C_3 = 0,433$		
	factor ¹⁾ :	and cross-sec	suonai area		$C_3 = 0,433$		
Nominal rope	Approximate	nominal	T	Minimum k	preaking force		
diameter	length mass				kN	;	
ulameter	¥		Dana arrada			da 1000	
	Fibre	Steel	Rope grade	e 1770	Rope gra	de 1960	
	centre	centre	L.			taalaantaa	
mm			Fibre or ste	eel centre		teel centre	
1	2	3	4		5		
6	13,8	14,4	20,9		23,1		
7	18,7	19,6	28,4		31,5		
8	24,4	25,7	37,2		41,1		
9	30,9	32,5	47,0		52,1		
10	38,2	40,1	58,1		64,3		
11	46,2	48,5	70,2		77,8		
12	55,0	57,7	83,6		92,6		
13	64,6	67,8	98,1		109		
14	74,9	78,6	114		126		
	97,8	103	149		165		
16		130	188		208		
18	124	1 100					
	124	160	232		257		
18					257 311		
18 20	153 185	160 194	232				
18 20 22 24	153 185 220	160 194 231	232 281 334		311		
18 20 22	153 185	160 194	232 281		311 370		

$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Construction cross section	Construction c	f rope			Constructio	n of strand	
Min.       Strands outer strands (layers of strands       34 to 36 17 to 18 3       Wires Layers of wires       5 to 9 4 to 8 1 $34(M) \times 7$ -FC       To pe - (excluding wire strand centre)       170 to 324       Wires Layers of wires       0uter wires Layers of wires       1 $700 \times 7$ -FC       Typical example       No. of outer wires factor ¹ No. of outer wires factor ¹ Outer wires factor ¹ $Min.$ breaking force factor stand $K_1 = 0.318$ $K_3 = 0.318$ $K_3 = 0.318$ Nominal length mass factor ¹ $1-6$ 102       6 $0.047$ 2 $Min.$ breaking force factor factor ¹ $K_1 = 0.318$ $K_3 = 0.318$ $K_9 = 0.401$ Nominal rope diameter       Min.       breaking force factor mass ¹¹ kg/100 m $K_1 = 0.390$ $W_2 = 0.401$ Nominal rope diameter       Approximate nominal length mass ¹¹ kg/100 m       Rope grade 1770       Rope grade 1960         11       2       3       4       5       5         10       39.0       40.1       56.3       62.3         11       47.2       48.5       68.1       75.4         12       56.2       57.7       81.1       89.8         13       65.9       67.8       <	example			-	-			I -
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$				Qua	ntity	ltem		Quantity
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Strands				Wires		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		outer	strands	17 to	o 18	Outer wires	i i i i i i i i i i i i i i i i i i i	4 to 8
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$								
Wires in rope - (excluding wire strand 34(M)×7-FC         Wires in rope - (excluding wire strand 0         170 to 324         No. of outer wires         Outer wire factor ¹¹ Typical example         No. of outer wires         0uter wires         0uter wires         0uter wires           Rope         Strand         Total         per strand         0.047 2         6         0.047 2           36(M)x7         1-6         108         6         0.045         0.045           Min. breaking force factor Nominal length mass factor ¹¹ K ₁ = 0.318         K ₃ = 0.318         0.045           Nominal rope diameter         Approximate nominal length mass ¹¹ kg/100 m         K ₁ = 0.318         K ₃ = 0.428         6           11         2         3         4         5         6         170         Rope grade 1960           mm         Fibre centre         Steel centre         Rope grade 1770         Rope grade 1960         156.3         62.3           11         47.2         48.5         68.1         75.4         105           13         65.9         67.8         95.1         105         14           14         76.4         78.6         110         122         202         202         202         202         202 <td></td> <td></td> <td></td> <td>ľ</td> <td></td> <td></td> <td></td> <td></td>				ľ				
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$				170	to 324			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	10.00 c				0 02 1			
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	34/M)~7-EC		Juliu					
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	J <del>4</del> (IVI)∧7-1 C	,				No of outo		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		i ypical examp	pie			INO. OF OUTER	rwires	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		Rope		Stra	nd	Total	per strand	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		34(M)x7		1-6		102	6	0,047 2
Min. breaking force factor Nominal length mass factor ¹¹ $K_1 = 0,318$ $K_3 = 0,318$ Nominal length mass factor ¹¹ $W_1 = 0,390$ $W_3 = 0,401$ Nominal metallic cross-sectional area factor ¹¹ $C_3 = 0,428$ Min. breaking force factor $K_1 = 0,390$ $W_3 = 0,401$ Nominal rope diameter         Approximate nominal length mass ¹¹ kg/100 m         Minimum breaking force kN           Fibre centre         Rope grade 1770         Rope grade 1960           11         2         3         4           5         5         5           10         39,0         40,1         56,3           11         47,2         48,5         68,1         75,4           12         56,2         57,7         81,1         89,8           13         65,9         67,8         95,1         105           14         76,4         78,6         110         122           16         99,8         103         144         160           18         126         130         182         202           20         156         160         225         249           22         189         194         272<				1-6		108	6	
Nominal length mass factor1) $W_1 = 0.390$ $W_3 = 0.401$ Nominal metallic cross-sectional area $C_3 = 0.428$ factor1)Approximate nominal lengthMinimum breaking forcemmFibre centreSteel centreRope grade 1770Rope grade 1960mm723451039,040,156,362,31147,248,568,175,41256,257,781,189,81365,967,895,11051476,478,61101221699,81031441601812613018220220156160225249221891942723022422523132435926264271380421283063144414893239941157663836505520729808406246429019974475577610901 210488999241 3001 440521 0601 0801 5201 690561 2201 2601 7701 960601 4001 4402 0302 240		00(						,
Nominal length mass factor1) $W_1 = 0.390$ $W_3 = 0.401$ Nominal metallic cross-sectional area $C_3 = 0.428$ factor1)Approximate nominal lengthMinimum breaking forcemmFibre centreSteel centreRope grade 1770Rope grade 1960mm723451039,040,156,362,31147,248,568,175,41256,257,781,189,81365,967,895,11051476,478,61101221699,81031441601812613018220220156160225249221891942723022422523132435926264271380421283063144414893239941157663836505520729808406246429019974475577610901 210488999241 3001 440521 0601 0801 5201 690561 2201 2601 7701 960601 4001 4402 0302 240								
Nominal length mass factor1) $W_1 = 0.390$ $W_3 = 0.401$ Nominal metallic cross-sectional area $C_3 = 0.428$ factor1)Approximate nominal lengthMinimum breaking forcemmFibre centreSteel centreRope grade 1770Rope grade 1960mm723451039,040,156,362,31147,248,568,175,41256,257,781,189,81365,967,895,11051476,478,61101221699,81031441601812613018220220156160225249221891942723022422523132435926264271380421283063144414893239941157663836505520729808406246429019974475577610901 210488999241 3001 440521 0601 0801 5201 690561 2201 2601 7701 960601 4001 4402 0302 240								
Nominal length mass factor1) $W_1 = 0.390$ $W_3 = 0.401$ Nominal metallic cross-sectional area $C_3 = 0.428$ factor1)Approximate nominal lengthMinimum breaking forcemmFibre centreSteel centreRope grade 1770Rope grade 1960mm723451039,040,156,362,31147,248,568,175,41256,257,781,189,81365,967,895,11051476,478,61101221699,81031441601812613018220220156160225249221891942723022422523132435926264271380421283063144414893239941157663836505520729808406246429019974475577610901 210488999241 3001 440521 0601 0801 5201 690561 2201 2601 7701 960601 4001 4402 0302 240		Min. breaking	force fact	or		$K_1 = 0.318$	$K_3 = 0.318$	<b>I</b>
Nominal metallic cross-sectional area $C_3 = 0.428$ Approximate nominal length mass ¹¹ kg/100 mMinimum breaking force kNdiameterFibre centreSteel centreRope grade 1770Rope grade 1960mmFibre cor steel centreFibre or steel centreFibre or steel centre123451039,040,156,362,31147,248,568,175,41256,257,781,189,81365,967,895,11051476,478,61101221699,81031441601812613018220220156160225249221891942723022422523132435926264271380421283063144414893239941157663836505520729808447557761 0901 210488999241 3001 440521 0601 0801 5201 690561 2201 2601 7701 960601 4001 4402 0302 240		Nominal lengt	n mass fa	ctor ¹⁾				
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$					nal area			
Nominal rope diameterApproximate nominal length mass 11 kg/100 mMinimum breaking force kNmmFibre centreSteel centreRope grade 1770Rope grade 1960123451039,040,156,362,31147,248,568,175,41256,257,781,189,81365,967,895,11051476,478,61101221699,810314416018126130182202201561602252492218919427230224225231324359262642713804212830631444148932399411576638365055207298084062464290199744755776109012104889992413001440521060108015201 6905612201 2601 7701 960601 4001 4402 0302 240				00000			03 0,120	·
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Nominal rope		ominal length			Minimun	ce.	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$		mass ¹⁾ kg/100	$nass^{1}$ kg/100 m					
mmImmFibre or steel centreFibre or steel centre1234510 $39,0$ $40,1$ $56,3$ $62,3$ 11 $47,2$ $48,5$ $68,1$ $75,4$ 12 $56,2$ $57,7$ $81,1$ $89,8$ 13 $65,9$ $67,8$ $95,1$ $105$ 14 $76,4$ $78,6$ $110$ $122$ 16 $99,8$ $103$ $144$ $160$ 18 $126$ $130$ $182$ $202$ 20 $156$ $160$ $225$ $249$ 22 $189$ $194$ $272$ $302$ 24 $225$ $231$ $324$ $359$ 26 $264$ $271$ $380$ $421$ 28 $306$ $314$ $441$ $489$ $32$ $399$ $411$ $576$ $638$ $366$ $505$ $520$ $729$ $808$ $40$ $624$ $642$ $901$ $997$ $44$ $755$ $776$ $1090$ $1210$ $48$ $899$ $924$ $1300$ $1440$ $52$ $1060$ $1080$ $1520$ $1690$ $56$ $1220$ $1260$ $1770$ $1960$ $60$ $1400$ $1440$ $2030$ $2240$				entre	Rope ar	ade 1770		e 1960
10 $39,0$ $40,1$ $56,3$ $62,3$ 11 $47,2$ $48,5$ $68,1$ $75,4$ 12 $56,2$ $57,7$ $81,1$ $89,8$ 13 $65,9$ $67,8$ $95,1$ $105$ 14 $76,4$ $78,6$ $110$ $122$ 16 $99,8$ $103$ $144$ $160$ 18 $126$ $130$ $182$ $202$ 20 $156$ $160$ $225$ $249$ 22 $189$ $194$ $272$ $302$ 24 $225$ $231$ $324$ $359$ 26 $264$ $271$ $380$ $421$ 28 $306$ $314$ $441$ $489$ 32 $399$ $411$ $576$ $638$ 36 $505$ $520$ $729$ $808$ 40 $624$ $642$ $901$ $997$ $44$ $755$ $776$ $1090$ $1210$ $48$ $899$ $924$ $1300$ $1440$ $52$ $1060$ $1080$ $1520$ $1690$ $56$ $1220$ $1260$ $1770$ $1960$ $60$ $1400$ $1440$ $2030$ $2240$	mm							
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56         1 220         1 260         1 770         1 960           60         1 400         1 440         2 030         2 240	48							
<u>60 1 400 1 440 2 030 2 240</u>	52							
	56	1 220			1 770		1 960	
	60							

#### Table 15 — Class: 34(M)x7

Construction cross section	Construction of rope		Construct	ion of strand					
example		r			-				
	ltem	Quantity	ltem		Quantity				
	Strands	28 to 40			5 to 9 4 to 8				
	outer strands	15 to 18		Outer wires					
	layers of strands	3	Layers of	wires	1				
	Wires in rope	196 to 280							
35(₩)×7	Typical example		No. of out	er wires	Outer wire factor ¹⁾				
	Rope	Strand	Total	per strand					
	35(W)×7	1-6	96	6	0,046 1				
	Min. breaking force factor: $K_3 = 0,360^{20}$ $K_3 = 0,350^{30}$ Nominal length mass factor 10 $W_3 = 0,454$ Nominal metallic cross-sectional $C_3 = 0,480$								
	Nominal length mass factor Nominal metallic cross-sec	$r^{1)}$ $W_3$	s = 0,454	₃ – 0,350					
Nominal rope	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾	$r^{1)}$ $W_3$	a = 0,454 = 0,480		ce				
	Nominal length mass factor Nominal metallic cross-sec	$r^{1)}$ $W_3$	a = 0,454 = 0,480	breaking ford	ce				
diameter mm	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m	$r^{1)}$ $W_3$	a = 0,454 = 0,480 Minimum	breaking for					
Nominal rope diameter mm 1	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal	r ¹⁾ W ₃ tional C ₃	a = 0,454 = 0,480 Minimum	breaking for kN					
diameter mm	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m	r ¹⁾ W ₃ tional C ₃ Rope grade	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra					
diameter mm 1 8	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2	r ¹⁾ W ₃ tional C ₃ Rope grade 3	a = 0,454 = 0,480 Minimum	breaking foro kN Rope gra					
diameter mm 1 8 9	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2	a = 0,454 = 0,480 Minimum	breaking foro kN Rope gra 4 48,4					
diameter mm 1 8 9 10	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2	a = 0,454 = 0,480 Minimum	breaking fore kN Rope gra 4 48,4 61,2					
diameter mm 1	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 48,4 61,2 75,6					
diameter mm 1 8 9 10 11 12	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 48,4 61,2 75,6 91,5					
diameter mm 1 8 9 10 11 12 13	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 4 48,4 61,2 75,6 91,5 109					
diameter mm 1 8 9 10 11 12 13 14	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 4 48,4 61,2 75,6 91,5 109 128					
diameter mm 1 8 9 10 11 12 13 14 16	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7 89,0	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119 138	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 4 48,4 61,2 75,6 91,5 109 128 148					
diameter mm 1 8 9 10 11 12 13 14 16 18	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7 89,0 116	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119 138 181	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 4 48,4 61,2 75,6 91,5 109 128 148 148 194 245					
diameter mm 1 8 9 10 11 12 13 14 16 18 20	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7 89,0 116 147	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119 138 181 229	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 4 48,4 61,2 75,6 91,5 109 128 148 148 194					
diameter mm 1 8 9 10 11 12 13 14 16 18 20 22	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7 89,0 116 147 182	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119 138 181 229 282	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 4 48,4 61,2 75,6 91,5 109 128 148 148 194 245 302					
diameter mm 1 8 9 10 11 12 13 14 16 18 20 22 24	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7 89,0 116 147 182 220	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119 138 181 229 282 342	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 4 48,4 61,2 75,6 91,5 109 128 148 148 194 245 302 366					
diameter mm 1 8 9 10 11 12 13 14 16 18 20 22 24 26	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7 89,0 116 147 182 220 262 307	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119 138 181 229 282 342 406 477	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 4 48,4 61,2 75,6 91,5 109 128 148 194 245 302 366 435 511					
diameter mm 1 8 9 10 11 12 13 14 16 18 20 22 24 24 26 28	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7 89,0 116 147 182 220 262 307 356	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119 138 181 229 282 342 406 477 553	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 48,4 61,2 75,6 91,5 109 128 148 148 194 245 302 366 435 511 593					
diameter mm 1 8 9 10 11 12 13 14 16 18 20 22 24 26 28 32	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7 89,0 116 147 182 220 262 307 356 465	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119 138 181 229 282 342 406 477 553 723	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 48,4 61,2 75,6 91,5 109 128 148 148 194 245 302 366 435 511 593 774					
diameter mm 1 8 9 10 11	Nominal length mass factor Nominal metallic cross-sec area factor ¹⁾ Approximate nominal length mass ¹⁾ kg/100 m 2 29,1 36,8 45,4 54,9 65,4 76,7 89,0 116 147 182 220 262 307 356	r ¹⁾ W ₃ tional C ₃ Rope grade 3 45,2 57,2 70,6 85,4 102 119 138 181 229 282 342 406 477 553	a = 0,454 = 0,480 Minimum	breaking for kN Rope gra 4 48,4 61,2 75,6 91,5 109 128 148 148 194 245 302 366 435 511 593					

³⁾ Greater than rope grade 1960 up to and including rope grade 2160

#### Table 17 — Large diameter ropes

Class	Number of strands	Outer strands	Layers of strand	Wires in rope ¹⁾	Wires per strand	Outer wires in one	Layer of wires	Typical rope diameter
	oliando		s			strand		range ²⁾
6×19	6	6	1	90 to 156	15 to 26	7 to 12	2 to 3	64 to 70
8×19	8	8	1	120 to 208	15 to 26	7 to 12	2 to 3	64 to 76
6×36	6	6	1	174 to 342	29 to 57	12 to 18	3	64 to 100
8×36	8	8	1	232 to 456	29 to 57	12 to 18	3	80 to 192
6×61	6	6	1	366 to 510	61 to 85	18 to 24	3 to 4	104 to 136
8×61	8	8	1	488 to 680	61 to 85	18 to 24	3 to 4	200 to 264
6×91N	6	6	1	510 to 654	85 to 109	24 to 36	4 to 6	144 to 192
8×91N	8	8	1	680 to 872	85 to 109	24 to 36	4 to 6	> 150
			th mass f	where <i>d</i> = non actor ( <i>W</i> ) = 0,4	115			
Nom	inal rope d	iameter	Approx	kimate nomina	I length	Minimu	m breakin	g force
				mass			1.81	
	<u>mm</u> 64			<u>kg/100 m</u> 1 700			<u>kN</u> 2 800	
	68			1 900			2 800	
	72			2 200			3 500	
	76			2 400			3 800	
	80			2 700			4 200	
	84			2 900			4 500	
	88			3 200			4 900	
	92 96			3 500 3 800			5 300 5 700	
	100			4 200			6 200	
	104			4 500			6 600	
	112			5 200			7 500	
	120			6 000			8 500	
	128			6 800			9 500	
	136			7 700			10 600	
	144 152			8 600 9 600			11 700 12 800	
	160			9 000 10 600			12 800	
	168		-	11 700			15 200	
	176			12 900			16 500	
	184			14 100			17 800	
	192			15 300			19 100	
	200			16 600			20 500	
	208			18 000			21 900	
	216 224			19 400			23 300	
	224			20 800 22 300			24 700 26 200	
	232			22 300			20 200 27 700	
	248			25 500			29 200	
	256			27 200			30 700	
	264			28 900			32 200	
	ding steel o ation only.							
morm	auon only.							

## Annex A (normative) Calculation of minimum breaking force for those ropes covered by Tables 5 to 17

#### A.1 Ropes from 2 mm to 60 mm diameter

The minimum breaking force,  $F_{min}$ , expressed in kilonewtons, shall be calculated using the following equation:

$$F_{\min} = \frac{K.d^2.R_{\rm r}}{1000}$$

where

- *d* is the nominal diameter of the rope, in mm;
- R_r is the rope grade intended by the manufacturer, in Newtons per square millimetres; and
- K is the empirical factor for the minimum breaking force for a given rope class and core type

 $K_1$  is the factor for stranded ropes with a fibre core (single layer rope) or fibre centre (rotation-resistant rope)

 $K_2$  is the factor for stranded ropes with an independent wire rope core

 $K_3$  is the factor for stranded ropes with a wire strand core (single layer rope) or wire strand centre (rotation-resistant rope)

#### A.2 Ropes over 60 mm and up to 264 mm diameter

The minimum breaking force,  $F_{min}$ , expressed in kilonewtons is calculated using the following equation:

 $F_{\rm min}$  = 8,55 d + 0,592 d² - 0,000 615 d³

where

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

## Annex B (normative) Summary of factors for calculations

Table B.1 summarises the factors used in the calculation of minimum breaking force, for those ropes covered by Tables 5 to 16.

Table B.1 - Factors for stranded wire ropes for	general lifting applications
-------------------------------------------------	------------------------------

		Ropes	with fibre core centre	or fibre	R	opes with	steel core	e or wire s	trand cen	tre
_		Nominal	Nominal	Minimum	Nominal		Nominal		Minimum	
Туре	Class	length	metallic	breaking		ngth	1	metallic b		aking
of		mass	cross-	force		ass		SS-		rce
rope		factor	sectional	factor	tao	ctor		ional	tao	ctor
		(approx.)	area					ea		
			factor					tor		
		<i>W</i> ₁	C ₁	<i>K</i> ₁	$W_2$	$W_3$	C ₂	<i>C</i> ₃	$K_2$	$K_3$
	6x7	0,345	0,369	0,332	0,384	0,384	0,432	0,432	0,359	0,388
	8x7	0,327	0,335	0,291	0,391		0,439		0,359	
Single	6x19	0,359	0,384	0,330	0,400		0,449		0,356	
layer	8x19	0,340	0,349	0,293	0,407		0,457		0,356	
round	6x36	0,367	0,393	0,330	0,409		0.460		0,356	
strand	8x36	0,348	0,357	0,293	0,417		0,468		0,356	
rope	6x35N	0,352	0,377	0,317	0,392		0,441		0,345	
	6x19M	0,346	0,357	0,307		0,381		0,418	0,332	0,362
	6x37M	0,346	0,357	0,295	0,381	0,381	0,418	0,418	0,319	0,346
Rotation	18x7	0,382		0,328		0,401		0,433		0,328
resistant	34(M)x7	0,390		0,318		0,401		0,428		0,318
rope	35(W)x7					0,454		0,480		0,360
										0,350 ²⁾
¹⁾ Up to an ²⁾ Greater	d including r	ope grade 19	960 to and includ	ina rone ara	10 2160					

NOTE 1 The nominal length mass factors and nominal cross-sectional area factors are only for information.

NOTE 2 See EN 12385-2 for calculation of nominal length mass, nominal metallic cross sectional area and minimum breaking force using the factors in Table B.1.

## Annex C

## (informative) Calculation of approximate nominal length mass of ropes over 60mm diameter

## C.1 Length mass of ropes over 60 mm and up to 264 mm diameter

The approximate rope length mass, *M*, expressed in kilograms per 100 m, should be calculated as follows:

#### $M = 0,415 d^2$

where d is the nominal diameter of the rope, in mm

## Annex D

## (informative)

## Information which should be provided with an enquiry or an order

At least the following information should be supplied with an enquiry or order:

a) reference to this standard, i.e. EN 12385-4;

b) quantity and length;

c) nominal diameter;

d) rope class or construction;

e) core type;

f) rope grade;

g) wire finish;

h) lay direction and type;

NOTE Single layer ropes are normally manufactured right hand ordinary lay unless otherwise stated by the purchaser.

i) preformation;

NOTE The outer strands of single layer and parallel-closed ropes are normally preformed during manufacture. The purchaser should specify any particular preformation requirements.

j) lubrication;

NOTE At least the strands are lubricated during manufacture. The purchaser should specify any particular lubrication requirements.

k) type of inspection document - refer EN 12385-1;

I) any particular marking requirements;

m) any particular packaging requirements;

n) minimum breaking force required.

## Annex ZA

(informative)

## **Relationship of this document with EC Directives**

This Part of this European Standard has been prepared under a Mandate given to CEN by the European Commission and the European Free Trade Association, and supports the essential requirements of EC Directives as follows:

Machinery Safety Directive 98/37/EC, amended by Directive 98/79/EC.

Compliance with the listed clauses of this Part provides one means of complying with the specific essential requirements of the Directive concerned and associated EFTA regulations.

WARNING: Other requirements and other EC Directives <u>may</u> be applicable to the products falling within the scope of this standard.

## Bibliography

ISO 4345:1988, Steel wire ropes - Fibre main cores - Specification.

## **BSI** — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

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