

ПІДТВЕРДЖУВАЛЬНЕ ПОВІДОМЛЕННЯ

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EN 12385-4:2002+A1:2008

en: Steel wire ropes — Safety — Part 4: Stranded ropes for general lifting
applications

прийнято як національний стандарт
методом підтвердження за позначенням

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(EN 12385-4:2002+A1:2008, IDT)

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English Version

Steel wire ropes - Safety - Part 4: Stranded ropes for general lifting applications

Câbles en acier - Sécurité - Partie 4: Câbles à torons pour applications de levage générales

Drahtseile aus Stahldraht - Sicherheit - Teil 4: Litzenseile für allgemeine Hebezwecke

This European Standard was approved by CEN on 12 November 2001, includes Amendment 1 approved by CEN on 14 February 2008 and includes Corrigendum 1 issued by CEN on 19 October 2005.

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Foreword

This document (EN 12385-4:2002+A1:2008) 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of an identical text or by endorsement, at the latest by September 2008, and conflicting national standards shall be withdrawn at the latest by September 2008.

This document includes Amendment 1, approved by CEN on 2008-02-14 and includes Corrigendum 1 issued by CEN on 19 October 2005.

This document supersedes EN 12385-4:2002.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **[A1]** **[A1]**.

The modifications of the related CEN Corrigendum have been implemented at the appropriate places in the text and are indicated by the tags **[AC]** **[AC]**.

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 EU Directive(s).

For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are integral parts 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.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and 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

Hazards 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 Grade	Wire tensile strength grades N/mm ²	
	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.

Table 3 — Tolerances on rope diameter

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

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.

Table 4 — Differences between diameter measurements

Nominal rope diameter mm	Difference between measurements as percentage of nominal rope diameter	
	Rope with strands that are exclusively of wire or incorporate solid polymer	Ropes with strands that incorporate 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.

Table 5 — Class 6x7

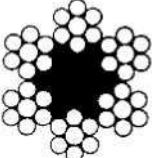
Construction cross section example  6x7-FC	Construction of rope		Construction of strand			
	Item	Quantity	Item	Quantity		
	Strands	6	Wires	5 to 9		
	outer strands	6	Outer wires	4 to 8		
	layers of strands	1	Layers of wires	1		
	Wires in rope (excluding metallic core)	30 to 54				
	Typical example		No. of outer wires	Outer wire factor ¹⁾		
Rope	Strand	Total	per strand			
6x7	1-6	36	6	0,106		
Min. breaking force factor:		$K_1 = 0,332$	$K_2 = 0,359$	$K_3 = 0,388$		
Nominal length mass factor ¹⁾ :		$W_1 = 0,345$	$W_2 = 0,384$			
Nominal metallic cross-sectional area factor ¹⁾		$C_1 = 0,369$	$C_2 = 0,432$			
Nominal rope diameter	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN			
	Fibre core	Steel core	Rope grade 1770		Rope grade 1960	
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						
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

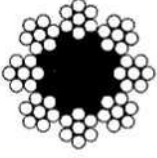
Construction cross section example	Construction of rope		Construction of strand			
	Item	Quantity	Item	Quantity		
 <p>8x7-FC</p>	Strands	8	Wires	5 to 9		
	outer strands	8	Outer wires	4 to 8		
	layers of strands	1	Layers of wires	1		
	Wires in rope (excluding steel core)	40 to 72				
	Typical example		No. of outer wires		Outer wire factor ¹⁾	
	Rope	Strand	Total	per strand		
8x7	1-6	48	6		0,087	
Min. breaking force factor		$K_1 = 0,291$	$K_2 = 0,359$	$K_3 = 0,404$		
Nominal length mass factor ¹⁾ :		$W_1 = 0,327$	$W_2 = 0,391$	$W_3 = 0,464$		
Nominal metallic cross-sectional area factor ¹⁾		$C_1 = 0,335$	$C_2 = 0,439$	$C_3 = 0,379$		
Nominal rope diameter	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN			
	mm	Fibre core	Steel core	Rope grade 1770		Rope grade 1960
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	46,2	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	74,2	91,5	82,1	101
13	55,3	66,1	87,0	107	96,4	119
14	64,1	76,6	101	125	112	138
16	83,7	100	132	163	146	180
18	106	127	167	206	185	228
20	131	156	206	254	228	281
22	158	189	249	308	276	341
24	188	225	297	366	329	405
26	221	264	348	430	386	476
28	256	307	404	498	447	552
32	335	400	527	651	584	721
36	424	507	668	824	739	912
40	523	626	824	1 020	913	1 130
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).						

Table 7 — Class: 6x19

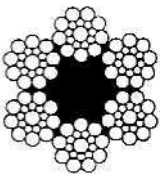
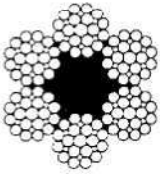
Construction cross section examples	Construction of rope		Construction of strand				
	Item	Quantity	Item	Quantity			
 6x19S-FC	Strands	6	Wires	15 to 26			
	outer strands layers of strands Wires in rope (excluding steel core)	6 1 90 to 156	Outer wires Layers of wires	7 to 12 2 to 3			
 6x25F-FC	Typical example		No. of outer wires		Outer wire factor ¹⁾		
	Rope	Strand	Total	per strand			
	6x19S	1-9-9	54	9		0,080	
	6x25F	1-6-6F-12	72	12		0,064	
	6x19W	1-6-6+6	72	12 6		0,073	
	6x26WS	1-5-5+5-10	60	10 6		0,055 0,074	
	Min. breaking force factor:		$K_1 = 0,330$	$K_2 = 0,356$			
	Nominal length mass factor ¹⁾		$W_1 = 0,359$	$W_2 = 0,400$			
	Nominal metallic cross-sectional area factor ¹⁾ :		$C_1 = 0,384$	$C_2 = 0,449$			
Nominal rope diameter mm	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN				
			Rope Grade				
			1770		1960		2160
	Fibre core	Steel core	Fibre core	Steel core	Fibre core	Steel core	Steel core
1	2	3	4	5	6	7	8
6	12,9	14,4	21,0	22,7	23,3	25,1	27,7
7	17,6	19,6	28,6	30,9	31,7	34,2	37,7
8	23,0	25,6	37,4	40,3	41,4	44,7	49,2
9	29,1	32,4	47,3	51,0	52,4	56,5	62,3
10	35,9	40,0	58,4	63,0	64,7	69,8	76,9
11	43,3	48,4	70,7	76,2	78,3	84,4	93,0
12	51,7	57,6	84,1	90,7	93,1	100	111
13	60,7	67,6	98,7	106	109	118	130
14	70,4	78,4	114	124	127	137	151
16	91,9	102	150	161	166	179	197
18	116	130	189	204	210	226	249
20	144	160	234	252	259	279	308
22	174	194	283	305	313	338	372
24	207	230	336	363	373	402	443
26	243	270	395	426	437	472	520
28	281	314	458	494	507	547	603
32	368	410	598	645	662	715	787
36	465	518	757	817	838	904	997
40	574	640	935	1 010	1 040	1 120	1 230
44	695	774	1 130	1 220	1 250	1 350	1 490
48	827	922	1 350	1 450	1 490	1 610	1 770
52	971	1 080	1 580	1 700	1 750	1 890	2 080
56	1 130	1 250	1 830	1 980	2 030	2 190	2 410
60	1 290	1 440	2 100	2 270	2 330	2 510	2 770
¹⁾ Informative only							

Table 8 — Class 8x19

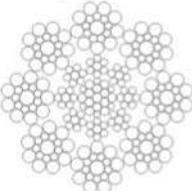
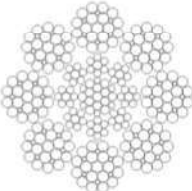
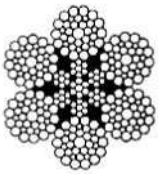
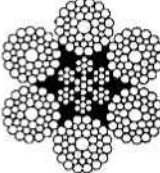
Construction cross section examples	Construction of rope		Construction of strand				
	Item	Quantity	Item	Quantity			
 8x19S-IWRC	Strands	8	Wires	15 to 26			
	outer strands layers of strands Wires in rope (excluding metallic core)	8 1 120 to 208	Outer wires Layers of wires	7 to 12 2 to 3			
 8x25F-IWRC	Typical example		No. of outer wires		Outer wire factor ¹⁾		
	Rope	Strand	Total	per strand			
	8x19S	1-9-9	72	9		0,065 5	
	8x25F	1-6-6F-12	96	12		0,052 5	
	8x19W	1-6-6+6	96	12		0,060 6	
				6		0,045 0	
				6		0,060 0	
				10		0,060 0	
	Min. breaking force factor:		$K_1 = 0,293$		$K_2 = 0,356$		
	Nominal length mass factor ¹⁾		$W_1 = 0,340$		$W_2 = 0,407$		
	Nominal metallic cross-sectional area factor ¹⁾		$C_1 = 0,349$		$C_2 = 0,457$		
Nominal rope diameter mm	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN				
			Rope Grade				
			1770		1960		2160
	Fibre core	Steel core	Fibre core	Steel core	Fibre core	Steel core	Steel core
1	2	3	4	5	6	7	8
8	21,8	26,0	33,2	40,3	36,8	44,7	49,2
9	27,5	33,0	42,0	51,0	46,5	56,5	62,3
10	34,0	40,7	51,9	63,0	57,4	69,8	76,9
11	41,1	49,2	62,8	76,2	69,5	84,4	93,0
12	49,0	58,6	74,7	90,7	82,7	100	111
13	57,5	68,8	87,6	106	97,1	118	130
14	66,6	79,8	102	124	113	137	151
16	87,0	104	133	161	147	179	197
18	110	132	168	204	186	226	249
20	136	163	207	252	230	279	308
22	165	197	251	305	278	338	372
24	196	234	299	363	331	402	443
26	230	275	351	426	388	472	520
28	267	319	407	494	450	547	603
32	348	417	531	645	588	715	787
36	441	527	672	817	744	904	997
40	544	651	830	1 010	919	1 120	1 230
44	658	788	1 000	1 220	1 110	1 350	1 490
48	783	938	1 200	1 450	1 320	1 610	1 770
52	919	1 100	1 400	1 700	1 550	1 890	2 080
56	1 070	1 280	1 630	1 980	1 800	2 190	2 410
60	1 220	1 470	1 870	2 270	2 070	2 510	2 770
¹⁾ Informative only							

Table 9 — Class 6x36

Construction cross section examples	Construction of rope		Construction of strand				
	Item	Quantity	Item	Quantity			
 6x36WS-IWRC	Strands	6	Wires	29 to 57			
	outer strands layers of strands Wires in rope (excluding steel core)	6 1 174 to 342	Outer wires Layers of wires	12 to 18 3 to 4			
 6x41WS-IWRC	Typical example		No. of outer wires		Outer wire factor ¹⁾		
	Rope	Strand	Total	per strand			
	6x31WS	1-6-6+6-12	72	12	0,064		
	6x36WS	1-7-7+7-14	84	14	0,056		
	6x41WS	1-8-8+8-16	96	16	0,050		
	6x49WS	1-8-8-8+8-16	96	16	0,050		
	6x46WS	1-9-9+9-18	108	18	0,045 5		
Min. breaking force factor:		$K_1 = 0,330$	$K_2 = 0,356$				
Nominal length mass factor ¹⁾		$W_1 = 0,367$	$W_2 = 0,409$				
Nominal metallic cross-sectional area factor ¹⁾		$C_1 = 0,393$	$C_2 = 0,460$				
Nominal rope diameter mm	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN				
			Rope Grade				
			1770		1960		2160
	Fibre core	Steel core	Fibre core	Steel core	Fibre core	Steel core	Steel core
1	2	3	4	5	6	7	8
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
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	1 010	1 040	1 120	1 230
44	711	792	1 130	1 220	1 250	1 350	1 490
48	846	942	1 350	1 450	1 490	1 610	1 770
52	992	1 110	1 580	1 700	1 750	1 890	2 080
56	1 150	1 280	1 830	1 980	2 030	2 190	2 410
60	1 320	1 470	2 100	2 270	2 330	2 510	2 770

¹⁾ Informative only

Table 10 — Class 8x36

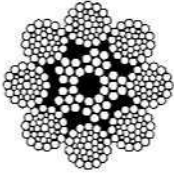
Construction cross section example	Construction of rope		Construction of strand				
	Item	Quantity	Item	Quantity			
 8x36WS-IWRC	Strands	8	Wires	29 to 57			
	outer strands	8	Outer wires	12 to 18			
	layers of strands	1	Layers of wires	3 to 4			
	Wires in rope (excluding steel core)	232 to 456					
	Typical example		No. of outer wires		Outer wire factor ¹⁾		
	Rope	Strand	Total	per strand			
	8x31WS	1-6-6+6-12	96	12	0,052 5		
	8x36WS	1-7-7+7-14	112	14	0,046 0		
	8x41WS	1-8-8+8-16	128	16	0,041 0		
	8x49WS	1-8-8-8+8-16	128	16	0,041 0		
8x46WS	1-9-9+9-18	144	18	0,037 3			
Min. breaking force factor:		$K_1 = 0,293$	$K_2 = 0,356$				
Nominal length mass factor ¹⁾		$W_1 = 0,348$	$W_2 = 0,417$				
Nominal metallic cross-sectional area factor ¹⁾		$C_1 = 0,357$	$C_2 = 0,468$				
Nominal rope diameter mm	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN				
			Rope Grade				
			1770		1960		2160
	Fibre core	Steel core	Fibre core	Steel core	Fibre core	Steel 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	42,0	51,0	46,5	56,5	62,3
10	34,8	41,7	51,9	63,0	57,4	69,8	76,9
11	42,1	50,5	62,8	76,2	69,5	84,4	93,0
12	50,1	60,0	74,7	90,7	82,7	100	111
13	58,8	70,5	87,6	106	97,1	118	130
14	68,2	81,7	102	124	113	137	151
16	89,1	107	133	151	147	179	197
18	113	135	168	204	186	226	249
20	139	167	207	252	230	279	308
22	168	202	251	305	278	338	372
24	200	240	299	363	331	402	443
26	235	282	351	426	388	472	520
28	273	327	407	494	450	547	603
32	356	427	531	645	588	715	787
36	451	540	672	817	744	904	997
40	557	667	830	1 010	919	1 120	1 230
44	674	807	1 000	1 220	1 110	1 350	1 490
48	802	961	1 200	1 450	1 320	1 610	1 770
52	941	1 130	1 400	1 700	1 550	1 890	2 080
56	1 090	1 310	1 630	1 980	1 800	2 190	2 410
60	1 250	1 500	1 870	2 270	2 070	2 510	2 770
¹⁾ Informative only							

Table 11 — Class 6x35N

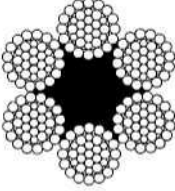
Construction cross section example	Construction of rope		Construction of strand				
	Item	Quantity	Item	Quantity			
 6x35NW-FC	Strands	6	Wires	28 to 48			
	outer strands	6	Outer wires	12 to 18			
	layers of strands	1	Layers of wires	3			
	Wires in rope (excluding steel core)	168 to 288					
	Typical example			No. of outer wires	Outer wire factor ¹⁾		
	Rope	Strand	Total	per strand			
6x28NW	1-5-5+5/12	72	12	0,064			
6x33NW	1-6-6+6/14	84	14	0,056			
6x34NW	1-6-6+6/15	90	15	0,053			
6x35NW	1-6-6+6/16	96	16	0,050			
Min. breaking force factor:		$K_1 = 0,317$	$K_2 = 0,345$				
Nominal length mass factor ¹⁾ :		$W_1 = 0,352$	$W_2 = 0,392$				
Nominal metallic cross-sectional area factor ¹⁾ :		$C_1 = 0,377$	$C_2 = 0,441$				
Nominal rope diameter	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN				
	mm	Fibre core	Steel core	Rope grade 1770		Rope grade 1960	
Fibre core				Steel core	Fibre core	Steel 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	1 430	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							

Table 12 — Class 6x19M

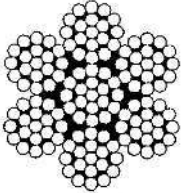
Construction cross section example  6x19M-WSC	Construction of rope		Construction of strand			
	Item	Quantity	Item	Quantity		
	Strands	6	Wires	12 to 19		
	outer strands	6	Outer wires	9 to 12		
	layers of strands	1	Layers of wires	2		
Wires in rope (excluding steel core)	72 to 114					
Typical example			No. of outer wires		Outer wire factor ¹⁾	
Rope	Strand	Total	per strand			
6x19M	1-6/12	72	12		0,064 0	
	Min. breaking force factor		$K_1 = 0,307$	$K_3 = 0,362$		
	Nominal length mass factor ¹⁾		$W_1 = 0,346$	$W_3 = 0,381$		
	Nominal metallic cross-sectional area factor ¹⁾		$C_1 = 0,357$	$C_3 = 0,418$		
Nominal rope diameter	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN			
	mm	Fibre core	Steel core	Rope grade 1770		Rope grade 1960
Fibre core				Steel core	Fibre core	Steel 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	10,3	9,63	11,4
5	8,65	9,53	13,6	16,0	15,0	17,7
6	12,5	13,7	19,6	23,1	21,7	25,5
7	17,0	18,7	26,6	31,4	29,5	34,8
¹⁾ Informative only						

Table 13 — Class 6x37M

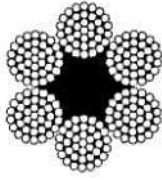
Construction cross section example	Construction of rope		Construction of strand			
	Item	Quantity	Item	Quantity		
 6x37M-FC	Strands	6	Wires	27 to 37		
	outer strands	6	Outer wires	16 to 18		
	layers of strands	1	Layers of wires	3		
	Wires in rope (excluding steel core)	162 to 222				
	Typical example		No. of outer wires		Outer wire factor ¹⁾	
Rope	Strand	Total	per strand			
	6x37M	1-6/12/18	108	18	0,0455	
	Min. breaking force factor		$K_1 = 0,295$	$K_2 = 0,319$	$K_3 = 0,346$	
	Nominal length mass factor ¹⁾		$W_1 = 0,346$	$W_2 = 0,381$	$W_3 = 0,381$	
	Nominal metallic cross-sectional area factor ¹⁾		$C_1 = 0,357$	$C_2 = 0,418$	$C_3 = 0,418$	
Nominal rope diameter	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN			
	mm	Fibre core	Steel core	Rope grade 1770		Rope grade 1960
Fibre core				Steel core	Fibre core	Steel core
1	2	3	4	5 ²⁾	6	7 ²⁾
5	8,65	9,53	13,1	15,3	14,5	17,0
6	12,5	13,7	18,8	22,0	20,8	24,4
7	17,0	18,7	25,6	30,0	28,3	33,2
8	22,1	24,4	33,4	39,2	37,0	43,4
9	28,0	30,9	42,3	49,6	46,8	54,9
10	34,6	38,1	52,2	61,2	57,8	67,8
11	41,9	46,1	63,2	74,1	70,0	82,1
12	49,8	54,9	75,2	88,2	83,3	97,7
¹⁾ Informative only						
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

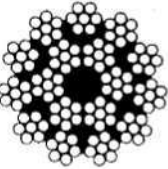
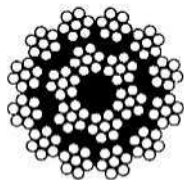
Construction cross section example	Construction of rope		Construction of strand		
	Item	Quantity	Item	Quantity	
 17x7-FC	Strands	17 to 18	Wires	5 to 9	
	outer strands layers of strands Wires in rope (excluding wire strand centre)	10 to 12 2 85 to 162	Outer wires Layers of wires	4 to 8 1	
 18x7-FC	Typical example		No. of outer wires		Outer wire factor ¹⁾
	Rope	Strand	Total	per strand	
	17x7	1-6	66	6	0,070
	18x7	1-6	72	6	0,063 2
Min. breaking force factor;			$K_1 = 0,328$	$K_3 = 0,328$	
Nominal length mass factor ¹⁾ :			$W_1 = 0,382$	$W_3 = 0,401$	
Nominal metallic cross-sectional area factor ¹⁾ :			$C_3 = 0,433$		
Nominal rope diameter	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN		
	Fibre centre	Steel centre	Rope grade 1770		Rope grade 1960
mm			Fibre or steel centre		Fibre or steel 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
16	97,8	103	149		165
18	124	130	188		208
20	153	160	232		257
22	185	194	281		311
24	220	231	334		370
26	258	271	392		435
28	299	314	455		504
¹⁾ Informative only					

Table 15 — Class: 34(M)x7

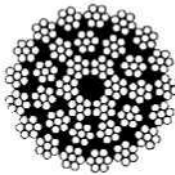
Construction cross section example	Construction of rope		Construction of strand		
	Item	Quantity	Item	Quantity	
 <p>34(M)x7-FC</p>	Strands	34 to 36	Wires	5 to 9	
	outer strands	17 to 18	Outer wires	4 to 8	
	layers of strands	3	Layers of wires	1	
	Wires in rope - (excluding wire strand centre)	170 to 324			
	Typical example		No. of outer wires		Outer wire factor ¹⁾
	Rope	Strand	Total	per strand	
34(M)x7	1-6	102	6	0,047 2	
36(M)x7	1-6	108	6	0,045	
Min. breaking force factor		$K_1 = 0,318$	$K_3 = 0,318$		
Nominal length mass factor ¹⁾		$W_1 = 0,390$	$W_3 = 0,401$		
Nominal metallic cross-sectional area factor ¹⁾			$C_3 = 0,428$		
Nominal rope diameter	Approximate nominal length mass ¹⁾ kg/100 m		Minimum breaking force kN		
	Fibre centre	Steel centre	Rope grade 1770	Rope grade 1960	
mm			Fibre or steel centre	Fibre or steel centre	
1	2	3	4	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	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	1 090	1 210	
48	899	924	1 300	1 440	
52	1 060	1 080	1 520	1 690	
56	1 220	1 260	1 770	1 960	
60	1 400	1 440	2 030	2 240	
¹⁾ Informative only					

Table 16 — Class 35(W)x7

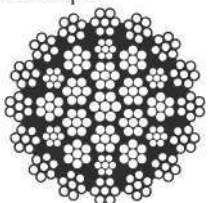
<p>Construction cross section example</p>  <p>35(W)x7</p>	Construction of rope		Construction of strand	
	Item	Quantity	Item	Quantity
	Strands	28 to 40	Wires	5 to 9
	outer strands	15 to 18	Outer wires	4 to 8
	layers of strands	3	Layers of wires	1
	Wires in rope	196 to 280		
	Typical example		No. of outer wires	
Rope	Strand	Total	per strand	
35(W)x7	1-6	96	6	0,046 1
Min. breaking force factor:		$K_3 = 0,360^{2)}$ $K_3 = 0,350^{3)}$		
Nominal length mass factor ¹⁾		$W_3 = 0,454$		
Nominal metallic cross-sectional area factor ¹⁾		$C_3 = 0,480$		
Nominal rope diameter mm	Approximate nominal length mass ¹⁾ kg/100 m	Minimum breaking force kN		
		Rope grade 1960	Rope grade 2160	
1	2	3	4	
8	29,1	45,2	48,4	
9	36,8	57,2	61,2	
10	45,4	70,6	75,6	
11	54,9	85,4	91,5	
12	65,4	102	109	
13	76,7	119	128	
14	89,0	138	148	
16	116	181	194	
18	147	229	245	
20	182	282	302	
22	220	342	366	
24	262	406	435	
26	307	477	511	
28	356	553	593	
32	465	723	774	
36	588	914	980	
38	656	1 020	1 090	
40	726	1 130	1 210	
¹⁾ Informative only ²⁾ Up to and including rope grade 1960 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 strands	Wires in rope ¹⁾	Wires per strand	Outer wires in one strand	Layer of wires	Typical rope diameter 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
$F_{\min} = 8,55 d + 0,592 d^2 - 0,000 615 d^3$, where d = nominal rope diameter $M = W \cdot d^2$, where nominal length mass factor (W) = 0,415								
Nominal rope diameter		Approximate nominal length mass		Minimum breaking force				
mm		kg/100 m		kN				
64		1 700		2 800				
68		1 900		3 100				
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		3 500		5 300				
96		3 800		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		8 600		11 700				
152		9 600		12 800				
160		10 600		14 000				
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		19 400		23 300				
224		20 800		24 700				
232		22 300		26 200				
240		23 900		27 700				
248		25 500		29 200				
256		27 200		30 700				
264		28 900		32 200				
¹⁾ Excluding steel core ²⁾ Information 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:

$$F_{\min} = \frac{K \cdot d^2 \cdot R_r}{1000}$$

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:

$$F_{\min} = 8,55 d + 0,592 d^2 - 0,000 615 d^3$$

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

Type of rope	Class	Ropes with fibre core or fibre centre			Ropes with steel core or wire strand centre					
		Nominal length mass factor (approx.)	Nominal metallic cross-sectional area factor	Minimum breaking force factor	Nominal length mass factor		Nominal metallic cross-sectional area factor		Minimum breaking force factor	
		W_1	C_1	K_1	W_2	W_3	C_2	C_3	K_2	K_3
Single layer round strand rope	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	
	6x19	0,359	0,384	0,330	0,400		0,449		0,356	
	8x19	0,340	0,349	0,293	0,407		0,457		0,356	
	6x36	0,367	0,393	0,330	0,409		0,460		0,356	
	8x36	0,348	0,357	0,293	0,417		0,468		0,356	
	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 resistant rope	18x7	0,382		0,328		0,401		0,433		0,328
	34(M)x7	0,390		0,318		0,401		0,428		0,318
	35(W)x7					0,454		0,480		0,360 ¹⁾ 0,350 ²⁾

¹⁾ Up to and including rope grade 1960

²⁾ Greater than rope grade 1960 up to and including rope grade 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;
- l) any particular marking requirements;
- m) any particular packaging requirements;
- n) minimum breaking force required.

Annex ZA
(informative)

Ⓐ Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 98/37/EC amended by 98/79/CE on machinery.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING - Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard. Ⓐ

Annex ZB (informative)

A1 Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING - Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard. **A1**

Bibliography

- [1] ISO 4345:1988, *Steel wire ropes – Fibre main cores – Specification*.