Section 4

WIRE ROPES

INTRODUCTION 35x7 NON ROTATION CRANE WIRE

Wire ropes can be grouped into several categories by the type of closing, the numbers of strands and the thickness of strands.

Along with the diameter, two numbers are normally used to define the construction of a wire rope. The first refers to the number of strands in the rope and the second to the number of wires per strand. In general, the greater the number of wires, the greater the flexibility of the rope. As the number of strands increase, so the section of the rope tends towards an even circle which is essential for the wear characteristics of ropes which pass over sheaves.

While it is impossible to include a comprehensive list of all wire ropes in a publication of this size, this section should be a useful reference guide for those constructions in common use.

SELECTION OF GREASE

For Active Hive Compensated System needs special lubricate because @ temperatures higher than 50°-60°C standard grease starts dripping out of the rope. Viking Moorings recommended as maintenance a pressure lubricates every 6. month to prevent mechanical wear and tear between stand – strand and between wire - sheaves. If possible registration of number of cycles bend over sheaves (CBOS) together with tension and temperature for logging the history of the wire rope.

INTRODUCTION FOR 6 x 36

Wire ropes can be grouped into two broad categories by the type of central core used. Independent wire rope core (IWRC) ropes are the stronger of the two and offer the greater resistance to crushing and high temperatures. Fibre core (FC) wire ropes while weaker, offer advantages in terms of flexibility, weight and of course price. Along with the diameter, two numbers are normally used to define the construction of a wire rope. The first refers to the number of strands in the rope and the second to the number of wires per strand. In general, the greater the number of wires, the greater the flexibility of the rope. As the number of strands increase, so the section of the rope tends towards an even circle which is essential for the wear characteristics of ropes which pass over sheaves. While it is impossible to include a comprehensive list of all wire ropes in a publication of this size, this section should be a useful reference guide for those constructions in common use.

GENERAL ENGINEERING ROPES

Classification of wire rope is provided as per API 9A I BS EN12385-4:2002 I ISO 2408

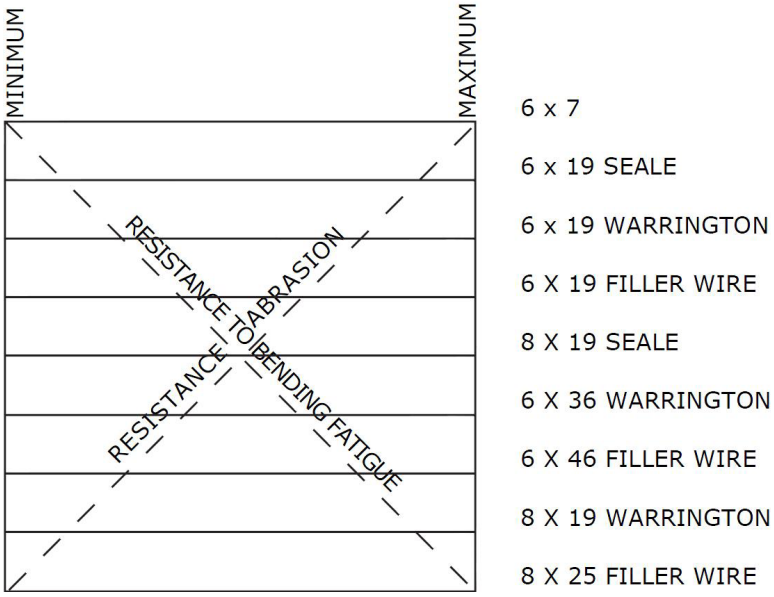
4.2

• 6x19 Class includes the following: contains 6 strands which are made up of 15 through 26 wires. Examples: 6x19, 6x25 and 6x26.
• 6x37 Class includes the following: contains 6 strands which are made up of 27 through 49 wires. Examples: 6x29, 6x31 , 6x36, 6x41 , 6x46, 6x47 and 6x49.
• 6x61 Class includes the following: contains 6 strands which are made up of 50 through 74 wires. Examples: 6x52, 6x55, 6x57 and 6x61 .
• 6x91 Class includes the following: contains 6 strands which are made up of 75 through 109 wires. Examples: 6x91 and 6x103.

EIPS: Extra Improved Plough Steel. In the ISO system, approximately equivalent to 1770 N/mm2 grade.
EEIPS: Extra Extra Improved Plough Steel. In the ISO system, approximately equivalent to 1960 N/mm2 grade.

Six strand ropes can be manufactured up to 160mm diameter with a net weight of 550 Tons per Reel. All ropes can come with compacted (Flat Strands upon request).

The choice of wire rope construction is a compromise between fatigue and abrasion resistance. The chart below illustrates this principle.



CORROSION

Where corrosive conditions exist the use of galvanised wires is recommended. In addition to physical protection due to the complete envelopment of steel wire, zinc provides sacrificial protection as corrosion of the steel is prevented until the zinc is removed from comparatively large areas. In extreme cases corrosion can be combated by the use of stainless steel wire rope.

Further guidance to rope selection is given in BS6570 Code of Practice for 'The selection, care, and maintenance of steel wire ropes'.

LUBRICATION

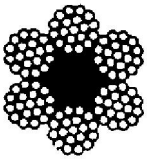
Unless otherwise indicated, by the customer or the intended duty, our ropes are thoroughly lubricated both internally and externally, during manufacture. In addition to providing internal lubrication for free movement of the component wires, the lubricant also gives protection against corrosion. Due to the internal pressures set up as the rope flexes and other outside influences met during its work, the original lubricant may soon be reduced and to ensure maximum rope life supplementary lubricant should be applied periodically during service. How rigorous the duty or corrosive the conditions will dictate the frequency of these applications.

All steel wire ropes, including galvanised and stainless, will derive benefits from lubrication.

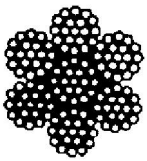
MAIN CORE OF ROPE

The function of the core in a steel wire rope is to serve as a foundation for the strands, providing support and keeping them in their proper position throughout the life of the rope.

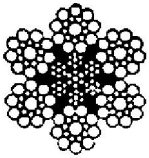
Fibre cores are generally used, as, when impregnated with grease, they help to provide internal lubrication as well as contributing to flexibility.
Where high resistance to crushing or to heat is needed and where additional strength or low stretch is required steel wire cores are used.



Fibre Main Core



Wire Strand Main Core (WSMC)



Independent Wire Rope Main Core (IWRC)

ROPE LAYS

LENGTH OF LAY
That distance in a rope, measured parallel to its axis, in which a strand in a rope makes one complete turn about the axis of the rope. Variations in length of lay alter the elastic properties of the rope, e.g. shortening the length of lay will increase a rope's elastic stretch but slightly reduce its breaking load.

ORDINARY (REGULAR) LAY AND LANG'S LAY
In an ordinary lay rope the direction of lay of the outer layer or wires in the strands is opposite to the direction of lay of the strands in the rope, whereas in a Lang's lay rope the direction of lay of the outer layer of wires in the strands is the same as the direction of lay of the strands in the rope.

Both ordinary lay and Lang's lay ropes are normally laid up in a right hand direction, but left hand lay can be supplied on request.

Ordinary lay ropes are suitable for all general engineering purposes. A Lang's lay rope offers a greater wearing surface and can be expected to last longer than an ordinary lay rope on an installation where resistance to wear is important, but it has less resistance to unlaying than an ordinary lay and its application must be limited to installations in which both ends of the rope are secured against rotation.

EQUAL LAY
An equal lay construction is one in which the wires in the strand are spun so they will have an equal length of lay. It follows that the contact between all wires in the strand is linear. Ropes of this construction are not subject to failure by the bending of wires over the wires of the underlying layer.

Example

6 x 19 (9/9/1)	6 x 19 (12/6 + 6F/1)	6 x 36 (14/7 & 7/7/1)
Seale	Filler	Warrington

CROSS LAY

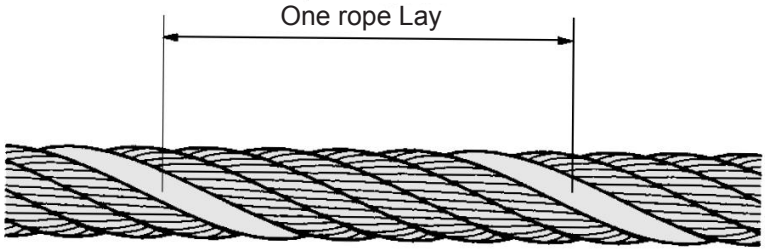
A cross lay construction is one in which the wires in successive layers of the strand are spun approximately the same angle of lay.

It follows that the wires in successive layers make point contact.

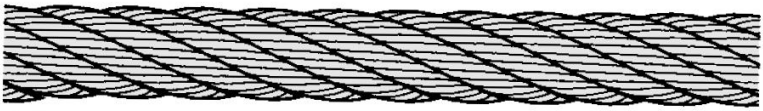
Where ropes are operating over pulleys, nicking of wires and secondary bending at these points of contact occur, and failure of the wires by early fatigue may result.

Example

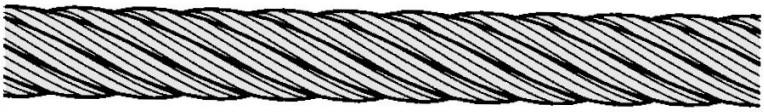
6 x 19 (12/6/1) 6 x 37 (18/12/6/1)



Length of lay



Ordinary lay



Lang's lay

ROPE AND STRAND DESCRIPTION

For most applications wire ropes are constructed with six strands which are generally laid round a fibre or wire rope core. It is seldom that fewer strands are used but, for special applications, more than six are employed.

Throughout this catalogue, the figures given to describe the construction of a rope, are arranged so that the FIRST figure always indicates the number of STRANDS in the rope, and the SECOND figure the number of WIRES in each strand.

eg 6 x 7 denotes a rope constructed with 6 STRANDS each strand comprising 7 WIRES
8 x 19 denotes a rope constructed with 8 STRANDS each strand comprising 19 WIRES

Where there are seven wires in a strand, they can be arranged in only one way, ie 6 around 1, given in the catalogue as 6/1, a rope arranged 6 strands each of 7 wires is shown as
6 x 7 (6/1)

Where there are more than seven wires in a strand, they can sometimes be arranged in different ways and it is because of this that in this catalogue the arrangement of the wires in the strand is invariably shown in brackets following the total number of wires per strand, eg where in
6 x 19

construction the 19 wires in each strand are laid 12 around 6 around 1 centre wire, the construction is shown as
6 x 19 (12/6/1)

Similarly, where the 19 wires in a strand are laid 9 around 9 around 1 centre wire, or ‘SEALE’ the arrangement is shown as
6 x 19 (9/9/1) ‘SEALE’

Where the wires in the strands are laid on the ‘WARRINGTON’ principle, the figures denoting a layer of large and small diameter wires are separated by the word ‘and’
eg 6 x 19 (6 and 6/6/1) ‘WARRINGTON’

Where small ‘FILLER’ wires are introduced between layers of wires they are denoted by the ‘+’ sign and the number of ’FILLER’ wires followed by the letter ‘F’ eg
6 x 19 (12/6+6F/1)’FILLER’

PREFORMING

Preforming is a manufacturing process which has the effect of relieving the wires and the strands of much of the internal stress which exist in nonpre-formed ropes. During the process the strands and wires are given the helical shape they will assume in the finished rope.

In a preformed rope broken wires do not protrude and greater care is required when inspecting for broken wires.

Preformed rope offers certain advantages over non-preformed rope, eg:

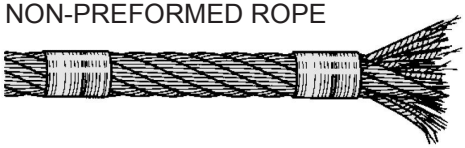
1 It does not tend to unravel and is less liable to form itself into loops or kinks and is thus more easily installed

2 It is slightly more flexible and conforms to the curvature of sheaves and pulleys

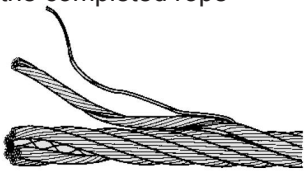
3 Due to the reduction in internal stresses it has greater resistance to bending fatigue

Unless otherwise requested all ropes are supplied preformed.

NON-PREFORMED ROPE



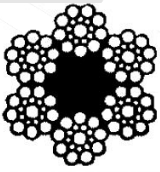
In PREFORMED rope the wires and strands are given the helix they take up in the completed rope



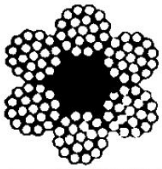
PREFORMED rope may be cut without servings although care must always be taken

COMMON STEEL WIRE ROPE CROSS SECTIONS

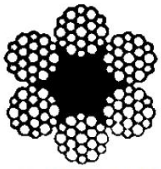
ROUND STRAND



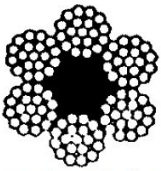
6 x 19 (9/9/1)
'SEALE'



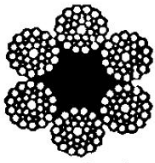
6 x 19 (12/6/1)



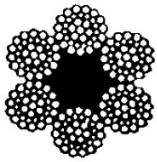
6 x19 (6 and 6/6/1)
'WARRINGTON'



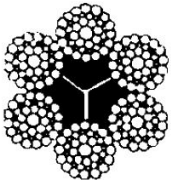
6 x 19 (12/6+6F/1)
'FILLER'



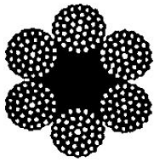
6 x 36 (14/7 and 7/7/1)
'WARRINGTON'



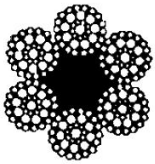
6 x 37 (15/15/61/1)
'SEALE'



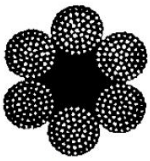
6 x 41 (16/8 and 8/8/1)
'WARRINGTON'



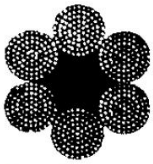
6 x 37
(18/12/6/1)



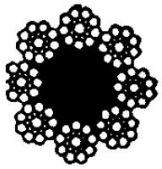
6 x 46 (18/9+9F/9/1)
'FILLER'



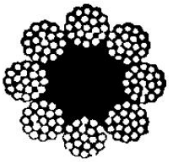
6 x 61
(24/18/12/6/1)



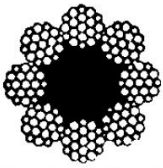
6 x 91
(30/24/18/12/6/1)



8 x19 (9/9/1)
'SEALE'

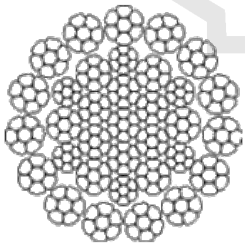


8 x19 (12/6+6F/1)
'FILLER'



8 x 19 (6 and 6/6/1)
'WARRINGTON'

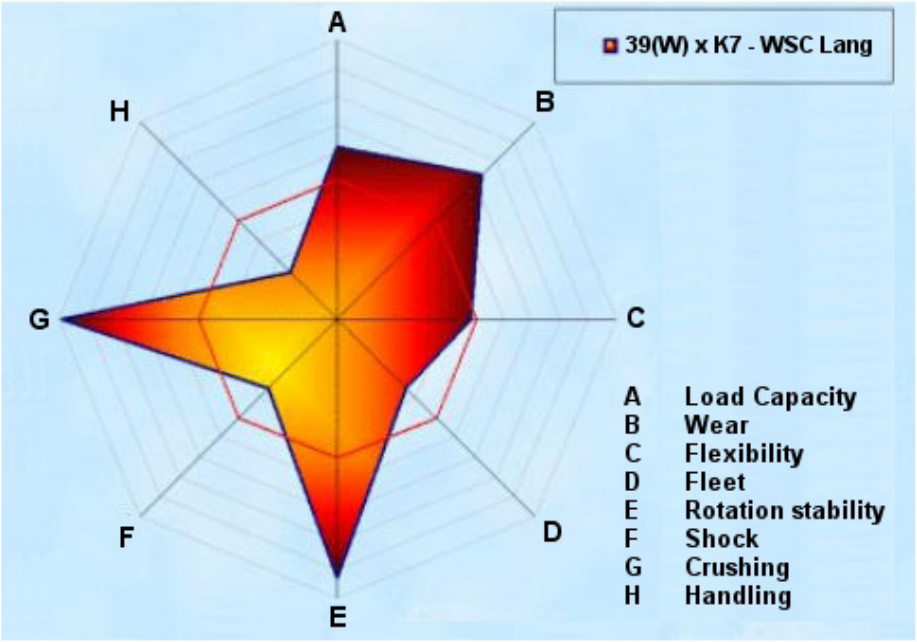
FLEXPACK



Description:
Non-rotating wire rope with extremely high breaking load

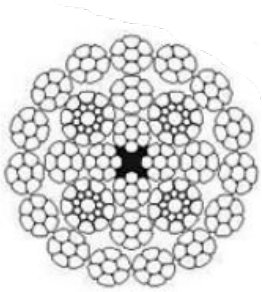
Applications:
Mobile Cranes, deck cranes, offshore, active heav compensated system.

Main Characteristics:
Type: Non Rotating
Outer Strands: 15 / 18 / 21
Compacted Strands: YES
Plastic Filling: NO
Lay: Lang's / Regular
Core: IWRC



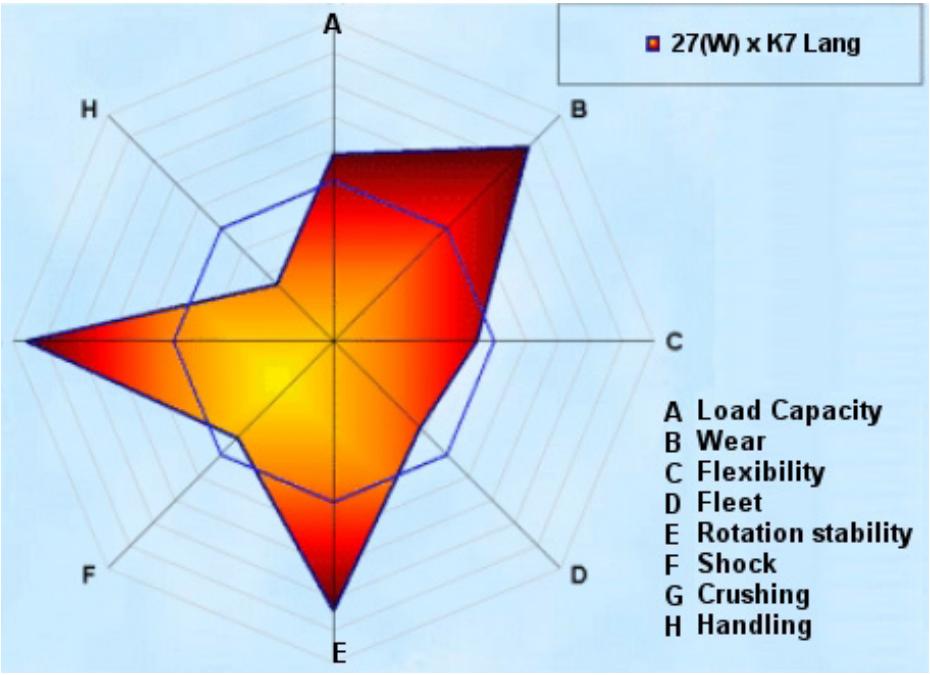
IPERPACK

Description:
Non-rotating wire rope with high breaking load.



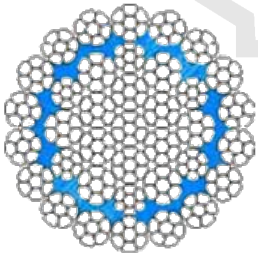
Applications:
Mobile cranes, deck cranes.

Main Characteristics:
Type: Non Rotating
Outer Strands: 15/18
Compacted Strands: YES
Plastic Filling: NO
Lay: Lang's/Regular
Core: IWRC



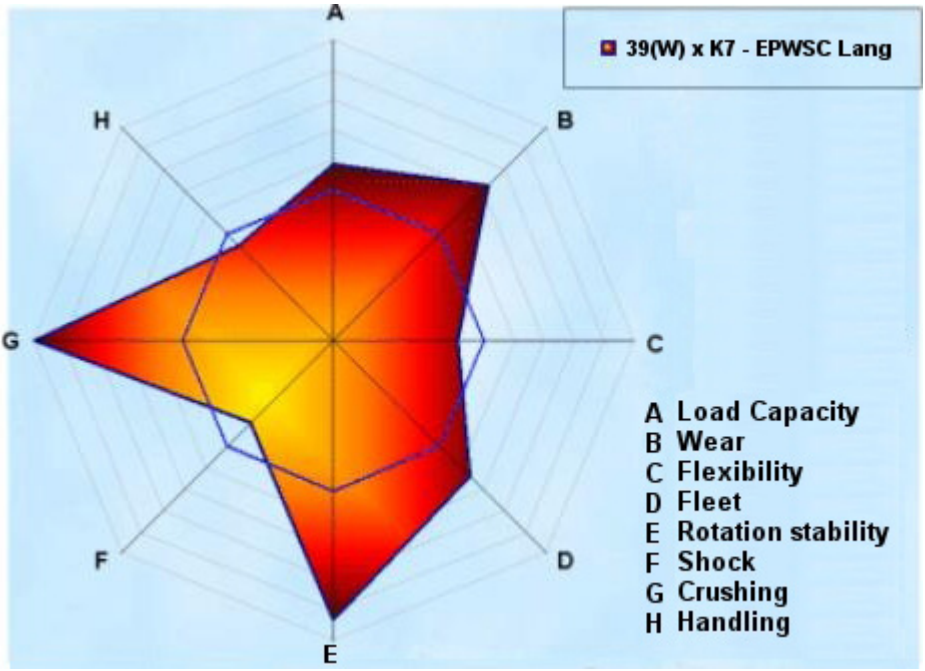
IPERPLAST

Description:
Non-rotating wire rope with extremely high breaking load. Excellent resistance to high fleet angles.



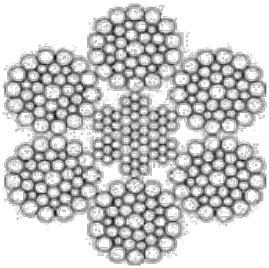
Applications:
Mobile Cranes, deck cranes, offshore.

Main Characteristics:
Type: Non Rotating
Outer Strands: 18 / 18
Compacted Strands: YES
Plastic Filling: YES
Lay: Lang's / Regular
Core: IWRC



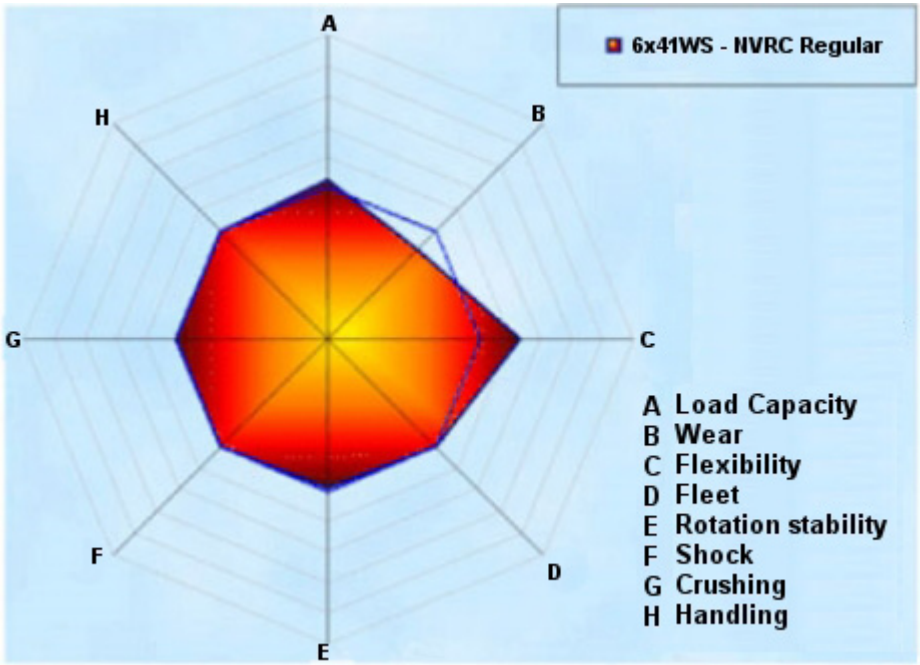
6 STRAND WIRE ROPES + IWRC

Description:
6 strand wire ropes (19S, 25F, 31WS, 36WS, 41WS).



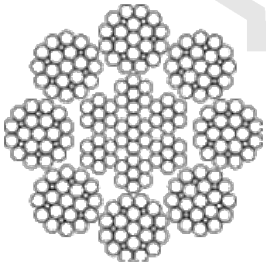
Applications:
Winches and hoisting devices.

Main Characteristics:
Type: Hoisting and Boom
Outer Strands: 6
Compacted Strands: NO
Plastic Filling: NO
Lay: Regular
Core: IWRC



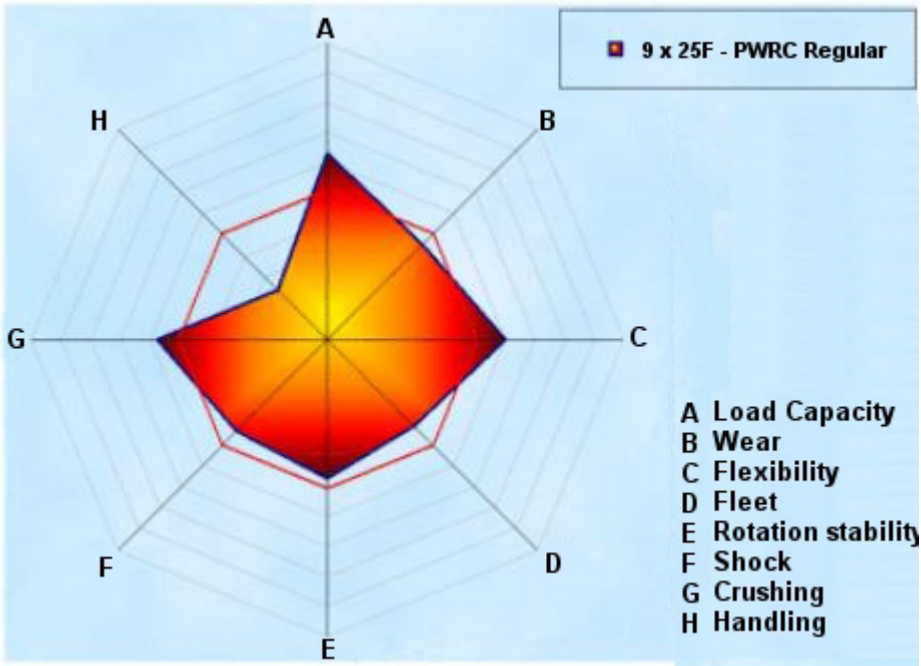
8 STRAND WIRE ROPES + IWRC

Description:
8 strand wire ropes (19S, 25F, 31WS, 36WS, 41WS).



Applications:
Winches and hoisting devices.

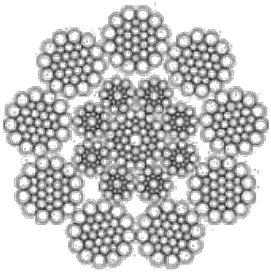
Main Characteristics:
Type: Hoisting and Boom
Outer Strands: 9
Compacted Strands: NO
Plastic Filling: NO
Lay: Regular
Core: IWRC



VIKING MOORINGS™
www.viking-moorings.com

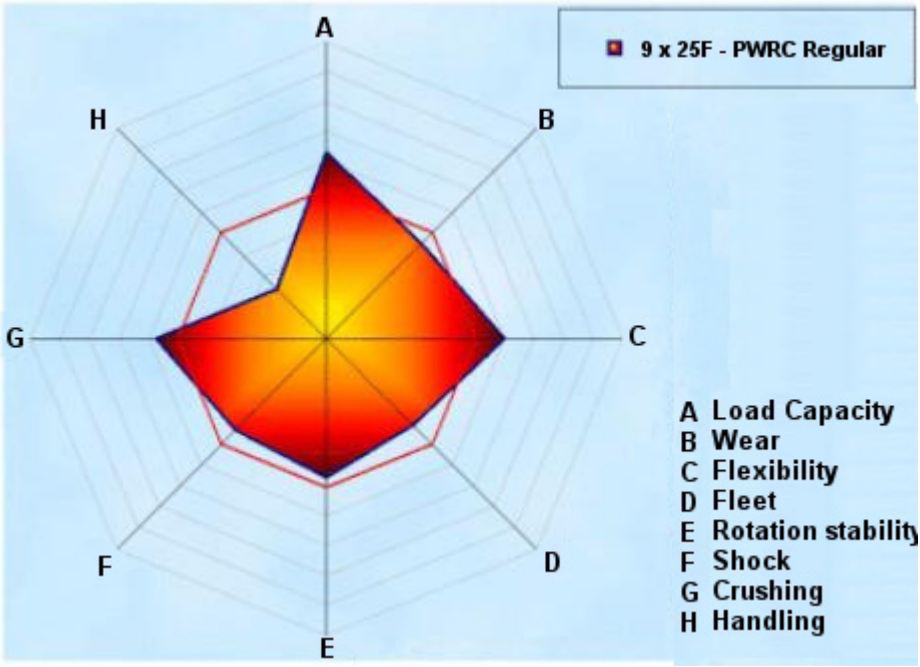
SPIN 9

Description:
Spin resistant wire rope with low torque and high breaking load.

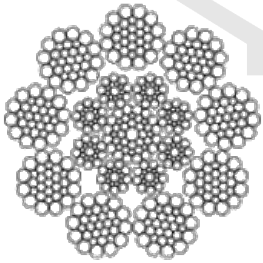


Applications:
Winches and hoisting devices

Main Characteristics:
Type: Hoisting
Outer Strands: 9
Compacted Strands: NO
Plastic Filling: NO
Lay: Regular
Core: IWRC



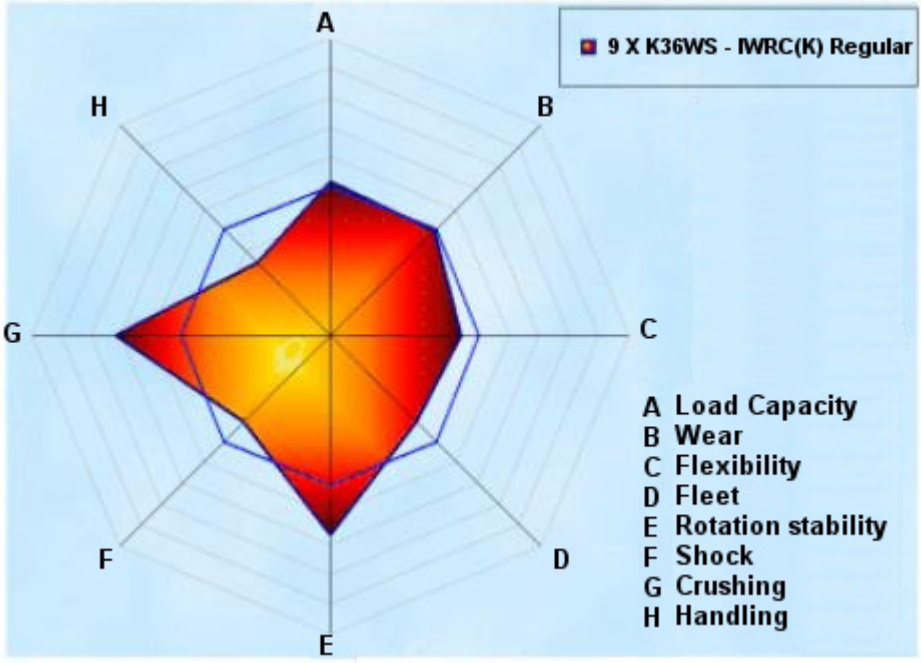
SPIN 9K



Description:
Spin resistant wire rope with low torque and high breaking load

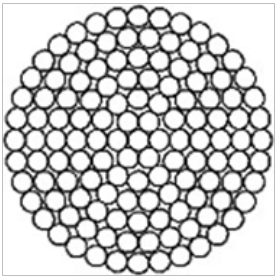
Applications:
Capstan winches

Main Characteristics:
Type: Spin Resistant
Outer Strands: 9
Compacted Strands: YES
Plastic Filling: NO
Lay: Regular
Core: IWRC



SPIRAL STRANDS / 1x37-1x61-1x91-1x127-1x169

Description:
Round-wires spiral strand ropes.

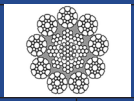
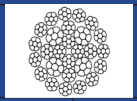
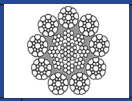


Applications:
Carrying cables, stabilizing cables, stay cables, pendant cables for tensile structures and for offshore mooring.

Main Characteristics:
Type: Spiral Strands
Lay: S/Z
Core: Spiroidale
Protection: Zinc / galfan
Galvanizing Class: A - B - C
Outer wires: 12 - 42

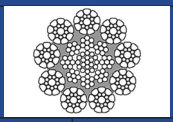
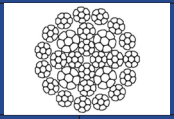
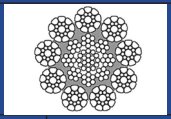
Mooring fleeting windmill, spiral strand wire

NON ROTATING HI TECH CRANE ROPES

Red 2P				Flexpack				2P		
										
Rope Dia (mm)	Mass kg/m	Min. breaking force		Mass kg/m		Min. breaking force		Mass kg/m	Min. breaking force	
		Bright kN	Galv. kN	Air kg/m	Sea Wa-ter kg/m	Bright kN	Galv. kN		Bright kN	Galv. kN
8	-	-	-	-	-	-	-	0,32	66,6	63,2
9	-	-	-	-	-	-	-	0,41	84,2	80
10	0,45	91,1	91,1	0,49	0,42	95	95	0,5	104	98,8
11	0,54	110	110	0,59	0,51	115	115	0,61	126	120
12	0,65	131	131	0,70	0,61	137	137	0,72	150	142
13	0,76	154	154	0,82	0,71	161	161	0,85	176	167
14	0,88	179	179	0,95	0,83	195	195	0,98	204	194
15	1,01	205	205	1,09	0,95	224	224	1,13	234	222
16	1,15	233	233	1,24	1,08	255	255	1,28	266	253
17	1,3	263	263	1,40	1,22	288	288	1,45	301	286
18	1,46	295	295	1,57	1,37	323	323	1,62	337	320
19	-	-	-	1,94	1,69	360	360	1,81	375	357
20	1,8	364	364	2,14	1,86	398	398	2	416	395
21	-	-	-	2,35	2,04	439	439	2,21	459	436
22	2,18	441	441	2,57	2,23	482	482	2,42	503	478
23	-	-	-	2,79	2,43	527	574	2,65	550	523
24	2,59	525	525	3,03	2,64	574	596	2,89	599	569
25	-	-	-	3,28	2,85	596	596	3,13	650	618
26	3,04	616	616	3,28	2,85	645	645	3,48	696	661
27	-	-	-	3,54	3,08	695	695	-	-	-
28	3,53	698	663	3,80	3,31	748	748	4,04	808	767
30	4,05	801	761	4,37	3,80	859	859	4,63	927	881
32	4,61	911	866	4,97	4,32	977	977	5,27	1050	1000
34	5,2	1030	977	5,61	4,88	1100	1100	5,95	1190	1130
36	5,83	1150	1100	6,29	5,47	1230	1230	6,67	1330	1270
38	6,5	1290	1220	7,00	6,09	1370	1370	7,44	1490	1410
40	7,2	1420	1350	7,76	6,75	1520	1520	8,24	1650	1570
42	7,94	1530	1430	8,80	7,70	1660	1660	8,84	1820	1730
44	8,71	1680	1570	9,70	8,40	1820	1820	9,7	1990	1890

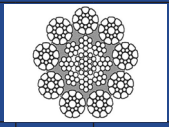
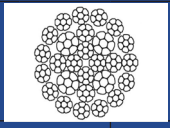
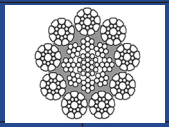
All dimensions are approximate

NON ROTATING HI TECH CRANE ROPES

Pack 1				Flexpack				Pack 2		
										
Rope Dia (mm)	Mass kg/m	Min. breaking force		Mass kg/m		Min. breaking force		Mass kg/m	Min. breaking force	
		Bright kN	Galv. kN	Air kg/m	Sea Water kg/m	Bright kN	Galv. kN		Bright kN	Galv. kN
46	9,52	1840	1710	10,6	9,2	1990	1990	10,6	2180	2070
48	10,4	2000	1860	11,5	10,0	2170	2170	11,5	2370	2250
50	11,3	2180	2020	12,5	10,9	2350	2350	12,5	2580	2450
52	12,2	2350	2190	13,5	11,8	2530	2530	13,5	2790	2650
54	13,1	2540	2360	14,6	12,7	2710	2710	14,6	2950	2800
56	14,1	2730	2540	15,7	13,6	2910	2910	15,7	3170	3010
58	15,1	2930	2720	16,8	14,6	3100	3100	16,9	3400	3230
60	16,2	3130	2910	18,0	15,7	3310	3310	18	3640	3450
62	17,3	3340	3110	19,2	16,7	3520	3520	19,3	3770	3500
64	18,4	3560	3310	20,5	17,8	3730	3730	20,5	4010	3730
66	19,6	3790	3520	21,8	18,9	3950	3950	21,8	4270	3970
68	20,8	4020	3740	23,1	20,1	4180	4180	23,2	4440	4130
70	22	4260	3960	24,5	21,3	4410	4410	24,5	4700	4370
72	23,3	4510	4190	25,9	22,6	4640	4640	-	-	-
74	24,6	4760	4430	27,4	23,8	4880	4880	-	-	-
76	26	5030	4670	28,9	25,1	5120	5120	-	-	-
78	-	-	-	30,4	26,5	5370	5370	-	-	-
80	-	-	-	32,0	27,8	5630	5630	-	-	-
82	-	-	-	33,6	29,2	5890	5890	-	-	-
84	-	-	-	35,3	30,7	6150	6150	-	-	-
86	-	-	-	37,0	32,2	6410	6410	-	-	-
88	-	-	-	38,7	33,7	6690	6690	-	-	-
90	-	-	-	39,5	35,2	6960	6960	-	-	-
92	-	-	-	40,2	36,8	7240	7240	-	-	-
94	-	-	-	42,0	38,4	7520	7520	-	-	-
96	-	-	-	43,8	40,1	7810	7810	-	-	-
98	-	-	-	45,6	41,8	7950	7950	-	-	-
100	-	-	-	47,5	43,5	8270	8270	-	-	-

All dimensions are approximate

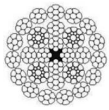
NON ROTATING HI TECH CRANE ROPES

Pack 1				Flexpack				Pack 2		
										
Rope Dia (mm)	Mass kg/m	Min. breaking force		Mass kg/m		Min. breaking force		Mass kg/m	Min. breaking force	
		Bright kN	Galv. kN	Air kg/m	Sea Water kg/m	Bright kN	Galv. kN		Bright kN	Galv. kN
102	-	-	-	49,4	-	-	8590	-	-	-
104	-	-	-	51,4	-	-	8920	-	-	-
106	-	-	-	53,4	-	-	9250	-	-	-
108	-	-	-	55,4	-	-	9590	-	-	-
110	-	-	-	57,5	-	-	9940	-	-	-
112	-	-	-	59,6	-	-	10200	-	-	-
114	-	-	-	61,7	-	-	10600	-	-	-
116	-	-	-	63,9	-	-	11000	-	-	-
118	-	-	-	66,1	-	-	11300	-	-	-
120	-	-	-	68,4	-	-	11700	-	-	-
122	-	-	-	70,7	-	-	12100	-	-	-
124	-	-	-	73,0	-	-	12500	-	-	-
126	-	-	-	75,4	-	-	12900	-	-	-
128				77,8	-	-	13300	-	-	-
130	-	-	-	80,3	-	-	13700	-	-	-
132	-	-	-	82,8	-	-	14100	-	-	-
134	-	-	-	85,3	-	-	14500	-	-	-
136	-	-	-	87,9	-	-	14900	-	-	-
138	-	-	-	90,5	-	-	15300	-	-	-
140	-	-	-	93,1	-	-	15800	-	-	-
142	-	-	-	95,8	-	-	16200	-	-	-
144	-	-	-	98,5	-	-	16600	-	-	-
146	-	-	-	101,3	-	-	17100	-	-	-
148	-	-	-	104,0	-	-	17500	-	-	-
150	-	-	-	106,9	-	-	18000	-	-	-
152	-	-	-	109,7	-	-	18500	-	-	-
154	-	-	-	112,7	-	-	18900	-	-	-
156	-	-	-	115,6	-	-	19400	-	-	-
158	-	-	-	118,6	-	-	19900	-	-	-
160	-	-	-	121,6	-	-	20400	-	-	-
162	-	-	-	124,7	-	-	20800	-	-	-

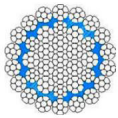
All dimensions are approximate

ROPE SPECIFICATIONS

ROTATION RESISTANT WIRE ROPE
Lay: Lang or regular



Iperpack
27x7/36x7/39x7



Iperplast
27x7/36x7/39x7
Compact Plastic impregnated

Size Nominal Diameter mm	Iperpack			Iperplast		
		Min. breaking force Kn			Min. breaking force Kn	
	Mass kg/m	2160 ung	2160 gal	Mass kg/m	2160 ung	2160 gal
8	0,27	49,9	49,9			
9	0,35	63,2	63,2			
10	0,43	78	78	0,48	90,4	90,4
11	0,52	94,4	94,4	0,59	109	109
12	0,61	112	112	0,7	130	130
13	0,72	132	132	0,82	153	153
14	0,83	153	153	0,95	177	177
15	0,96	176	176	1,09	203	203
16	1,09	200	200	1,24	231	231
17	1,23	225	225	1,4	261	261
18	1,38	253	253	1,57	293	293
19	1,54	282	282	1,75	326	326
20	1,7	312	312	1,94	362	362
21	1,88	344	344	2,14	399	399
22	2,06	378	378	2,35	438	438
23	2,25	413	413	2,57	478	478
24	2,45	449	449	2,79	521	521
25	2,75	481	481	3,03	565	551
26	2,97	520	520	3,28	611	596
27	3,21	561	561	3,54	659	643
28	3,45	603	603	3,8	709	691
29	3,7	647	647	4,08	760	741
30	3,96	692	692	4,37	814	793
31	4,23	739	721	4,66	869	847
32	4,51	787	768	4,97	926	903
33	4,79	837	817	5,28	984	960
34	5,09	889	867	5,61	1050	1020
35	5,39	942	918	6	1110	1080
36	5,7	997	972	6,53	1170	1140
38	6,35	1110	1080	6,71	1240	1210
40	7,05	1230	1200	7,84	1450	1410
42	7,76	1340	1310			
44	8,52	1470	1430			

SIX STRAND ROPES

In accordance to API 9 A Standards

Diameter		Weight	1960 kN/mm^2		2060 kN/mm^2		2160 kN/mm^2		2260 kN/mm^2	
mm	inches	kg/m								
50,8	2	11,3	1,93	197	2,216	226	2,285	233	2,384	243
54,0	2 1/8	12,8	2.160	220	2.363	241	2.471	252	2.578	263
57,2	2 1/4	14,3	2,42	247	2,697	275	2,834	289	2,957	302
63,5	2 1/2	17,8	2.950	301	3.295	336	3.462	353	3.612	369
66,7	2 5/8	19,7	3,24	330	3,629	370	3,815	389	3,98	406
69,9	2 3/4	21,4	3.530	360	4.011	409	4.207	429	4.394	448
73	2 7/8	23,5	3,84	392	4,384	447	4,599	469	4,805	490
76,2	3	25,4	4.170	425	4.815	491	5.060	516	5.276	538
79,4	3 1/8	27,6	4,49	458	5,119	522	5,374	548	5,61	572
82,6	3 1/4	29,9	4.840	494	5.462	557	5,737	585	5.992	611
85,7	3 3/8	32,2	5,18	528	5,953	607	6,247	637	6,531	666
88,9	3 1/2	34,8	5.520	563	6.463	659	6.786	692	7.090	723
95,3	3 3/4	39,9	6,28	640	7,002	714	7,355	750	7,698	785
102,0	4	45,3	7.060	720	7.806	796	8.199	836	8.554	873
108	4,1/4	51,1	7,73	788	8,287	845	8,699	887	9,076	926
114,0	4.1/2	57,4	8.590	876	9.209	939	9.670	986	10.089	1.029
121	4,3/4	63,9	9,48	967	10,16	1,036	10,67	1,088	11,132	1,136
127,0	5,0	70,8	10.430	1.064	11.160	1.138	11.719	1.195	12.226	1.248

All dimensions are approximate

SIX STRAND ROPES COMPACTED

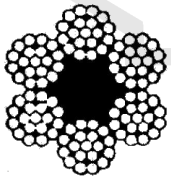
In accordance to API 9 A Standards

Diameter		Weight	1960 kN/mm^2		2060 kN/mm^2		2160 kN/mm^2		2260 kN/mm^2	
mm	inches	kg/m								
50,8	2	12,1	2,141	218	2,458	251	2,535	259	2,575	263
54,0	2 1/8	13,8	2.396	244	2.621	267	2.741	280	2.784	284
57,2	2 1/4	15,5	2,684	274	2,992	305	3,144	321	3,193	326
63,5	2 1/2	19,1	3.272	334	3.655	373	3.840	392	3.901	398
66,7	2 5/8	21,1	3,594	367	4,025	411	4,232	432	4,299	439
69,9	2 3/4	23,1	3.916	400	4.449	454	4.667	476	4.742	484
73	2 7/8	25,2	4,26	435	4,863	496	5,101	521	5,186	529
76,2	3	27,4	4.626	472	5.341	545	5.613	573	5.694	581
79,4	3 1/8	29,8	4,981	508	5,678	579	5,961	608	6,055	618
82,6	3 1/4	32,3	5.369	548	6.059	618	6.364	649	6.467	660
85,7	3 3/8	34,8	5,746	586	6,603	674	6,929	707	7,049	719
88,9	3 1/2	37,6	6.123	625	7.169	732	7.527	768	7.652	781
95,3	3 3/4	43	6,966	711	7,767	793	8,159	833	8,308	848
102,0	4	48,9	7.831	799	8.659	884	9.095	928	9.238	943

All dimensions are approximate

ROPE SPECIFICATIONS

6 X 19 AND 6 X 37 CONSTRUCTION GROUPS WITH FIBRE OR STEEL CORE



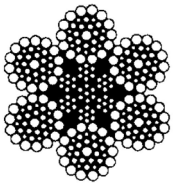
Typical Construction
6 x 19 Group 6 x 37 Group
6 x 19 (9/9/1) 6 x 36 (14/7 and 7/7/1)
6 x 19 12/6 + F/1 6 x 41 (16/8 and 8/8/1)
6 x 26 (10/5 and 5/5/1) 6 x 49 (16/8 and 8/8/8/1)
6 x 31 (12/6 and 6/6/1)
These ropes are in accordance with BS302 parts 1, 2: 1987 for corresponding sizes.

Nominal Diameter mm	Approx Equivalent Diameter ins	Sea Water kg/m		Sea Water kg/m	
		Approx Mass kg/100m	Min Breaking Load at 1770N/mm^2 (180kgf/mm^2) tonnes	Mass kg/100m	Min Breaking Load at 1770N/mm (180kgf/mm) tonnes
51	13	11	1460	2270	430
58	16	14	1890	2930	630
64	20	17	2300	3570	850
70	24	20	2760	4280	1120
77	29	24	3340	5170	1490
83	34	28	3880	6010	1870
89	39	33	4460	6920	2300
92	41	34.7	4920	6300	
96	44.6	37.7	5360	6860	
100	48.4	40.9	5810	8000	

All dimensions are approximate

ROPE SPECIFICATIONS

6 X 37 CONSTRUCTION GROUPS WITH STEEL CORE



Typical Constructions
6 x 37 Group
6 x 36 (14/7 and 7/7/1)
6 x 49 (16/8 and 8/8/1)

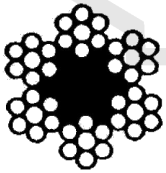
These ropes are in accordance with BS302 part 7: 1987 for corresponding sizes.

Nominal Diameter mm	Approx equivalent Diameter ins	Approx Mass kg/100m	Min Breaking Load tonnes
64	2 1/2	1700	274
67	2 5/8	1860	299
71	2 3/4	2090	333
74	2 7/8	2270	361
77	3	2460	389
80	3 1/8	2660	417
83	3 1/4	2860	447
87	3 7/16	3140	487
90	3 1/2	3360	519
96	3 3/4	3820	585
103	4	4400	665
109	4 1/4	4930	728
115	4 1/2	5490	805
122	4 3/4	6180	896
128	5	6800	979

All dimensions are approximate

ROPE SPECIFICATIONS

Round Strand with Fibre Main Core
6 x 7 classification



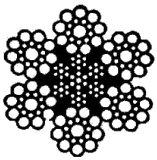
These ropes are in accordance with
API Standard 9A-Table 3.4.
(Bright (uncoated) or Drawn Galvanised Wire).

Nominal Diameter mm	Approx Mass lbs per ft	Plow Steel		Improved Plow Steel	
		tonnes	lbs	tonnes	lbs
3/8	0,21	4,63	10,2	5,32	11,72
7/16	0,29	6,26	13,8	7,2	15,86
1/2	0,38	5,13	17,92	9,35	20,6
9/16	0,48	10,3	22,6	11,8	26
5/8	0,59	12,6	27,8	14,4	31,8
3/4	0,84	18	39,6	20,6	45,4
7/8	1,15	24,2	53,4	27,9	61,4
1	1,5	31,3	69	36	79,4

All dimensions are approximate

ROPE SPECIFICATIONS

ROUND STRAND WITH STEEL MAIN CORE
6 X 19 CLASSIFICATION



This table is applicable to:
6 x 19 (9/9/1)
6 x 25 (12/6 + 6F/1)
6 x 26 (10/5 and 5/5/1)

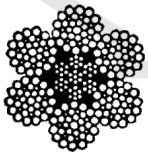
These ropes are in accordance with API Standard 9A - Table 3.6 (Bright (uncoated) or Drawn Galvanised Wire).

Nominal Diameter mm	Approx Mass lbs per ft	Improved Plow Steel		Extra Improved Plow Steel	
		tonnes	lbs	tonnes	lbs
1/2	0,46	10,4	23	12,1	26,6
9/16	0,59	13,2	29	15,2	33,6
5/8	0,72	16,2	35,8	18,7	41,2
3/4	1,04	23,2	51,2	26,7	58,8
7/8	1,42	31,4	69,2	36,1	79,6
1	1,85	40,7	89,8	46,9	103,4
1 1/8	2,34	51,3	113	59	130
1 1/4	2,89	63	138	72,5	159,8
1 3/8	3,5	75,7	167	87,1	192
1 1/2	4,16	89,7	197,8	103	228
1 5/8	4,88	104	230	120	264
1 3/4	5,67	121	266	139	306
1 7/8	6,5	138	304	158	348
2	7,39	156	334	180	396

All dimensions are approximate

ROPE SPECIFICATIONS

ROUND STRAND WITH STEEL MAIN CORE
6 X 19 CLASSIFICATION



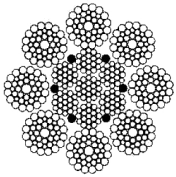
This table is applicable to:
6 x 19 (9/9/1), 6 x 25 (12/6 + 6F/1), 6 x 26 (10/5 and 5/5/1)
These ropes are in accordance with API Standard 9A - Table 3.6 (Bright (uncoated) or Drawn Galvanised Wire).

Nominal Diameter mm	Approx Mass lbs per ft	Improved Plow Steel		Extra Improved Plow Steel	
		tonnes	lbs	tonnes	lbs
13	0,46	23	10,4	26,6	12,1
14,5	0,59	29	13,2	33,6	15,2
16	0,72	35,8	16,2	41,2	18,7
19	1,04	51,2	23,2	58,8	26,7
22	1,42	69,2	31,4	79,6	36,1
26	1,85	89,8	40,7	103,4	46,9
29	2,34	113	51,3	130	59
32	2,89	138	63	159,8	72,5
35	3,5	167	75,7	192	87,1
38	4,16	197,8	89,7	228	103
42	4,88	230	104	264	120
45	5,67	266	121	306	139
48	6,5	304	138	348	158
52	7,39	344	156	396	180
54	8,35	384	174	442	200
58	9,36	430	195	494	224
60	10,44	478	217	548	249
64	11,65	524	238	604	274
67	12,85	576	261	658	299
71	14,06	628	285	736	333
74	15,36	682	309	796	361
77	16,67	740	336	856	389
80	18,07	798	362	920	417
83	19,58	858	389	984	447
87	21,09	918	416	1,074,00	1020
90	22,79	981,2	445	1,144,000	519
96	26	1,114,000	505	1,129,000	585
103	29,6	1,254,000	569	1,466,600	665

All dimensions are approximate

ROPE SPECIFICATIONS

HIGH PERFORMANCE WIRE ROPES FOR MOORING 8x41WS-IWRC (6x19W-1x19W) + zinc anodes



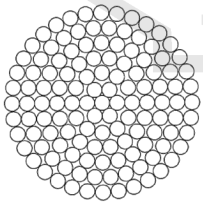
- Surface finish: hot dip galvanised
- Designed to improve service life in comparison with 6-strands ropes
- Improved flexibility
- Reduced external wear
- Rope size, mass and MBF may be customised according to project design requirements
- Supply includes: Quality plan - Fatigue design calculations
  Wear design calculation - Corrosion design calculation

Wire rope Diameter mm	Mass		Metallic Area² mm	MBF kN	Stiffness MN	Torque 25% MBF Nm	Turns 25% MBF deg/m
	Air kg/m	Sea water kg/m					
77	27	22	3040	4000	335	6650	17
83	31	26	3540	4640	390	8350	16
89	35	30	4070	5340	450	10300	14
96	41	35	4730	6220	525	12900	13
102	47	39	5340	7020	595	15500	13
108	52	44	5990	7870	665	18400	12
115	59	50	6790	8920	755	22200	11
121	66	55	7520	9880	835	25850	11
127	72	61	8290	10880	920	29900	10

All dimensions are approximate

ROPE SPECIFICATIONS

SPIRAL STRAND



- Designed to improve service life
- Surface finish: hot dip galvanised
- Sheathing: HDPE yellow colour with longitudal dark stripe
- Tensile grades of wire optimised to improve wire ductility
- Rope, size, mass and MBF may be customised according to project design requirements
- Supply includes: Quality plan - Fatigue design calculations Wear design calculation - Corrosion design calculation

Wire rope dia		Mass (un-sheathed)		Mass (sheathed)		Metallic Area mm2	MBF kN	Stiff-ness MN	Torque 25% MBF Nm	Turns 25% MBF Nm
Un-coated mm	Sheathed mm	Air kg/m	Sea water kg/m	Air kg/m	Sea water kg/m					
77	91	29	25	32	25	3440	5480	525	750	0,5
83	99	34	29	37	29	4000	6370	610	950	0,5
89	105	39	33	42	33	4600	7330	700	1200	0,4
96	114	46	38	49	38	5350	8530	820	1500	0,4
102	122	51	43	55	43	6040	9360	925	1750	0,4
108	128	58	49	61	48	6770	10490	1035	2100	0,4
115	137	65	55	69	54	7680	11760	1175	2500	0,3
121	145	72	61	76	60	8500	12720	1300	2850	0,3
127	151	80	67	84	66	9370	13930	1435	3300	0,3
134	160	89	75	93	73	10430	15510	1595	3850	0,3
140	168	97	82	101	79	11390	16930	1740	4400	0,3
147	175	107	90	112	88	12550	18660	1920	5100	0,3

All dimensions are approximate

MARINE WIRE ROPES FOR SHIPPING AND FISHING PURPOSES

High resistance to the corrosive effect of salt water is accomplished by the use of specially galvanised steel wires and by impregnating the fibre core with special lubricant.

RUNNING RIGGING
Ropes used as running rigging require to be flexible, and 6 x 12 fibre cores or 6 x 19 in the small sizes is usually preferred.

WIRE HAWSERS
6 x 12 and 6 x 24 constructions, both having 7 fibre cores, are used, 6 x 12 for sizes up to about 16mm dia (2 in circ) and 6 x 24 for sizes up to about 28mm dia (31/2 in circ). For larger diameters, the more flexible 6 x 37 rope is recommended.

MOORING LINES AND TOWING LINES
6 x 36, 6 x 41 and 6 x 47 are all used and suitable for this application.

ROTARY DRILLING LINES
Rotary drilling lines are used for controlling the position of the drill string. The construction is normally a 6 x 19 (9.9.1) IWRC rope right hand ordinary lay in extra improved plow steel bright finish, however a flattened strand rope may be more preferable for drilling rig with a construction 6 x 28 offering a higher breaking load.

RISER TENSIONER LINES
The high concentration of bending stresses combined with heavy abrasive wear on the outer surface of the rope can cause premature failure of the rope unless the correct rope is chosen.

Either a 6 x 41 IWRC or 6 x 49 IWRC right hand Langs Lay, bright finish could be used.

ANCHOR LINES
Anchor lines are supplied in Right Hand (Ordinary) Lay in drawn galvanised finish with independent wire rope
core in either 6 x 36, 6 x 41 or 6 x 49
construction dependent upon the diameter.

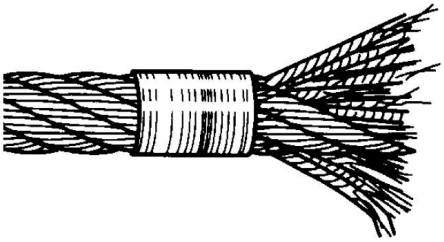
STRANDED ROPE SERVINGS

When cutting non-preformed rope, adequate servings should first be applied to both sides of the point where the cut is to be made, to prevent the rope from untwisting. Even with Preformed rope, it is recommended that one serving be applied at each side of the cutting point to prevent distortion of the rope ends by the pressure applied during cutting.

Soft annealed single wire or marlin should be used. Where wire is used the table below is given as a guide to size of wire, length and number of servings recommended, for Stranded Ropes.

Rope diameter	**Serving wire diameter**
Less than 22mm	1.32mm
22mm to 38mm	1.57mm
Larger than 38mm	1.83mm

At least two servings each of a length six times the diameter of the rope should be employed.



METHOD OF APPLYING BULLDOG GRIPS

The bulldog grip should be fitted to wire rope as shown in Fig 1, and not as shown in Fig 2. The bridge of the grip should invariably be fitted on the working part of the rope, and the U-bolt on the rope tail or dead end of the rope. Grips should not alternate in position on the rope.

As a safety measure and to secure best results it is important to re-tighten all grips after a short period in operation, for, due to the compression of the rope under load, there will be a tendency for the grips to loosen. Refer to the manufacturers instructions for quantity of grips recommended.

Fig 1 Correct method of fitting bulldog grips

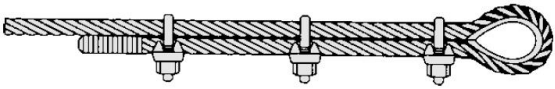
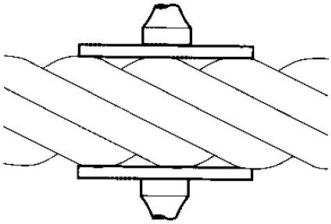


Fig 2 Incorrect method of fitting bulldog grips

HOW TO MEASURE

The actual diameter is measured with a suitable caliper fitted with jaws broad enough to cover not less than two adjacent strands.



The measurements are taken at two points at least 1 metre apart and at each point the two diameters at right angles are measured. The average of these four measurements is the actual diameter of the rope.

BULLDOG CLIP WIRE ROPE REQUIREMENTS

Rope Size (mm)	Minimum No. of Clips	Amount of Rope to Turn Back in (mm)	*Torque in Nm
3-4	2	85	6.1
5	2	95	10.2
6-7	2	120	20.3
8	2	133	40.7
9-10	2	165	61.0
11-12	2	178	88
13	3	292	88
14-15	3	305	129
16	3	305	129
18-20	4	460	176
22	4	480	305
24-25	5	660	305
28-30	6	860	305
32-34	7	1120	488
36	7	1120	488
38-40	8	1370	488
41-42	8	1470	583
44-46	8	1550	800
48-52	8	1800	1017
56-58	8	1850	1017
62-65	9	2130	1017
68-72	10	2540	1017
75-78	10	2690	1627
85-90	12	3780	1627

All dimensions are approximate

NOTES

If a greater number of clips are used than shown in the table, the amount of turnback should be increased proportionately.

*The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.

DRUMS AND PULLEYS

GENERAL PURPOSE WIRE ROPE

The diameter of a drum or pulley should not be less than 500 times the diameter of the outside wire of the rope. The groove radius of a pulley should be within the range 5% to 15% larger than D/2 with the optimum radius 10% greater than D/2. The recommended radius of a drum groove is 6% greater than D/2 - where D is the nominal rope diameter. The bottom of the grooves should be arcs of circles equal in length to one-third of the circumference of the rope. The depth of a groove in a pully should be at least equal to one and a half times the rope diameter and the groove in a drum should not be less than one-third of the rope diameter.

The angle of flare between the sides of the sheaves should be approximately 52° but should be greater if the fleet angle exceeds 1.5°.

The clearance between neighbouring turns of rope on a drum should not be less than:

- 1.6mm for ropes up to 13mm diameter
- 2.4mm for ropes over 13mm and up to 28mm diameter
- 3.2mm for ropes over 28mm and up to 38mm diameter

In terms of rope diameters the sizes of drums and pulleys would be:

Rope construction round strand	**Minimum pulley diameter**
6 x 19 (9/9/1)	40 x D
6 x 19 (12/6+6F/1)	33 x D
6 x 36 (14/7&7/7/1)	29 x D
Multi-Strand	
17 x 7	18D
34 x 7	18D

Always refer to the wire rope manufacturers own recommendations.

TREAD PRESSURE

Too great a radial pressure between sheave and rope will cause excess wear of the sheave grooves and will result in reduced rope life.

The radial pressure may be determined from $P = \frac{T1 + T2}{Dd}$

Where: P = the tread pressure kgf/cm2 (lbsf/in2)
T = tension on each side of the sheave kgf (lbsf)
D = diameter of the sheave cm (in)
d = diameter of the rope cm (in)

Recommended maximum tread pressures to minimise sheave wear:

Rope construction	Cast iron (kgf/cm^2) lbsf/in^2		Cast steel (kgf/cm^2) lbsf/in^2		11% to 13% Manganese steel (kgf/cm^2) lbsf/in^2	
6 x 7	21	300	39	550	105	1500
6 x 19	21	500	63	900	175	2500
6 x 37	21	600	76	1075	210	3000
8 x 19	21	600	76	1075	210	3000

All dimensions are approximate

The above values are for Ordinary Lay ropes; for Lang's Lay ropes these values may be increased by 15%.

ROPE STRETCH

The stretch of a wire rope under load consists of permanent constructional stretch and elastic stretch.

Permanent constructional stretch is due to the settling of the wires in the strand and the compression of the central core. This stretch is irrecoverable and most of it occurs during the early part of the rope's life. The following figures of percentage constructional stretch will give results within acceptable practical limits.

	Light loads		Heavy loads
Six-Strand ropes			
With Fibre Core	0.50	to	1.00% of length
With Steel Wire Core	0.25	to	0.50% of length
Eight-Strand ropes			
With Fibre Core	0.75	to	1.00% of length

Elastic stretch is the capacity of the individual wires to elongate, under load, due to their elastic properties. Providing the rope is not loaded beyond its elastic limit, it will return to its original length after removal of the load.

The elastic stretch may be calculated from the expression:-

$$\frac{WL}{AE} \text{ mm}$$

Where:	W is the load on the rope	kgf
	L is the length of the rope	mm
	A is the area of rope	mm^2
and	E is the modulus of elasticity of the rope	kgf/mm^2

MODULUS OF ELASTICITY

35x7 Group 136 kN/mm^2
6 x 7 Group 12,000 kgf/mm^2
6 x 19 Group 10,500 kgf/mm^2
6 x 37 Group 9,800 kgf/mm^2
For six stranded ropes with an IWRC these figures should be increased by 10%.

17/7 and 34/7 9,800 kgf/mm^2

According to the number of wires in the strand.

METALLIC AREA

Metallic area = Xd^2
Where: d is the rope diameter and X is the factor.

Rope construction	Factor (X)	Rope construction	Factor (X)
6 x 7	21 300	8 x 19 (9/9/1)	0.342
6 x 19	21 500	8 x 19 (12/6 + 6f/1) 8 x 19 (6 and 6/6/1)	0.350
6 x 37	21 600	6 x 12 (12/FC)	0.232
8 x 19	21 600	6 x 24 (15/9/ FC) 17 x 7 (6/1)	0.322
6 x 26 (10/5 and 5/5/1) 6 x 31 (12/6 and 6/6/1) 6 x 36 (14/7 and 7/7/1) 6 x 41 (16/8 and 8/8/1)	0.393	34 x 7 (6/1)	0.408

All dimensions are approximate

OUTSIDE WIRE DIAMETER

The approximate diameter of the outer wires of a six stranded round strand rope may be found from the formulae:

$$d = \frac{D}{N + 3.5}$$

For an eight strand round strand rope from

$$d = \frac{D}{N + 6.5}$$

Where D is the rope diameter and N is the number of outer wires in a strand.

FACTORS OF SAFETY

General purpose wire ropes
A uniform factor of safety cannot be given for all engineering applications. Where a rope is used on equipment, the factor of safety of which is not specified, the minimum factor of safety shall not be less than 5 to 1. After termination losses of 10% are considered.

WIRE ROPE WORKING LOADS

The load to which a rope is subjected in service includes forces due to acceleration, bending and shock in addition to static force.

The load due to acceleration maybe determined from:

$$F = 0.102 \times W \times a$$

Where F = Load due to acceleration (kgf)
W = The static load (kg)
a = The acceleration (m/S2)

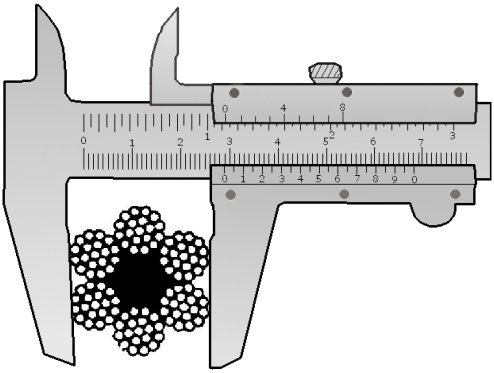
The load due to bending may be determined from:

$$F = \frac{Ed}{D} A$$

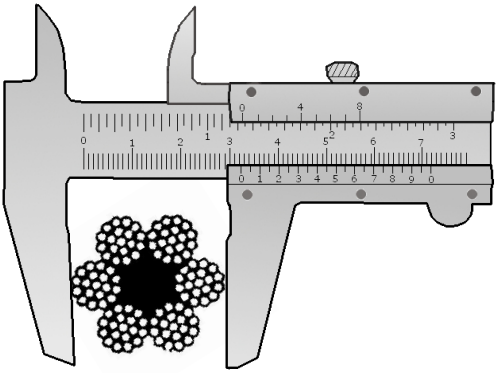
Where F = Load due to bending (kg)
E = Modulus of elasticity on the rope (kgf/mm^2)
d = Outside wire diameter (mm)
D = Drum or sheave diameter (mm)
A = Metallic area of the rope (mm^2)

MEASURING THE WIRE DIAMETER

Incorrect method

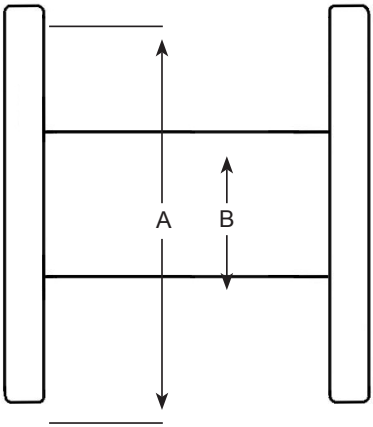


Correct method



Under conditions of repeated bending the fatigue strength of rope wire is approximately 25% of its strength in simple tension.
The load due to shock is dependant upon the magnitude of the static load and the speed of load application. Every effort should be made to avoid ‘slack rope’ when load is applied.

CAPACITY OF DRUM OR REEL



The undernoted formula may be used in computing the rope capacity of any size of drum or reel. While it will give results that are very nearly correct for wire rope evenly spooled, when the rope is not spooled evenly the drum capacity is slightly reduced. Remember to take account of large end terminations which could hamper spooling.

Formula: $\frac{A}{d} \times \frac{C}{d} \times \pi (A+B) = \text{capacity}$

Where d = Rope diameter

* Do not use fractions

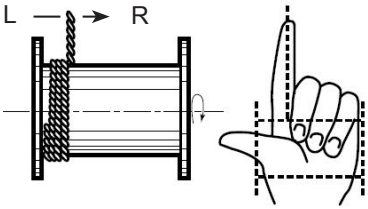
NB - The flange (A) will extend beyond the outer layer of rope. The dimension (A) should be taken to the outside of the rope only, and not to the outside of the flange.

CORRECT SPOOLING OF ROPE ON DRUM

The sketch shown below may be used to determine the proper direction of rope lay for spooling or winding on flat or smooth face drums.

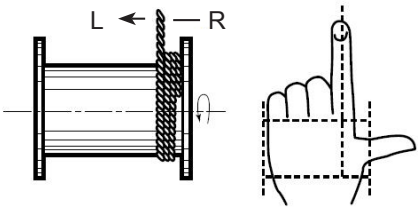
When a rope is wound on to a drum any tendency of the rope to twist when tension is released will be in a direction which would untwist the rope at the free end.

The advantage of spooling in the correct directions is that when any load is slackened off the laps on the drum will hug together and maintain an even layer. With incorrect spooling the laps will move apart on removal of load and when the load is reapplied the rope may criss-cross and overlap, and flattening and crushing of the rope will result. The correct spooling direction for right and left hand lay ropes is shown in the sketch below. This applies to both ordinary and Lang's lay ropes.



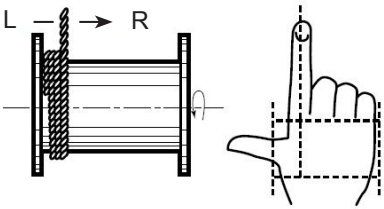
Underwind left to right.
Use left lay rope

Left lay
Underwind



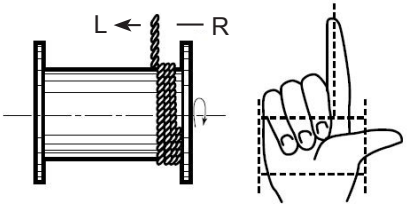
Overwind left to right
Use left lay rope

Left lay
Overwind



Overwind left to right.
Use right lay rope

Right lay
Overwind



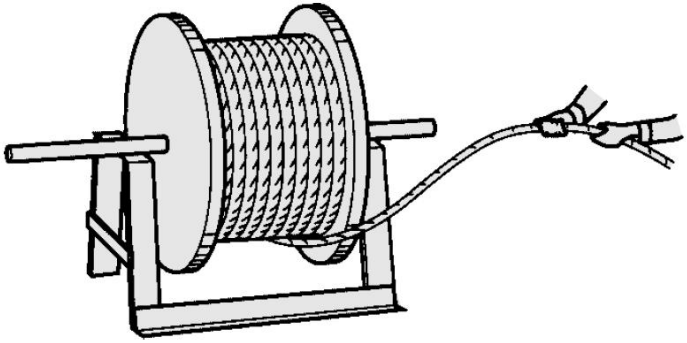
Underwind left to right
Use right lay rope

Right lay
Underwind

VIKING MOORINGS™
www.viking-moorings.com

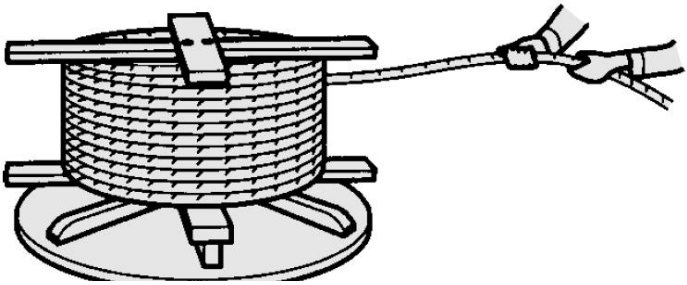
UNREELING AND UNCOILING

UNREELING



Pass a shaft through the centre of the reel and jack it up to allow the reel to revolve freely. Pull the rope straight ahead keeping it taut to prevent it from loosening up on the reel.

UNCOILING

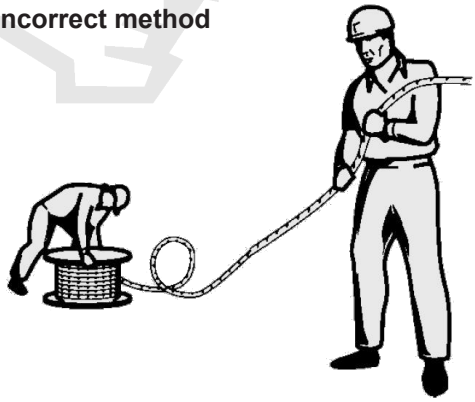


Heavy coils should be placed on a turntable and two crosspieces placed on top of the coil to prevent laps springing out of place and kinking. Light Flexible Ropes may be rolled along the ground so that the rope lies straight.

WIRE ROPE

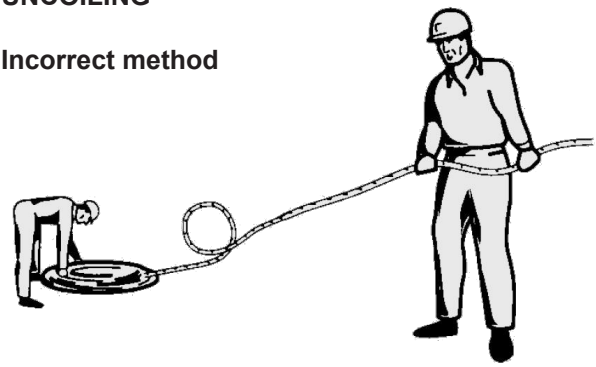
UNREELING

Incorrect method



UNCOILING

Incorrect method



Correct method

A GUIDE TO WIRE ROPE DAMAGE

The life of a rope depends on many factors and includes:

a The integrity of rope records and certification
b Wear and tear of rope contact points
c Operator skills

The technical characteristics of a wire rope can be easily determined of the beginning of its life cycle whilst monitoring high contact areas can also be effectively managed. Operator skills, however, are more difficult to monitor.

Typical reasons for a wire rope to be withdrawn from service are listed below:

a Unsuitable rope composition, diameter and quality for purpose
b Ropes wound over or across each other
c Lack of regular and correct lubrication
d Use of incorrect reels and drums
e Use of misaligned reels and drums
f Use of reels and drums with unsuitable grooves and/or flanges
g Damage caused by ropes protruding from reels and/or drums
h Ropes being affected by humidity, chemicals or heat
i Use of unsuitable rope joints
j Looped ropes
k Excessive loads
l Damaged rope particles penetrating the internal structure

The following conditions should be noted when examining a rope:

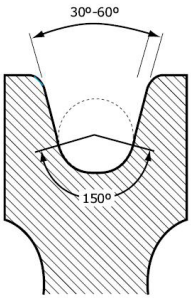
a Decrease in diameter
b General wear and tear
c Lay length changes
d Traces of shock and stretch
e Corrosion
f Broken wires and their position in the rope structure

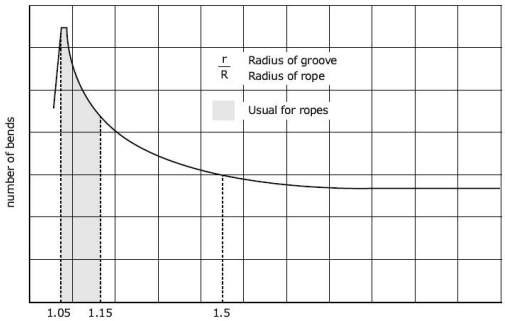
In examination, if possible, all the records should be analysed and inappropriate points should be eliminated. Some of the hints to help in finding possible cause for these failings are given below.

Possible causes of rope damage

Fatigue	Traversal wire breaks on strands	a bends on small dimensioned reels b Vibration and shock loads c Unsuitable rope compositions d Corrosion e Unsuitable joints at terminals
Breaking under excessive load	Conical and plastic type of breaks at rope wires	a Excessive load b Wrong rope diameter and construction c Unsuitable joints at terminals
Wear	Wear on external wires	a Changes in rope or reel diameters b Changes on load c Big fleet angle d Unsuitable reels e Abrasives in the rope f Unsuitable groove dimensions
Corrosion	Pittings on wire surfaces and breaks on wires caused by corrosion	a Insufficient lubrication b Unsuitable storing conditions c Corrosive atmospheric effects

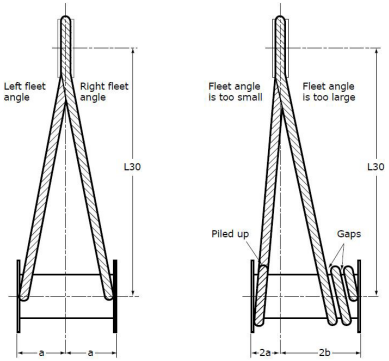
Apart from the sheave diameter, the lifetime of a rope also depends on the design and dimensions of the groove. If the groove is too narrow, the rope gets wedged in it, the strands and wires cannot move as is required for bending, and this condition is detrimental to the life cycle of the rope. On the other hand, too wide a groove also has an adverse effect on rope life due to the high surface pressure between rope and sheave.
The graph below clearly shows that a radius 5% larger than half the rope diameter will give the longest service life of the rope. For traction sheaves the radius of the groove is usually adapted as closely as possible to the radius of the rope to obtain maximum traction.
The rope is supported in the best possible manner if the arc of contact with the groove contour can be 150 deg. This corresponds to a throat angle of 30 degrees. However, with a large fleet angle or with oscillating loads, the throat angle should be larger (up to 60 degrees) to avoid undue wear of the rope and sheave flanges.
The height of the flanges should be at least 1.5 times the rope diameter to prevent the rope running off the sheave. The rope and groove are inevitably subject to wear during operation. Since the diameter of a rope becomes smaller due to abrasion and stretch, it will wear out the groove to the smaller diameter of the worn rope. If a new rope is laid in such a worn groove, it will get wedged in the narrow groove and this will have a very adverse effect on its life. It is also possible that the rope cuts its profile into the groove. Therefore the grooves should be inspected before installing a new rope and if necessary they must be remachined, preferably with a profile cutting tool. If a groove shows excessive wear, this may be an indication that the sheave material is too soft. In this case a sheave of a harder grade steel must be used which better resists the abrasive effect of the rope, or a larger diameter sheave should be taken.





FLEET ANGLE

When ropes are wound on drums, attention must be paid to the fleet angle, that is the included angle between the rope running to or from the extreme left or right of the drum and an imaginary line drawn from the centre of the sheave normal to the axis of the drum. When this angle is too large, the rope in this extreme position will be pressed with great force against the flange of the sheave which causes undue friction and wear of both the rope and the sheave. With a plain faced drum a large fleet angle will, in addition, cause the rope to travel too fast from the side to the centre of the drum thereby leaving gaps between the wraps. When winding a second layer, the rope is forced into these gaps which results in serious deterioration. When, on the other hand, the rope is wound past the centre of the drum, a too large fleet angle will cause the next wrap to scrub against the preceding wrap as the rope runs more towards the side of the drum. If the fleet angle is too small, the rope does not travel fast enough towards the centre of the drum and, apart from scrubbing, at a certain moment the wraps will pile up ie the next wrap is laid on top of the preceding one and is then pressed to the side of the preceding wrap with great force. This has a detrimental effect on the rope and the equipment on which it is used (shock loads). For plain faced drums a minimum fleet angle of 1/2 deg. and a maximum fleet angle of 1 1/2 deg. is recommended. For groove drums these figures
are 1/2 deg. minimum and 2 deg. maximum. In terms of length these figures correspond to a minimum distance between sheave and drum of 40 x ‘a’ (a=half the drum width) and a maximum distance of 115 x ‘a’ for plain faced drums, and minimum 30 x ‘a’ and maximum 115 x ‘a’ for grooved drums (approximate values).



Hence for a grooved drum 1 metre in width the distance between sheave and drum should be 30 x ‘a’ = 15 metres minimum, or conversely, if the distance between drum and sheave is 7 metres, the maximum drum width should be (7:30)x2 = approx. 47 cm.

SHEAVES AND DRUMS(D)

Recommended diameter for Sheaves and Drums on cranes according to FEM 1001-4

Machine group	Drums	Pulleys	Compensating pulleys
M1	11.2 x d	12.5 x d	11.2 x d
M2	12.5 x d	14 x d	12.5 x d
M3	14 x d	16 x d	12.5 x d
M4	16 x d	28 x d	14 x d
M5	18 x d	20 x d	14 x d
M6	20 x d	22.4 x d	16 x d
M7	22.4 x d	25 x d	16 x d
M8	25 x d	28 x d	18 x d

All dimensions are approximate

SAFETY FACTORS

Recommended safety factors for wire rope on cranes according to FEM 1001-4

Machine group	Running ropes	Static ropes
M1	11.2 x d	12.5 x d
M2	12.5 x d	14 x d
M3	14 x d	16 x d
M4	16 x d	28 x d
M5	18 x d	20 x d
M6	20 x d	22.4 x d
M7	22.4 x d	25 x d
M8	25 x d	28 x d

All dimensions are approximate

DRUMS

Installation of a wire rope on a plain (smooth) face drum requires a great deal of care. The starting position should be at the correct drum flange so that each wrap of the rope will wind tightly against the preceding wrap. See illustration on p 4.44. Here too, close supervision should be maintained throughout installation. This will help ensure:

1 the rope is properly attached to the drum
2 appropriate tension on the rope is maintained as it is wound on the drum
3 each wrap is guided as close to the preceding wrap as possible, so that there are no gaps between turns
4 there are at least two dead wraps on the drum when the rope is fully unwound during normal operating cycles

Loose and uneven winding on a plain (smooth) faced drum, can and usually does create excessive wear, crushing and distortion of the rope. The results of such abuse are lower operating performance and a reduction in the rope's effective strength. Also, for an operation that is sensitive in terms of moving and spotting a load, the operator will encounter control difficulties as the rope will pile up, pull into the pile and fall from the pile to the drum surface. The ensuing shock can break or otherwise damage the rope. The proper direction of winding the first layer on a smooth drum can be determined by standing behind the drum and looking along the path the rope travels, and then following one of the procedures illustrated on page 4.33. The diagrams show: the correct relationship that should be maintained between the direction of lay of the rope (right or left), the direction of rotation of the drum (overwind or underwind), winding from left to right or right to left.

CORRECT/INCORRECT LAYERING

When working with long lengths of wire it is essential that the wires are spooled onto the winches correctly. Wires should be installed using spooling machines that can apply back tension to the winch. It is also important to check whether the winch is over or under wound, for left or for right stranded wire rope. See page 4.24.

The application of tension and the employment of correct spooling techniques will ensure that the wraps of wire will nestle neatly and tightly when spooled onto a winch. If wire is spooled slackly, or incorrectly placed on the winch, it will result in damaged wire. If an outer layer is pulled through the inner wraps towards the core of the drum it can result in the wire being cut.