MEGA
CHAINS & ROPES

MEGA LINK CHAINS (INDIA) LTD.

Linking Safety, Strength & Reliability

WIRE ROPES

OUR STORY

Established in 1996 as the leading manufacturers & exporters of Lifting chains of Grade 80, Grade 100, S.S. Chains, Steel wire ropes, Deep ocean trawler fishing ropes & Lifting tackles. MEGA proudly states that we are the only one in India to manufacture all these products under one roof.

MEGA is an Indian multinational having 3 state-of- the- art manufacturing facilities, two in India each for Link Chain & Steel Wire Ropes, we also have a most modern manufacturing facility in Jinhua, China. Setting new global standards in high-quality link chains and wire ropes. Rooted in innovation, reliability & safety, we empower industries with precision-engineered solutions that enhance efficiency & drive progress. Through cutting-edge technology & strong client partnerships, we are forging a future where strength, performance & trust create lasting impact worldwide.

Backed by over 30 years of industry trust, Leading the way in innovation, we engineer world-class chains, wire ropes & accessories with cutting-edge technology and continuous improvement. Committed to international quality standards, we enhance efficiency, safety & performance across industries. Proudly driving the **Make in India** initiative, we are transforming India into a global powerhouse for high-quality lifting and rigging solutions, delivering reliability & excellence to the world.

"From a bold vision in 1996 to a global force today—our true strength lies in unmatched quality, unwavering reliability & the enduring bonds we forge with our clients. Together, we don't just build; we elevate industries, empower progress & shape a future of excellence!"


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CONTENT

CERTIFICATION

ISO 9001 : 2015

Certificate of Registration

This certificate has been awarded to

MEGA LINK CHAINS (INDIA) LIMITED

Plot No B-36/1 & B-38, Additional Ambarnath, Anandnagar, MIDC, Dist. Thane, Maharashtra, 421506, India

in recognition of the organization's Quality Management System which complies with

ISO 9001:2015

The scope of activities covered by this certificate is defined below

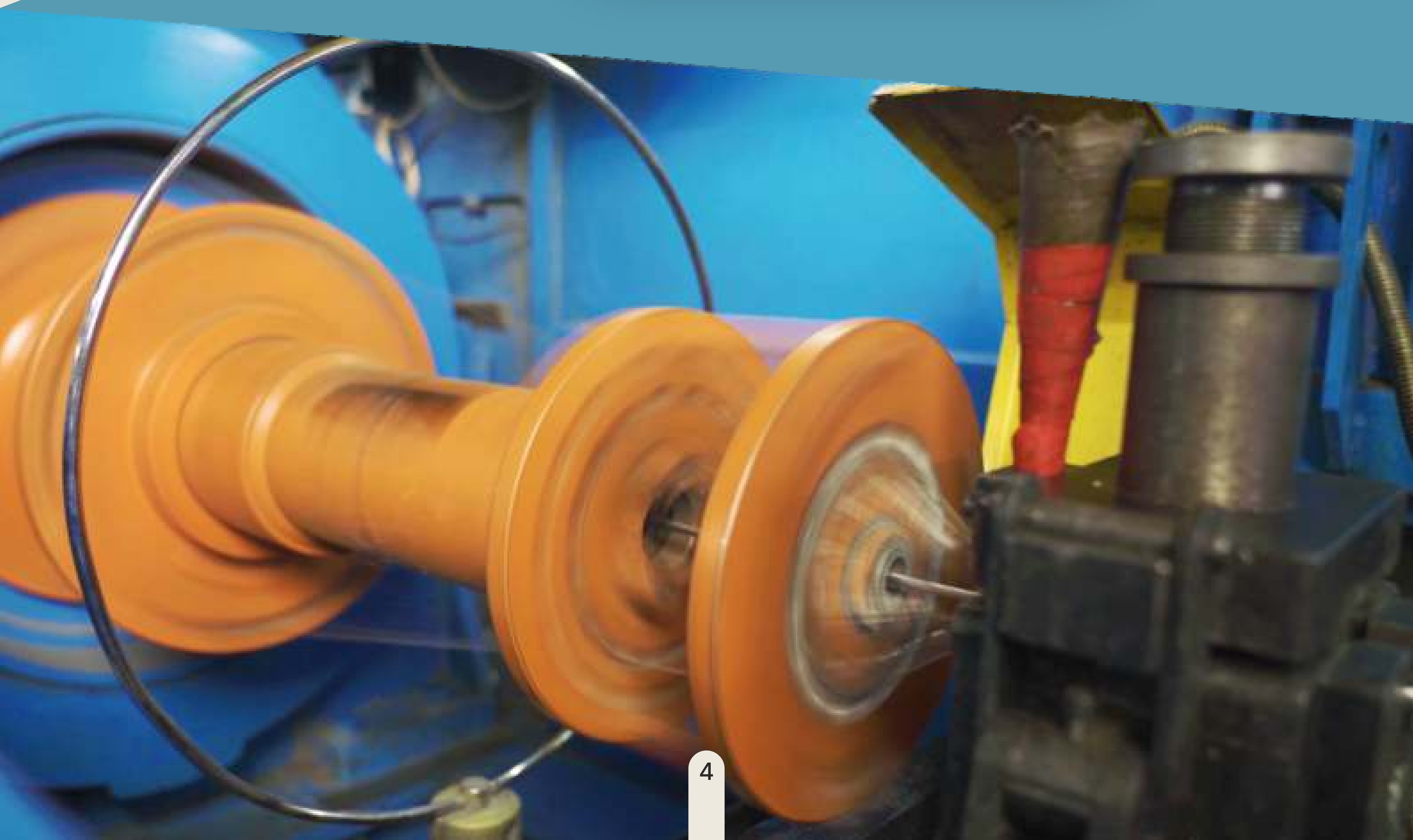
Manufacture and Supply of Steel Link Chains, Steel Wire Ropes and Slings

Certificate Number: [illegible]

Date of Issue of Certification Cycle	Issue Number	Certificate Expiry Date	Certification Cycle
[illegible]	[illegible]	[illegible]	[illegible]
Revision Date	**Revision Number**	**Original Certificate Issue Date**	**Scheme Number**
[illegible]	[illegible]	[illegible]	n/a

For detailed explanation for the data fields above, refer to [illegible]

Issued by: [illegible] – On behalf of the Schemes Manager



COMPANY's CULTURE

Mega Link Chains (India) Ltd. fosters a strong culture built on safety, quality, and sustainability. The company prioritizes safe working practices, enforces rigorous quality standards, and integrates responsible resource management across every stage of manufacturing.

With disciplined processes and continuous improvement, it ensures reliable performance, safeguards people and the environment, and creates lasting value for customers, employees, and industry partners alike.

INTRODUCTION TO WIRE ROPES

A wire rope is constructed of a number of small wires, which extend continuously throughout the entire length; these wires are laid up into strands, and the strands themselves are laid up to form the rope. With the exception of certain special types described later, all wire rope is preformed, are galvanized or ungalvanised finish.

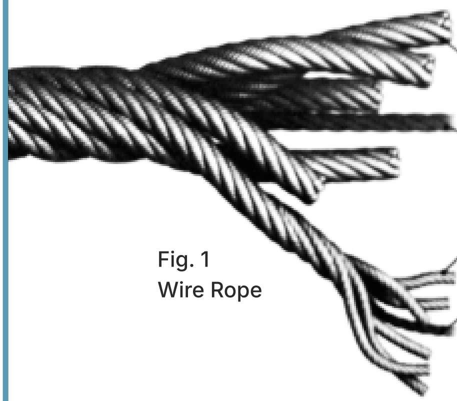


Fig. 1
Wire Rope

During manufacture the individual strands are preformed to give the exact spiral they take up in the completed rope. Therefore, the wires and strands lie in their true positions free from internal stress and will not spring out of place the rope break or be cut.

A wire rope can be made flexible in one of two ways:

(a) By replacing the center wires of each strand with a large fiber core, in which case strength is sacrificed for flexibility,

(b) By making up each strand with a large number of small-gauge wires round a wire core, in which case the full strength is retained.

Raw Material

Wires are usually made from specified carbon steel. The carbon content is between 0,4% and 1%, the manganese content between 0,3% and 1%, the silicon content between 0,1% and 0,3% and the contents of phosphorus and sulphur each under 0,45%.

Manufacturing Process

Wire rod of 5.5 to 9mm diameter, the raw material, will be transformed to the desired strength, diameter or shape by drawing in a cold forming process.

Wire Surfaces

Galvanized wires are zinc coated by going through a bath of liquid zinc. The wire is called "finally galvanized "if it does not get drawn further after this process. If the wire cross section is further reduced after this process, the wire is called "drawn galvanized ". Bright wires, uncoated, are indicated with the capital letter "U", whereas zinc coated wires are divided into class "A" and class "B", depending on the a zinc weight coating

Wire Forms

A distinction is made between the wire shapes. A round wire is a wire with a round cross section. Every wire that has a non-round cross section is called a profiled wire. There are oval wires, flat wires, Z- and S-profiled wires, H-shaped wires, trapezoidal or wedge-shaped wires and triangular wires. Profiled wires are produced by drawing or rolling processes.

Wire Tensile Strength

The tensile strength of a wire is defined as the maximum tensile force a wire can stand in longitudinal direction without breaking, divided by the cross section of the wire. The nominal tensile strength of a wire is a theoretical value, the actual tensile strength of the wire should not fall below the nominal tensile strength and should only exceed it in defined limits. Rope wires with the nominal tensile strengths of 1370 N/mm2, 1420 N/mm2, 1570 N/mm2, 1770 N/mm2, 1960 N/mm2 and 2160 N/mm2 are commonly used in modern wire ropes.

Lay Length of a Strand

The lay length of a strand is generally understood as the pitch of the helical lay of the wires, which means the lengths of a strand at which the wire circulates completely one time. By varying the lay length, the contact conditions of adjacent wires, the elastic properties and the breaking strength of a strand can be changed.

Lay Direction of a Strand

A distinction is made between right hand and left hand lay strands. The lay direction is left hand, when (moving away from the beholder) the wires are rotated counterclockwise (fig.2). The lay direction of a strand is right hand, when its wires (moving away from the beholder) are rotated clockwise (fig.3). The lay direction of a strand is often given by small s for the left hand lay strand and by a small z for the right hand lay strand.

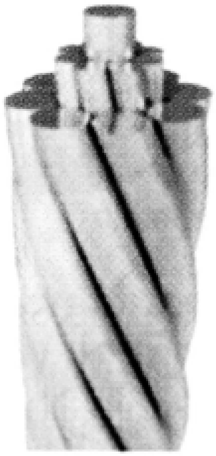


Fig. 2 Left Hand Lay

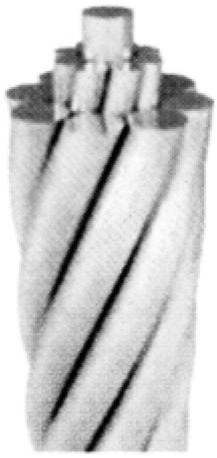


Fig. 3 Right Hand Lay

Diameter of a strand The diameter of a strand is the diameter of the smallest, all wires enclosing enveloped circle. The strand diameter is usually measured with a micrometer caliper and is given accurate to 1/100mm.

Strand Design

One understands the formation law by the design of a strand according to which the wires are relatively to each other arranged. So all strands of the design Seale have for example the construction 1 - n - n with n=3, 4, 5, 6, 7, 8, 9..... wire layers, which get stranded parallel to each other in a single operation. According to EN 12385-3 these are connected by a minus „-„ sign in the designation.

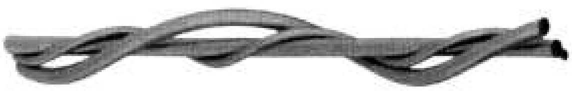


Fig. 4 Cross Lay Strand

Fig. 5 Parallel Lay Strand

The most important strand designs are one-, two and three-layer standard strands (fig.4), as well as parallel lay strands of the strand designs Seale, Filler, Warrington and Warrington-Seale (fig.5 & 6). The two and three-layer standard strands show crossovers between the wires of the different wire layers (fig.4). Here the wire layers get stranded in separate operations in the same direction (designation N) with a same stranding angle but with different lay lengths. The so called parallel lay strands (Seale, Filler, Warrington, Warrington-Seale) avoid crossovers and create line contact of the wires instead. This happens due to a stranding of all wire layers at once with different stranding angles but the same lay length (fig.5 & 6).

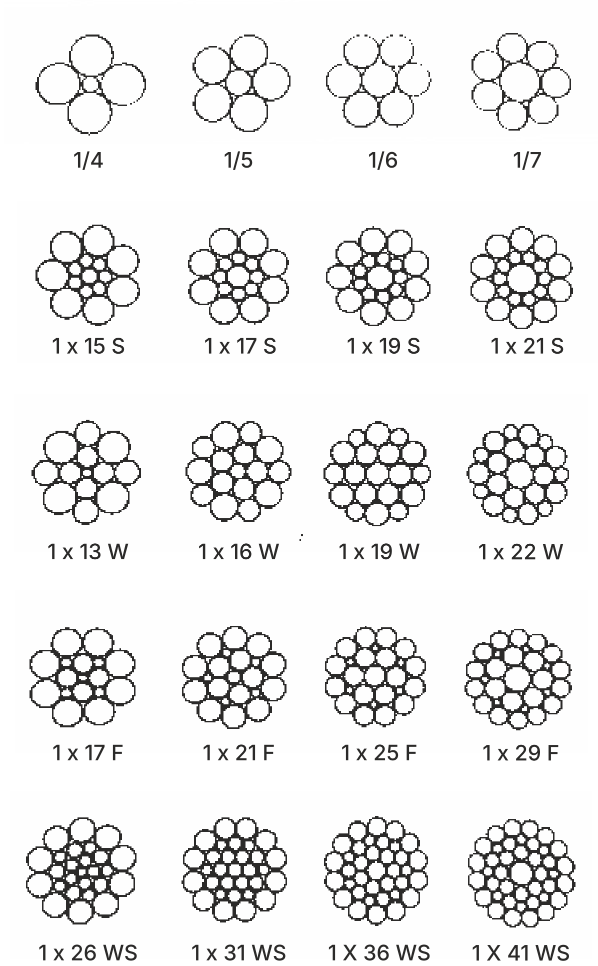


Fig. 6 Strand Design

Lay Direction of a Wire Rope

Lay direction of a wire rope A distinction is made between right hand and left hand lay ropes. The lay direction is left hand, when the strands (moving away from the beholder) are rotated ounterclockwise (fig.7). The lay direction of a rope is right hand, when its strands (moving away from the beholder) are rotated clockwise (fig.8). The lay direction of a rope is often given by a capital S for the left hand lay rope and by a capital Z for the right hand lay rope. Others often use RH for Right Hand and LH for Left Hand lay ropes.

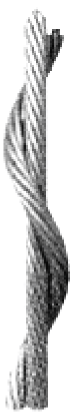


Fig. 7 Left Hand Lay Rope

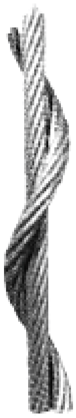


Fig. 8 Right Hand Lay Rope

Lay Types of Wire Ropes

Two lay types are to be considered: Regular or ordinary lay and lang's lay. In regular lay ropes the lay direction of the wires in the strands is opposite to the lay direction of the strands in the rope. We distinguish between regular lay left hand (right hand strand, left hand rope, zS) (fig.9)and regular lay right hand (left hand strand, right hand rope, sZ) (fig.10). In lang's lay ropes the lay direction of the wires in the strands is equal to the strands in the rope. We distinguish between lang's lay left hand (left hand strand, left hand rope, sS) (fig.11) and lang's lay right hand (right hand strand, right hand rope, zZ) (fig.12)

The advantages of regular lay ropes are:

Better structural stability Higher number of broken wires are allowed Easier identification of broken wires The advantages of lang's lay ropes are: Better contact in the groove of the sheaves Superior resistance to wear Longer lifetime in case of high dead loads Considerably better spooling behavior on a multi-layer drum.

Wire Rope Diameter

A distinction is made between the nominal rope diameter and the effective rope diameter. The nominal wire rope diameter is an agreed theoretical value for the diameter of the smallest circle circumscribing the outer strands. The effective rope diameter, also called actual rope diameter, is the diameter of the smallest circle enclosing all outer strands, as measured on the rope itself.

Fig. 9 Left Hand Regular Lay

Fig. 10 Right Hand Regular Lay

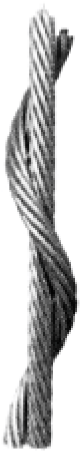


Fig. 11 Left Hand Lang's Lay

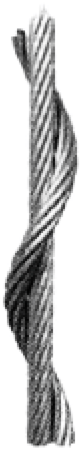


Fig. 12 Right Hand Lang's Lay

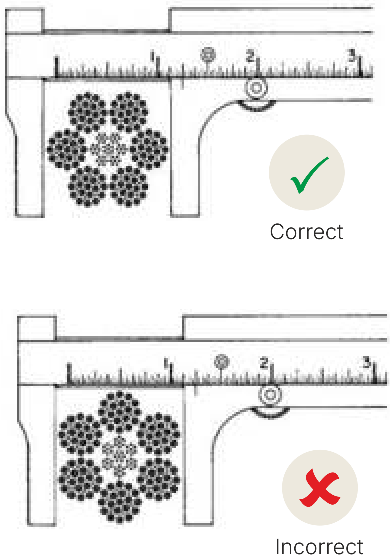


Fig. 13 Measurement Technique

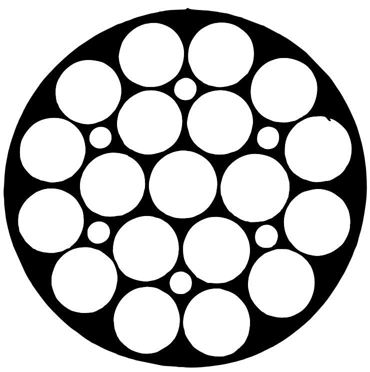


Fig. 14 Strand Cross Section

The tolerance range for the effective rope diameter is specified in related national and international standards. According to EN 12385-4 it is between -0% and +5% (for nominal rope diameters > 8mm) This means that the effective rope diameter upon delivery must neither be smaller nor bigger than 5% than the nominal rope diameter. The tolerance range is often higher for smaller ropes like 3mm to 7mm nominal diameter.

In the Oil and Gas industry, which is firmly based on US regulations, a tolerance range from -1% to 4% is applied. The effective rope diameter changes depending on the load applied. Therefore, the effective rope diameter should in critical cases be measured on a rope that is loaded with 5% of the calculated breaking strength. BIL produces standard tolerances of +2% to +4%.

Measuring devices and their correct handling In order to define the correct effective rope diameter, the correct measuring device has to be used. The measurement should strictly be done over the round ends (circumscribed circle of the rope). If one measures in the strand valleys, the result will be inaccurate. For ropes with an uneven number of outer strands, it is important that the measuring surface covers several strands (fig.13).

Rope Design

By the design of a wire rope, one understands the formation principle according to which the elements of the wire rope (the wires and the strands) are relatively arranged to each other. The designation of a fiber core is FC, for an independent steel wire rope core it is IWRC. As an example all round strand ropes of the 6x19 Warrington design with a fiber core have the construction 6 x [1-6-(6-6)] - FC.

Fill Factor of a Rope

The fill factor of a rope is defined as the ratio of the metallic cross section of the rope (or a simplified calculation of the sum of the single wire cross sections) related to the nominal rope diameter. The fill factor specifies which amount of space the wires and strands take in the rope. The fill factors of the most common ropes are between 0,46 and 0,75. This means, that the amount of steel in the rope volume is about 46% to 75%. Wire ropes with a wire rope core have higher fill factors than ropes with a fiber core.

A rope of the design 6x25 Filler-FC for example has a fill factor of 0,50 and a rope with a design 6x25 Filler-IWRC has a fill factor of 0,58. Usually fill factors of wire ropes with a fiber core (FC) decrease with an increasing number of outer strands. A rope of the design 6x25 Filler-FC has a fill factor of 0,50, a rope of the design 8x25 Filler FC has only a fill factor of 0,445.

Usually fill factors of wire ropes with a wire rope core increase with an increasing number of outer strands. Wire ropes that are made of compacted strands have higher fill factors than ropes of uncompacted strands. By compacting and rotary swaging of the rope itself the fill factor can further be increased.

Rotation-resistant Wire Ropes

A wire rope is semi rotation- resistant when: "The wire rope which turns around its longitudinal axis when subjected to unguided load and/or hardly transmits a torque to the attachment at the end in the event of guided rope ends." According to ISO 21669 and EN 12385-3: "a rope is considered to be semi rotation resistant if it rotates at least once and at most four times around its axis at a length of 1000 x d under a load of 20 % of the minimum breaking force. For the twist angle, this implies: 360°< cp <1440°."

The wire rope, which hardly turns around its longitudinal axis when subjected to unguided load and/or hardly transmits a torque to the attachment at the end in the event of guided rope ends is known as Rotation resistant wire rope. According to ISO 21669 and DIN EN 12385-3: "a rope is considered to be rotation resistant if it rotates around its axis at most once at a length of 1000 x d under a load of 20 % of the minimum breaking force. The rotation can be exhibited here in rope closing or rope opening sense. For the twist angle, this implies : -360° < cp > 360°" (fig. 15)

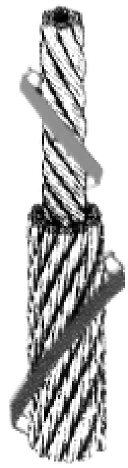


Fig. 15 Rotation Resistance Wire Rope

Calculating the Capacity of a Reel or Drum

The following formula, used in conjunction with the information in Fig. 15, gives an approximate indication as to what length, in meters, of rope of a given size can be placed on any reel or drum.

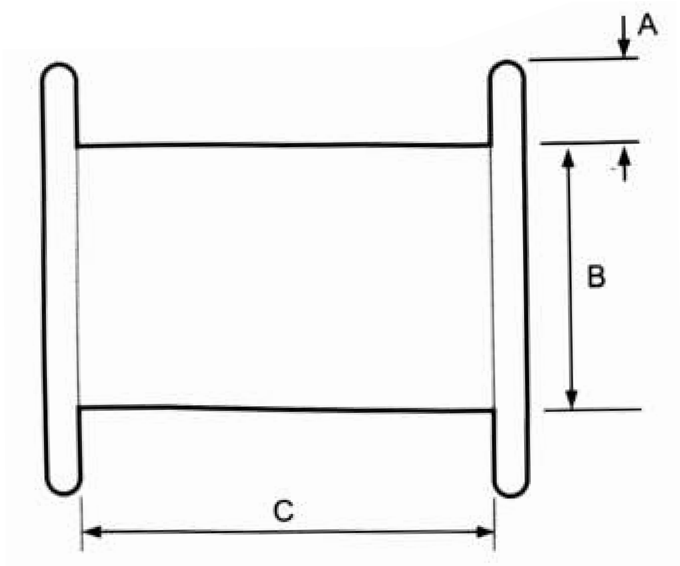


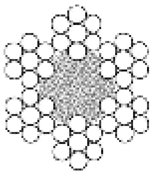
Fig. 16 Calculation of Drum Capacity

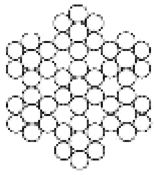
$$L = \frac{(A+B) \times A \times C \times л}{d^2}$$

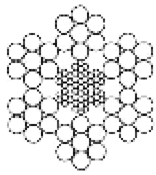
Where,
A, B, C in Mtr.
L in Mtr.
D in mm

Note. Ropes are normally manufactured to a maximum oversize tolerance of 4%; therefore the actual diameter `d' could be nominal diameter + 4%.

SPECIFICATION OF WIRE ROPES
6 x 7


6 x 7-FC

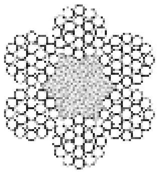

6 x 7-WSC


6 x 7-IWRC

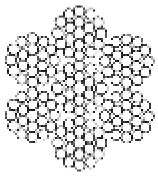
Nominal Rope Diameter	Approx Weight		Minimum Breaking Load					
			Rope Grades, MPa					
			1570		1770		1960	
	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN
2	1.40	1.55	2.08	2.25	2.35	2.54	2.60	2.81
3	3.16	3.48	4.69	5.07	5.29	5.72	5.86	6.33
4	5.62	6.19	8.34	9.02	9.40	10.2	10.4	11.3
5	8.78	9.68	13.0	14.1	14.7	15.9	16.3	17.6
6	12.6	13.9	18.8	20.3	21.2	22.9	23.4	25.3
7	17.2	19.0	25.5	27.6	28.8	31.1	31.9	34.5
8	22.5	24.8	33.4	36.1	37.6	40.7	41.6	45.0
9	28.4	31.3	42.2	45.7	47.6	51.5	52.7	57.0
10	35.1	38.7	52.1	56.4	58.8	63.5	65.1	70.4
11	42.5	46.8	63.1	68.2	71.1	76.9	78.7	85.1
12	50.5	55.7	75.1	81.2	84.6	91.5	93.7	101
13	59.3	65.4	88.1	95.3	99.3	107	110	119
14	68.8	75.9	102	110	112	115	128	138
16	89.9	99.1	133	144	150	163	167	180
18	114	125	169	183	190	206	211	228
20	140	155	208	225	235	254	260	281
22	170	187	252	273	284	308	315	341
24	202	223	300	325	338	366	375	405
26	237	262	352	381	397	430	440	476
28	275	303	409	442	461	498	510	552
32	359	396	534	577	602	651	666	721
36	455	502	676	730	762	824	843	912
40	562	619	834	902	940	1020	1041	1130
44	680	749	1010	1090	1140	1230	1260	1360

SPECIFICATION OF WIRE ROPES

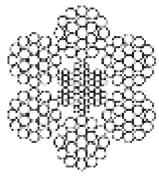
6 x 19



6 x 19M-FC



6 x 19M-WSC



6 x 19M-IWRC

Nominal Rope Diameter	Approx Weight		Minimum Breaking Load					
			Rope Grades, MPa					
			1570		1770		1960	
	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN
3	3.16	3.60	4.34	4.69	4.89	5.29	5.42	5.86
4	5.62	6.40	7.71	8.34	8.69	9.40	9.63	10.4
5	8.78	10.0	12.0	13.0	13.6	14.7	15.0	16.3
6	12.6	14.4	17.4	18.8	19.6	21.2	21.7	23.4
7	17.2	19.6	23.6	25.5	26.6	28.8	29.5	31.9
8	22.5	25.6	30.8	33.4	34.8	37.6	38.5	41.6
9	28.4	32.4	39.0	42.2	44.0	47.6	48.7	52.7
10	35.1	40.0	48.2	52.1	54.3	58.8	60.2	65.1
11	42.5	48.4	58.3	63.1	65.8	71.1	72.8	78.7
12	50.5	57.6	69.4	75.1	78.2	84.6	86.6	93.7
13	59.3	67.6	81.5	88.1	91.8	99.3	102	110
14	68.8	78.4	94.5	102	107	115	118	128
16	89.9	102	123	133	139	150	154	167
18	114	130	156	169	176	190	195	211
20	140	160	193	208	217	235	241	260
22	170	194	233	252	263	284	291	315
24	202	230	278	300	313	338	347	375
26	237	270	326	352	367	397	407	440
28	275	314	378	409	426	461	472	510
32	359	410	494	534	556	602	616	666
36	455	518	625	676	704	762	780	843
40	562	640	771	834	869	940	963	1041
44	680	774	933	1010	1050	1140	1160	1260
48	809	922	1110	1200	1250	1350	1390	1500
52	949	1080	1300	1410	1470	1590	1630	1760

SPECIFICATION OF WIRE ROPES
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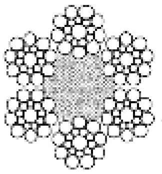
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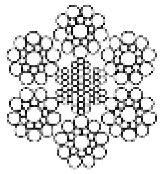
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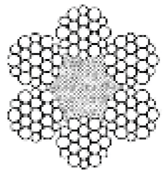
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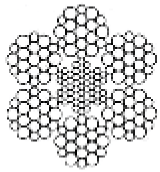
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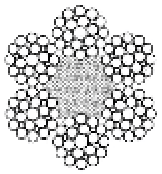
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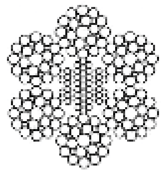
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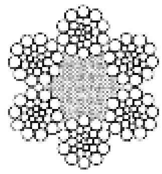
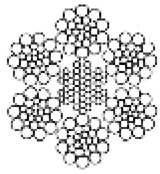
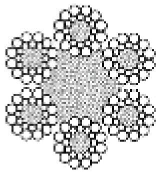

6 x 26WS-FC

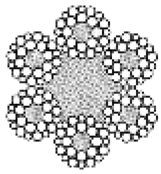

6 x 26WS-IWRC

Nominal Rope Diameter	Approx Weight		Minimum Breaking Load							
			Rope Grades, MPa							
			1570		1770		1960		2160	
	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN	kN	kN
6	13.7	15.0	18.7	20.1	21.0	22.7	23.3	25.1	25.7	27.7
7	18.6	20.5	25.4	27.4	28.6	30.9	31.7	34.2	34.9	37.7
8	24.3	26.8	33.2	35.8	37.4	40.3	41.4	44.7	45.6	49.2
9	30.8	33.9	42.0	45.3	47.3	51.0	52.4	56.5	57.7	62.3
10	38.0	41.8	51.8	55.9	58.4	63.0	64.7	69.8	71.3	76.9
11	46.0	50.6	62.7	67.6	70.7	76.2	78.3	84.4	86.2	93.0
12	54.7	60.2	74.6	80.5	84.1	90.7	93.1	100	103	111
13	64.2	70.6	87.6	94.5	98.7	106	109	118	120	130
14	74.5	81.9	102	110	114	124	127	137	140	151
16	97.3	107	133	143	150	161	166	179	182	197
18	123	135	168	181	189	204	210	226	231	249
20	152	167	207	224	234	252	259	279	285	308
22	184	202	251	271	283	305	313	338	345	372
24	219	241	298	322	336	363	373	402	411	443
26	257	283	350	378	395	426	437	472	482	520
28	298	328	406	438	458	494	507	547	559	603
32	389	428	531	572	598	645	662	715	730	787
36	492	542	671	724	757	817	838	904	924	997
40	608	669	829	894	935	1010	1030	1120	1140	1230
44	736	809	1000	1080	1130	1220	1250	1350	1380	1490
48	876	963	1190	1290	1350	1450	1490	1610	1640	1770
52	1030	1130	1400	1510	1530	1700	1750	1890	1930	2080
56	1190	1310	1620	1750	1830	1980	2030	2190	2240	2410

SPECIFICATION OF WIRE ROPES
6 x 24



6 x 24SFC-FC

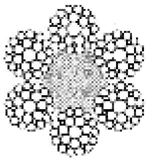


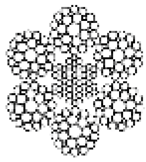
6 x 24WFC-FC

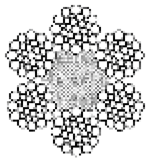
Nominal Rope Diameter	Approx Weight	Minimum Breaking Load Rope Grades, MPa	
		1570	1770
mm	kg/100m	kN	kN
8	21.2	29.2	33.0
9	26.8	37.0	41.7
10	33.1	45.7	51.5
11	40.1	55.3	62.3
12	47.7	65.8	74.2
13	55.9	77.2	87.0
14	64.9	89.5	101
15	74.5	103	116
16	84.7	117	132
18	107	148	167
20	132	183	206
22	160	221	249
24	191	263	297
26	224	309	348
28	260	358	404
30	298	411	464
32	339	468	527
36	429	592	668
40	530	731	824

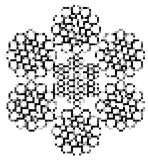
SPECIFICATION OF WIRE ROPES

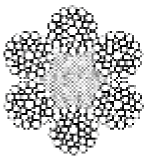
6 x 36

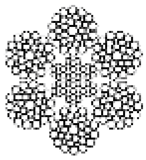

6 x 29F-FC

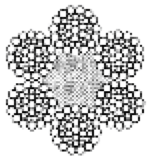

6 x 29F-IWRC

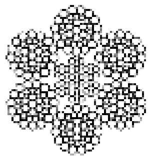

6 x 31WS-FC


6 x 31WS-IWRC


6 x 36WS-FC


6 x 36WS-IWRC

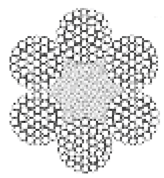

6 x 37S-FC


6 x 37S-IWRC

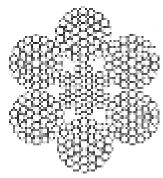
Nominal Rope Diameter	Approx Weight		Minimum Breaking Load Rope Grades, MPa							
			1570		1770		1960		2160	
	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN	kN	kN
8	24.3	26.8	33.2	35.8	37.4	40.3	41.4	44.7	45.6	49.2
9	30.8	33.9	42.0	45.3	47.3	51.0	52.4	56.5	57.7	62.3
10	38.0	41.8	51.8	55.9	58.4	63.0	64.7	69.8	71.3	76.9
11	46.0	50.6	62.7	67.6	70.7	76.2	78.3	84.4	86.2	93.0
12	54.7	60.2	74.6	80.5	84.1	90.7	93.1	100	103	111
13	64.2	70.6	87.6	94.5	98.7	106	109	118	120	130
14	74.5	81.9	102	110	114	124	127	137	140	151
16	97.3	107	133	143	150	161	166	179	182	197
18	123	135	168	181	189	204	210	226	231	249
20	152	167	207	224	234	252	259	279	285	308
22	184	202	251	271	283	305	313	338	345	372
24	219	241	298	322	336	363	373	402	411	443
26	257	283	350	378	395	426	437	472	482	520
28	298	328	406	438	458	494	507	547	559	603
32	389	428	531	572	598	645	662	715	730	787
36	492	542	671	724	757	817	838	904	924	997
40	608	669	829	894	935	1010	1030	1120	1140	1230
44	736	809	1000	1080	1130	1220	1250	1350	1380	1490
48	876	963	1200	1290	1350	1450	1490	1610	1640	1770
52	1030	1130	1400	1510	1530	1700	1750	1890	1930	2080
56	1190	1310	1620	1750	1830	1980	2030	2190	2230	2410
60	1370	1500	1870	2010	2100	2270	2330	2510	2570	2770

SPECIFICATION OF WIRE ROPES

6 x 37M



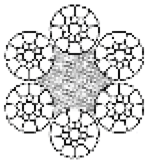
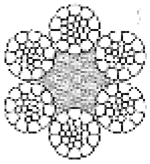
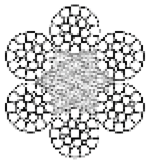
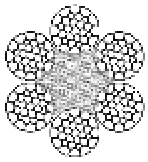
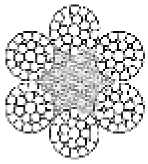
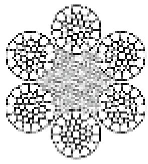
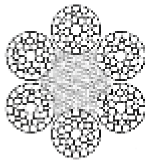
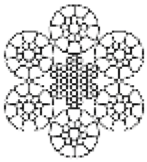
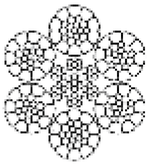
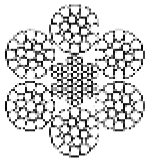
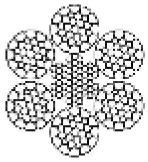
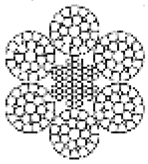
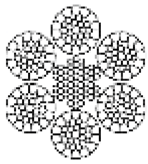
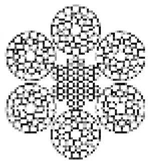
6 x 37M-FC



6 x 37M-IWRC

Nominal Rope Diameter	Approx Weight		Minimum Breaking Load, Rope Grades, MPa					
			1570		1770		1960	
	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN
5	8.65	10.0	11.6	12.5	13.1	14.1	14.5	15.6
6	12.5	14.4	16.7	18.0	18.8	20.3	20.8	22.5
7	17.0	19.6	22.7	24.5	25.6	27.7	28.3	30.6
8	22.1	25.6	29.6	32.1	33.4	36.1	37.0	40.0
9	28.0	32.4	37.5	40.6	42.3	45.7	46.8	50.6
10	34.6	40.0	46.3	50.1	52.2	56.5	57.8	62.5
11	41.9	48.4	56.0	60.6	63.2	68.3	70.0	75.7
12	49.8	57.6	66.7	72.1	75.2	81.3	83.3	90.0
13	58.5	67.6	78.3	84.6	88.2	95.4	97.7	106
14	67.8	78.4	90.8	98.2	102	111	113	123
16	88.6	102	119	128	134	145	148	160
18	112	130	150	162	169	183	187	203
20	138	160	185	200	209	226	231	250
22	167	194	224	242	253	273	280	303
24	199	230	267	288	301	325	333	360
26	234	270	313	339	353	382	391	423
28	271	314	363	393	409	443	453	490
32	354	410	474	513	535	578	592	640
36	448	518	600	649	677	732	749	810
40	554	640	741	801	835	903	925	1000
44	670	774	897	970	1010	1090	1120	1210
48	797	922	1070	1150	1200	1300	1330	1440
52	936	1082	1250	1350	1410	1530	1560	1690
56	1090	1254	1450	1570	1640	1770	1810	1960
60	1250	1440	1670	1800	1880	2030	2080	2250

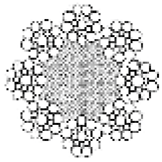
SPECIFICATION OF WIRE ROPES
6 x K19 & 6 x k36

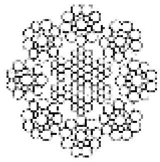

6 x K19S-FC

6 x K26WS-FC

6 x K25F-FC

6 x K31WS-FC

6 x K29-FC

6 x K36WS-FC

6 x K41WS-FC

6 x K19S-IWRC

6 x K26WS-IWRC

6 x K25F-IWRC

6 x K31WS-IWRC

6 x K29F-IWRC

6 x K36WS-IWRC

6 x K41WS-IWRC

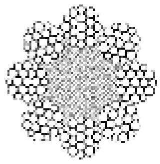
Nominal Rope Diameter	Approx Weight		Minimum Breaking Load											
			Rope Grades, MPa											
			1570		1670		1770		1870		1960		2160	
	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN
10	42.5	46.5	58.6	65.2	62.3	69.3	66.0	73.5	69.8	77.6	73.1	81.3	80.6	89.6
12	61.2	67.0	84.3	93.8	89.7	99.8	95.1	106	100	112	105	117	116	129
14	83.3	91	115	128	122	136	129	144	137	152	143	159	158	176
16	109	119	150	167	159	177	169	188	179	199	187	208	206	230
18	138	151	190	211	202	225	214	238	226	251	237	264	261	290
20	170	186	234	261	249	277	264	294	279	310	292	325	222	359
22	206	225	283	315	301	335	320	356	338	376	354	394	390	434
24	245	268	337	375	359	399	380	423	402	447	421	469	464	516
26	287	314	396	440	421	469	446	497	472	525	494	550	545	606
28	333	365	459	511	488	543	518	576	547	608	573	638	632	703
30	382	419	527	586	561	624	594	661	628	698	658	732	725	807
32	435	476	600	667	638	710	676	752	714	795	749	833	825	918
34	491	538	677	753	720	801	763	849	806	897	845	940	931	1040
36	551	603	759	844	807	898	856	952	904	1010	947	1050	1040	1160
38	614	671	846	941	899	1000	953	1060	1010	1120	1060	1170	1160	1290
40	680	744	937	1040	1000	1110	1060	1180	1120	1240	1170	1300	1290	1430
42	750	820	1030	1150	1100	1220	1160	1300	1230	1370	1290	1430	1420	1580
44	823	900	1130	1260	1210	1340	1280	1420	1350	1500	1420	1570	1560	1740
46	899	984	1240	1380	1320	1470	1400	1550	1480	1640	1550	1720	1700	1900
48	979	1070	1350	1500	1440	1600	1520	1690	1610	1790	1680	1870	1860	2070
50	1060	1160	1460	1630	1560	1730	1650	1840	1740	1940	1830	2030	2010	2240
52	1150	1260	1580	1760	1680	1870	1790	1990	1890	2100	1980	2200	2180	2420
54	1240	1360	1710	1900	1820	2020	1930	2140	2030	2260	2130	2370	2350	2610
56	1330	1460	1840	2040	1950	2170	2070	2300	2190	2430	2290	2550	2530	2810
58	1430	1560	1970	2190	2100	2330	2220	2470	2350	2610	2460	2740	2710	3020
60	1530	1670	2110	2350	2240	2490	2380	2640	2510	2790	2630	2930	2900	3230

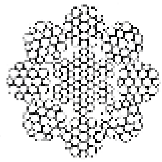
SPECIFICATION OF WIRE ROPES

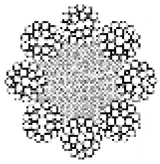
8 x 19

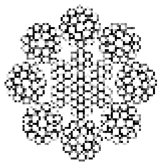

8 x 19S-FC

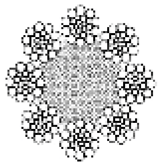

8 x 19S-IWRC

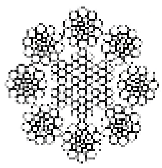

8 x 19W-FC


8 x 19W-IWRC


8 x 25F-FC


8 x 25F-IWRC

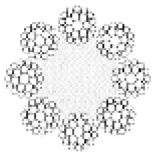

8 x 26WS-FC

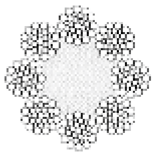

8 x 26WS-IWRC

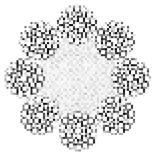
Nominal Rope Diameter	Approx Weight		Minimum Breaking Load Rope Grades, MPa							
			1570		1770		1960		2160	
	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN	kN	kN
8	22.8	27.8	29.4	34.8	33.2	39.2	36.8	43.4	40.5	47.8
9	28.9	35.2	37.3	44.0	42.0	49.6	46.5	54.9	51.3	60.5
10	35.7	43.5	46.0	54.3	51.9	61.2	57.4	67.8	63.3	74.7
11	43.2	52.6	55.7	65.7	62.8	74.1	69.5	82.1	76.6	90.4
12	51.4	62.6	66.2	78.2	74.7	88.2	82.7	97.7	91.1	108
13	60.3	73.5	77.7	91.8	87.6	103	97.1	115	107	126
14	70.0	85.3	90.2	105	102	120	113	133	124	146
16	91.4	111	118	139	133	157	147	174	162	191
18	116	141	149	176	168	198	186	220	205	242
20	143	174	184	217	207	245	230	271	253	299
22	173	211	223	263	251	296	278	328	306	362
24	206	251	265	313	299	353	331	391	365	430
26	241	294	311	367	351	414	388	458	428	505
28	280	341	361	426	407	480	450	532	496	586
32	366	445	471	556	531	627	588	694	648	765
36	463	564	596	704	672	794	744	879	820	969
40	571	696	736	869	830	980	919	1090	1010	1200
44	691	842	891	1050	1000	1190	1110	1310	1230	1450
48	823	1000	1060	1250	1190	1410	1320	1560	1460	1720
52	965	1180	1240	1470	1400	1660	1550	1830	1710	2020
56	1120	1360	1440	1700	1630	1920	1800	2130	1980	2340
60	1290	1570	1660	1960	1870	2200	2070	2440	2280	2690

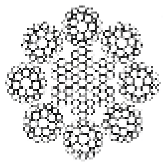
SPECIFICATION OF WIRE ROPES

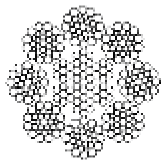
8 x 36

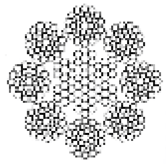

8 x 29F-FC


8 x 31WS-FC


8 x 36WS-FC

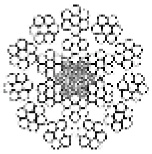

8 x 29F-IWRC

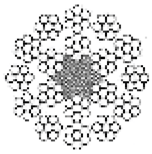

8 x 31WS-IWRC

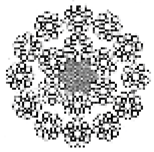

8 x 36WS-IWRC

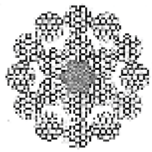
Nominal Rope Diameter	Approx Weight		Minimum Breaking Load Rope Grades, MPa							
			1570		1770		1960		2160	
	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN	kN	kN
12	51.4	62.6	66.2	78.2	74.7	88.2	82.7	97.7	91.1	108
13	60.3	73.5	77.7	91.8	87.6	103	97.1	115	107	126
14	70.0	85.3	90.2	106	102	120	113	133	124	146
16	91.4	111	118	139	133	157	147	174	162	191
18	116	141	149	176	168	198	186	220	205	242
20	143	174	184	217	207	245	230	271	253	299
22	173	211	223	263	251	296	278	328	306	362
24	206	251	265	313	299	353	331	391	365	430
26	241	294	311	367	351	414	388	458	428	505
28	280	341	361	426	407	480	450	532	496	586
32	366	445	471	556	531	627	588	694	648	765
36	463	564	596	704	672	794	744	879	820	969
40	571	696	736	869	830	980	919	1090	1010	1200
44	691	842	891	1050	1000	1190	1110	1310	1230	1450
48	823	1000	1060	1250	1190	1410	1320	1560	1460	1720
52	965	1180	1240	1470	1400	1660	1550	1830	1710	2020
56	1120	1360	1440	1700	1630	1920	1800	2130	1980	2340
60	1290	1570	1660	1960	1870	2200	2070	2440	2280	2690

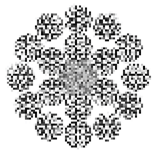
SPECIFICATION OF WIRE ROPES
18 (M) x 7

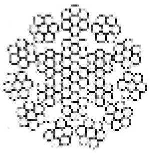

17 x 7 - FC

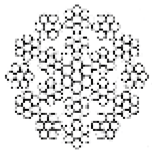

18 x 7- FC

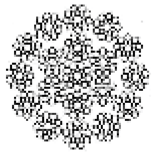

18 x 19S- FC

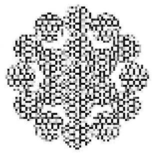

18 x 19W- FC

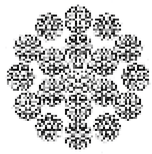

18 x 19M- FC


17 x 7- WSC


18 x 7- WSC

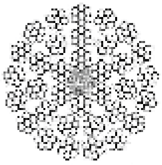

18 x 19S- WSC

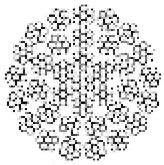

18 x 19W- WSC

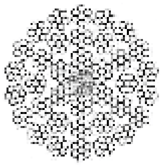

18 x 19M- WSC

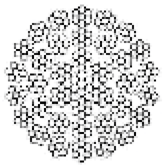
Nominal Rope Diameter	Approx Weight		Minimum Breaking Load Rope Grades, MPa							
			1570		1770		1960		2160	
	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN	kN	kN
6	14.0	15.5	17.5	18.5	19.8	20.9	21.9	23.1	24.1	25.5
7	19.1	21.1	23.8	25.2	26.9	28.4	29.8	31.5	32.8	34.7
8	25.0	27.5	31.1	33.0	35.1	37.2	38.9	41.1	42.9	45.3
9	31.6	34.8	39.4	41.7	44.4	47.0	49.2	52.1	54.2	57.4
10	39.0	43.0	48.7	51.5	54.9	58.1	60.8	64.3	67.0	70.8
11	47.2	52.0	58.9	62.3	66.4	70.2	73.5	77.8	81.0	85.7
12	56.2	61.9	70.1	74.2	79.0	83.6	87.5	92.6	96.4	102
13	65.9	72.7	82.3	87.0	92.7	98.1	103	109	113	120
14	76.4	84.3	95.4	101	108	114	119	126	131	139
16	100	110	125	132	140	149	156	165	171	181
18	126	139	158	167	178	188	197	208	217	230
20	156	172	195	206	219	232	243	257	268	283
22	189	208	236	249	266	281	294	311	324	243
24	225	248	280	297	316	334	350	370	386	408
26	264	291	329	348	371	392	411	435	453	479
28	306	337	382	404	430	445	476	504	525	555
30	351	387	438	463	494	523	547	579	603	638
32	399	440	498	527	562	594	622	658	686	725
36	505	557	631	667	711	752	787	833	868	918
40	624	688	779	824	878	929	972	1030	1070	1130
44	755	832	942	997	1060	1120	1180	1240	1300	1370
48	899	991	1120	1190	1260	1340	1400	1480	1540	1630
52	1050	1160	1320	1390	1480	1570	1640	1740	1810	1920
56	1220	1350	1530	1610	1720	1820	1910	2020	2100	2220
60	1400	1550	1750	1850	1980	2090	2190	2310	2410	2550

SPECIFICATION OF WIRE ROPES
34 (M) x 7


34 (M) x 7-FC

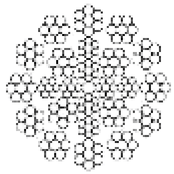

34 (M) x 7-WSC


36 (M) x 7-FC


36 (M) x 7-WSC

Nominal Rope Diameter	Approx Weight		Minimum Breaking Load Rope Grades, MPa					
			1570		1770		1960	
	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN
10	40.0	43.0	48.4	49.9	54.5	56.3	60.4	62.3
11	48.4	52.0	58.5	60.4	66.0	68.1	73.0	75.4
12	57.6	61.9	69.6	71.9	78.5	81.1	86.9	89.8
13	67.6	72.7	81.7	84.4	92.1	95.1	102	105
14	78.4	84.3	94.8	97.9	107	110	118	122
16	102	110	124	128	140	144	155	160
18	130	139	157	162	177	182	196	202
20	160	172	193	200	218	225	241	249
22	194	208	234	242	264	272	292	302
24	230	248	279	288	314	324	348	359
26	270	291	327	337	369	380	408	421
28	314	337	379	391	427	441	473	489
30	360	387	435	449	491	507	543	561
32	410	440	495	511	558	576	618	638
36	518	557	627	647	707	729	782	808
40	640	688	774	799	872	901	966	997
44	774	832	936	967	1060	1090	1170	1210
48	922	991	1110	1150	1260	1300	1390	1440
52	1080	1160	1310	1350	1470	1520	1630	1690
56	1250	1350	1520	1570	1710	1770	1890	1950
60	1440	1550	1740	1800	1960	2030	2170	2240

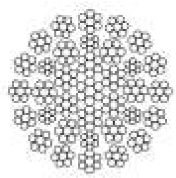
SPECIFICATION OF WIRE ROPES
24 (W) x 7



24 (W) x 7

Nominal Rope Diameter	Approx Weight	Minimum Breaking Load			
		Rope Grades, MPa			
		1570	1770	1960	2160
mm	kg/100m	kN	kN	kN	kN
8	29.4	36.2	40.8	45.2	48.4
9	37.3	45.8	51.6	57.2	61.2
10	46.0	56.5	63.7	70.6	75.6
11	55.7	68.4	77.1	85.4	91.5
12	66.2	81.4	91.8	102	109
13	77.7	95.5	108	119	128
14	90.2	111	125	138	148
16	118	145	163	181	194
18	149	183	206	229	245
20	184	226	255	282	302
22	223	274	308	342	366
24	265	326	367	406	435
26	311	382	431	477	511
28	361	443	500	553	593
30	414	509	573	635	680
32	471	579	652	723	774
36	596	732	826	914	980
40	736	904	1020	1130	1210
44	891	1090	1230	1370	1460
48	1060	1300	1470	1630	1740
52	1240	1530	1720	1910	2040
56	1440	1770	2000	2210	2370
60	1660	2030	2290	2540	2720

SPECIFICATION OF WIRE ROPES
35 (W) x 7

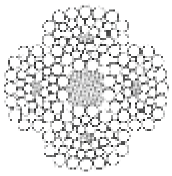


35 (W) x 7

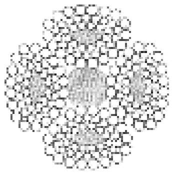
Nominal Rope Diameter	Approx Weight	Minimum Breaking Load Rope Grades, MPa			
		1570	1770	1960	2160
mm	kg/100m	kN	kN	kN	kN
10	46.0	56.5	63.7	70.6	75.6
11	55.7	68.4	77.1	85.4	91.5
12	66.2	81.4	91.8	102	109
13	77.7	95.5	108	119	128
14	90.2	111	125	138	148
16	118	145	163	181	194
18	149	183	206	229	245
20	184	226	255	282	302
22	223	274	308	342	366
24	265	326	367	406	435
26	311	382	431	477	511
28	361	443	500	553	593
30	414	509	573	635	680
32	471	579	652	723	774
36	596	732	826	914	980
40	736	904	1020	1130	1210
44	891	1090	1230	1370	1460
48	1060	1300	1470	1630	1740
52	1240	1530	1720	1910	2040
56	1440	1770	2000	2210	2370
60	1660	2030	2290	2540	2720

SPECIFICATION OF WIRE ROPES

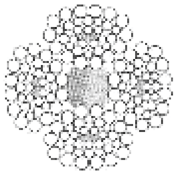
4 x V39



4 x V39SFC-FC



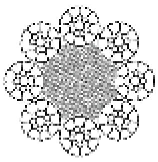
4 x V48SFC-FC

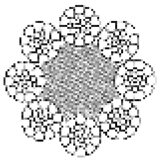


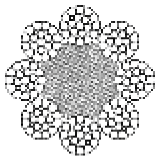
4 x V35WSFC-FC

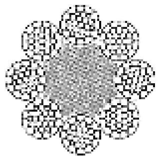
Nominal Rope Diameter	Approx Weight	Minimum Breaking Load		
		Rope Grades, MPa		
		1570	1770	1960
mm	kg/100m	kN	kN	kN
10	41.0	56.5	63.7	70.6
11	49.6	68.4	77.1	85.4
12	59.0	81.4	91.8	102
13	69.3	95.5	108	119
14	80.4	111	125	138
16	105	145	163	181
18	133	183	206	229
20	164	226	255	282
22	198	274	308	342
24	236	326	367	406
26	277	382	431	477
28	321	443	500	553
30	369	509	573	635
32	420	579	652	723
36	531	732	826	914
40	656	904	1020	1130
44	794	1090	1230	1370
48	945	1300	1470	1630

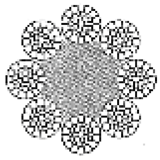
SPECIFICATION OF WIRE ROPES
8 x K19 & 8 x K36

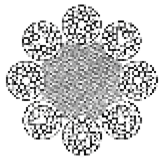

8 x K19S-FC

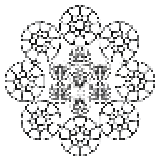

8 x K26WS-FC

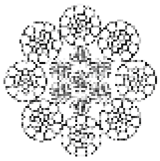

8 x K25F-FC

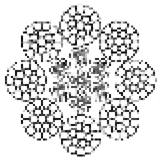

8 x K31WS-FC

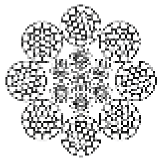

8 x K36WS-FC

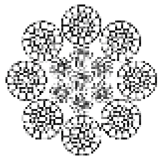

8 x K41WS-FC

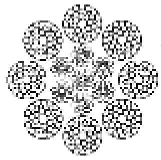

8 x K19S-IWRC


8 x K26WS-IWRC


8 x K25F-IWRC


8 x K31WS-IWRC

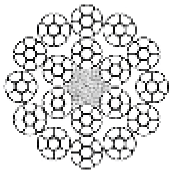

8 x K36WS-IWRC


8 x K41WS-IWRC

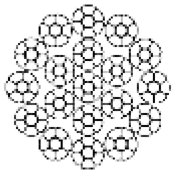
Nominal Rope Diameter	Approx Weight		Minimum Breaking Load											
			Rope Grades, MPa											
			1570		1670		1770		1870		1960		2160	
	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN
10	40.5	48.5	51.8	65.2	55.1	69.3	58.4	73.5	61.7	77.6	64.7	81.3	71.2	89.6
12	58.3	69.8	74.6	93.8	79.4	99.8	84.1	106	88.9	112	93.1	117	103	129
14	79.4	95.1	102	128	108	136	114	144	121	152	127	159	140	176
16	104	124	133	167	141	177	150	188	158	199	166	208	183	230
18	131	157	168	211	179	225	189	238	200	251	210	264	231	290
20	162	194	207	261	220	277	234	294	247	310	259	325	285	359
22	196	235	251	315	267	335	283	356	299	376	313	394	345	434
24	233	279	298	375	317	399	336	423	355	447	373	469	411	516
26	274	328	350	440	373	469	395	497	417	525	437	550	482	606
28	318	380	406	511	432	543	458	576	484	608	507	638	559	703
30	364	437	466	586	496	624	526	661	555	698	582	732	642	807
32	415	497	531	667	564	710	598	752	632	795	662	833	730	918
34	468	561	599	753	637	801	675	849	713	897	748	940	824	1040
36	525	629	671	844	714	898	757	952	800	1010	838	1050	924	1160
38	585	700	748	941	796	1000	843	1060	891	1120	934	1170	1030	1290
40	648	776	829	1040	882	1110	935	1180	987	1240	1030	1300	1140	1430
42	714	856	914	1150	972	1220	1030	1300	1090	1370	1140	1430	1260	1580
44	784	939	1000	1260	1070	1340	1130	1420	1190	1500	1250	1570	1380	1740
46	857	1030	1100	1380	1170	1470	1240	1550	1310	1640	1370	1720	1510	1900
48	933	1120	1190	1500	1270	1600	1350	1690	1420	1790	1490	1870	1640	2070
50	1010	1210	1300	1630	1380	1730	1460	1840	1540	1940	1620	2030	1780	2240
52	1100	1310	1400	1760	1490	1870	1580	1990	1670	2100	1750	2200	1930	2420
54	1180	1410	1510	1900	1610	2020	1700	2140	1800	2260	1890	2370	2080	2610
56	1270	1520	1620	2040	1730	2170	1830	2300	1940	2430	2030	2550	2240	2810
58	1360	1630	1740	2190	1850	2330	1960	2470	2080	2610	2180	2740	–	3020
60	1460	1750	1870	2350	1980	2490	2100	2640	2220	2790	2330	2930	–	3230

SPECIFICATION OF WIRE ROPES

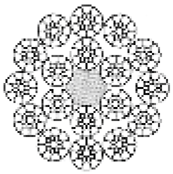
18 x K7 & 18 x K19



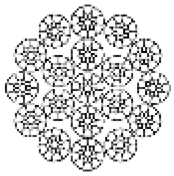
18 x K7-FC



18 x K7-WSC



18 x K19S-FC

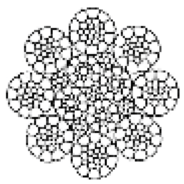


18 x K19S-WSC

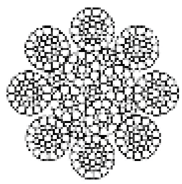
Nominal Rope Diameter	Approx Weight		Minimum Breaking Load — Rope Grades, MPa											
			1570		1670		1770		1870		1960		2160	
	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC	FC	WC
mm	kg/100m		kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN
14	83.7	90.2	108	114	115	121	121	128	128	136	134	142	148	157
16	109	118	141	149	150	158	159	168	168	177	176	186	194	205
18	138	149	178	188	189	200	201	212	212	224	222	235	245	259
20	171	184	220	232	234	247	248	262	262	277	274	290	302	320
22	207	223	266	281	283	299	300	317	317	335	332	351	366	387
24	246	265	317	335	337	356	357	377	377	399	395	418	436	460
26	289	311	371	393	395	418	419	443	442	468	464	490	511	540
28	335	361	431	455	458	484	486	513	513	542	538	569	593	627
30	384	414	495	523	526	556	558	589	589	632	617	653	680	719
32	437	471	563	595	599	633	634	671	670	709	702	743	774	818
34	494	532	635	672	676	714	716	757	757	800	793	838	874	924
36	553	596	712	753	758	801	803	849	848	897	889	940	980	1040
38	617	664	793	839	844	892	895	946	945	999	991	1050	1090	1150
40	683	736	879	929	935	989	991	1050	1050	1110	1100	1160	1210	1280
42	753	811	969	1020	1030	1090	1090	1160	1150	1220	1210	1280	1330	1410
44	827	891	1060	1120	1130	1200	1200	1270	1270	1340	1330	1400	1460	1550
46	904	973	1160	1230	1240	1310	1310	1390	1380	1460	1450	1530	1600	1690
48	984	1060	1270	1340	1350	1420	1430	1510	1510	1590	1580	1670	1740	1840
50	1070	1150	1370	1450	1460	1540	1550	1640	1640	1730	1720	1810	1890	2000
52	1150	1240	1490	1570	1580	1670	1680	1770	1770	1870	1850	1960	2040	2160
54	1250	1340	1600	1690	1700	1800	1810	1910	1910	2020	2000	2110	2200	2330
56	1340	1440	1720	1820	1830	1940	1940	2050	2050	2170	2150	2270	2370	2510
58	1440	1550	1850	1950	1970	2080	2080	2200	2200	2330	2310	2440	2540	2690
60	1540	1660	1980	2090	2100	2220	2230	2360	2360	2490	2470	2610	2720	2880

SPECIFICATION OF WIRE ROPES

8 x K26WS-PWRC(K) & 8 x 36WS-PWRC(K)



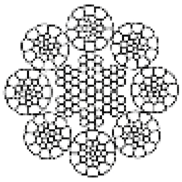
8 x K26WS-PWRC(K)



8 x K36WS-PWRC(K)

Nominal Rope Diameter	Approx Weight	Minimum Breaking Load Rope Grades, MPa		
		1770	1960	2160
mm	kg/100m	kN	kN	kN
12	75.3	124	137	151
13	88.4	145	161	177
14	103	169	187	206
15	118	194	214	236
16	134	220	244	269
17	151	249	275	303
18	169	279	309	340
19	189	311	344	379
20	209	344	381	420
21	231	379	420	463
22	253	416	461	508
23	277	455	504	555
24	301	495	549	605
25	327	538	595	656
26	354	582	644	710
27	381	627	694	765
28	410	674	747	823
29	440	723	801	883
30	471	774	857	945
32	536	881	975	1070
34	605	994	1100	1210
36	678	1110	1230	1360
38	755	1240	1380	1520
40	837	1380	1520	1680
42	923	1520	1680	1850
44	1010	1670	1840	2030
46	1110	1820	2020	2220
48	1200	1980	2190	2420
50	1310	2150	2380	2620
52	1410	2330	2580	2840
54	1530	2510	2780	3060
56	1640	2700	2990	3290
58	1760	2890	3200	3530
60	1880	3100	3430	3780

SPECIFICATION OF WIRE ROPES
8 x K26WS-IWRC

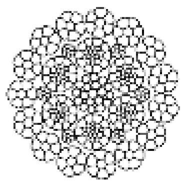


8 x K26WS-IWRC

Nominal Rope Diameter	Approx Weight	Minimum Breaking Load Rope Grades, MPa		
		1770	1960	2160
mm	kg/100m	kN	kN	kN
10	48.0	76.8	85.1	93.7
11	58.1	92.9	103	113
12	69.1	111	122	135
13	81.1	130	144	158
14	94.1	151	167	184
15	108	173	191	211
16	123	197	218	240
17	139	222	246	271
18	156	249	276	304
19	173	277	307	338
20	192	307	340	375
21	212	339	375	413
22	232	372	412	454
23	254	406	450	496
24	276	442	490	540
25	300	480	532	586
26	324	519	575	634
27	350	560	620	683
28	376	602	667	735
29	404	646	715	788
30	432	691	766	844
32	492	787	871	960
34	555	888	983	1080
36	622	1000	1100	1210
38	693	1110	1230	1350
40	768	1230	1360	1500
42	847	1360	1500	1650
44	929	1490	1650	1810
46	1020	1630	1800	1980
48	1110	1770	1960	2160
50	1200	1920	2130	2340
52	1300	2080	2300	2530
54	1400	2240	2480	2730
56	1510	2410	2670	2940
58	1610	2580	2860	3150
60	1730	2770	3060	3370

SPECIFICATION OF WIRE ROPES

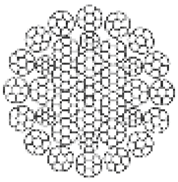
15 x K7 : IWRC(K)



15 x K7-IWRC(K)

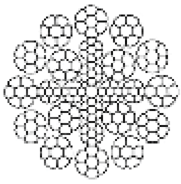
Nominal Rope Diameter	Approx Weight	Minimum Breaking Load Rope Grades, MPa		
		1770	1960	2160
mm	kg/100m	kN	kN	kN
20	209	348	385	424
21	231	383	424	468
22	253	421	466	513
23	277	460	509	561
24	301	501	554	611
25	327	543	601	663
26	354	587	651	717
27	381	634	702	773
28	410	681	754	831
29	440	731	809	892
30	471	782	866	955
32	536	890	985	1090
34	605	1000	1110	1230
36	678	1130	1250	1370
38	755	1250	1390	1530
40	837	1390	1540	1700
42	923	1530	1700	1870
44	1010	1680	1860	2050

SPECIFICATION OF WIRE ROPES
35 (W) x K7


35(W) x K7

Nominal Rope Diameter	Approx Weight	Minimum Breaking Load Rope Grades, MPa		
		1770	1960	2160
mm	kg/100m	kN	kN	kN
12	77.5	123	136	150
13	90.9	144	160	176
14	105	167	185	204
15	121	192	213	234
16	138	218	242	267
17	155	247	273	301
18	174	276	306	337
19	194	308	341	376
20	215	341	378	416
21	237	376	417	459
22	260	413	457	504
23	285	451	500	551
24	310	491	544	600
25	336	533	590	651
26	364	577	639	704
27	392	622	689	759
28	422	669	741	816
29	452	717	795	876
30	484	768	850	937
32	551	874	967	1070
34	622	986	1090	1200
36	697	1110	1220	1350
38	777	1230	1360	1500
40	861	1370	1510	1670
42	949	1500	1670	1840
44	1040	1650	1830	2020
46	1140	1810	2000	2200
48	1240	1970	2180	2400
50	1350	2130	2360	2600
52	1450	2310	2550	2820
54	1570	2490	2750	3040
56	1690	2680	2960	3260
58	1810	2870	3180	3500
60	1940	3070	3400	3750

SPECIFICATION OF WIRE ROPES
24 (W) x K7

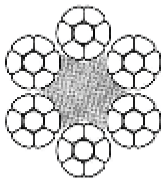


24 (W) x K7

Nominal Rope Diameter	Approx Weight	Minimum Breaking Load Rope Grades, MPa			
		1570	1770	1960	2160
mm	kg/100m	kN	kN	kN	kN
8	31.4	41.2	46.4	51.4	56.7
9	39.7	52.1	58.8	65.1	71.7
10	49.0	64.4	72.6	80.4	88.6
12	70.6	92.7	104	116	128
14	96.0	126	142	158	174
16	125	165	186	206	227
18	159	209	235	260	287
20	196	257	290	321	354
22	237	312	351	389	429
24	282	371	418	463	510
26	331	435	491	543	599
28	384	505	569	630	694
30	441	579	653	723	797
32	502	659	743	823	907
34	566	744	839	929	1020
36	635	834	941	1040	–
38	708	930	1050	1160	–
40	784	1030	1160	1290	–
42	864	1140	1280	1420	–
44	949	1250	1400	1560	–
46	1040	1360	1540	1700	–

SPECIFICATION OF WIRE ROPES

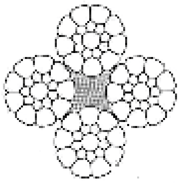
6 x K7-FC



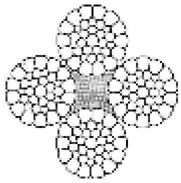
6 x K7-FC

Nominal Rope Diameter	Approx Weight	Minimum Breaking Load		
		Single Tensile, MPa		
		1570	1770	1960
mm	kg/100m	kN	kN	kN
10	41.0	58.9	66.4	73.5
12	59.0	84.8	95.6	106
14	80.4	115	130	144
16	105	151	170	188
18	133	191	215	238
20	164	236	266	294
22	198	285	321	356
24	236	339	382	423
26	277	398	449	497
28	321	462	520	576
30	369	530	597	662
32	420	603	680	753
34	474	681	767	850
36	531	763	860	953
38	592	850	958	1060
40	656	942	1060	1180

SPECIFICATION OF WIRE ROPES
4 x K19 & 4 x K36



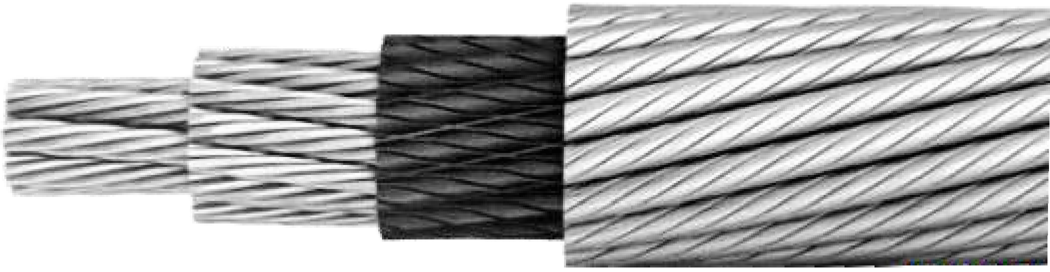
4 x K19S-FC



4 x K36WS-FC

Nominal Rope Diameter	Approx Weight	Minimum Breaking Load			
		Rope Grades, MPa			
		1570	1770	1960	2160
mm	kg/100m	kN	kN	kN	kN
22	218	312	351	389	429
24	259	371	418	463	510
26	304	435	491	543	599
28	353	505	569	630	694
30	405	579	653	723	797
32	461	659	743	823	907
34	520	744	839	929	1020
36	583	834	941	1040	1150
38	650	930	1050	1160	–
40	720	1030	1160	1290	–
42	794	1140	1280	1420	–
44	871	1250	1400	1560	–
46	952	1360	1540	1700	–
48	1040	1480	1670	1850	–

According lo EN 12385-2 Usually wire ropes have either a fi ber core (FC) or a steel/wire core. The steel/wire core can be a strand (WC) or a small rope, named as independent wire rope core (IWRC). The IWRC can be made in a separate operation or during the closing operation of the wire rope (PWRC). The wire core can also have a plastic coating (EPIWRC). Cores made of compacted strands have the additional designation (K). An independent wire core made of compacted strands is therefore called IWRC (K). A rope closed in a single operation and made out of compacted strands both in the core and the outer strands is called PWRC (K).



A. Fiber Core (NFC)

The main fiber core of a wire rope has two main functions:

(a) It acts as a cushion into which the strands bed, allowing them to take up their natural positions as the rope is bent or subjected to strain.

(b) It absorbs lubricant with which the rope should be periodically dressed, so that as the rope is stretched or flexed the lubricant is squeezed between the wires, thus lubricating them and reducing the friction between hem.

Natural fiber ropes are made from fibers of varying length dependent upon their source, and the first process is to comb out these fibers into a long.The ribbons are then twisted up into yarns, and the twist given binds the fibers firmly together so that they hold by friction when the yarn is subjected to strain. This process is known as 'spinning', and the yarns are said to be spun left-handed or right-handed according to the direction of the twist. Next, a certain number of yarns are twisted together to form strands.

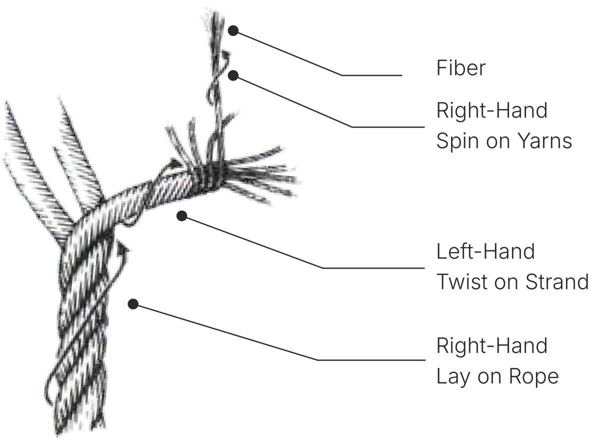


Fig. 17 Components Parts of a Natural Fiber Righ-Handed Hawser-laid Rope

The number and size of yarn to make each strand depends on the size of the rope to be made. This stage is known as 'twisting the strands', and again, the twist can be left-handed or right handed. Three or four strands are now made up into a left-handed or right-handed rope. This process is called 'laying' or 'closing', and is always carried out in the direction opposite to that used in the previous stage of twisting the strands; it is, moreover, distinct from the simple spin or twist and is two-fold, in that:

(a) The strands are twisted up together to form the rope.

(b) At the same time the strands are rotated individually in the direction of the original twist.

i. Were this not done, laying the strands up together would tend to untwist the yarns in each strand.

ii. As the rope is laid up, its length contracts like a coiled spring, giving it certain elasticity. The harder the twist given to the strands in laying, the shorter will be the resultant rope and thus a rope is said to be hard-laid, ordinary laid or soft-laid rope

General Characteristics :

The strands tend to unlay unless the end of the rope is whipped (i.e. firmly bound) with twine. The rope will stretch under load and will not completely recover when the load is removed. The rope acquires a permanent and irreversible set; the higher the oad in relation to the breaking strength, the greater the set. The set may be observed by the extension in length and reduction in diameter when the rope is slack and will eventually render the rope unfit for service.

The older and more worn the rope, the less elasticity it will possess and the weaker it will become. Rope under load will tend to twist in the opposite direction to that of its lay and thereby tend to unlay itself, but it should regain its normal form when slack. When wet, Natural Fiber Cordage will usually shrink in length in proportion to the amount by which it swells in diameter, but it will recover its original length when dry and after use. Rope which is continually subjected to heat and damp - when in the tropics, for example - will lose its elasticity and strength sooner than rope used under normal conditions of temperature and humidity.

Materials :

There are now three natural fiber ropes, Jute, Manila and Sisal. The fibers of the rope are treated with a water proofing solution during the first stage of rope making when the fibers are combed into ribbons.

(1) Manila Rope. This rope is made from the leaf fiber of the Abaco plant, which is grown in the Philippines and shipped from the port of Manila (whence its name), and also Sumatra and Borneo. When new and untreated, it is a deep golden-brown in color. The rope is flexible, durable, strong when compared with other natural fiber ropes. However, its advantages over man fiber cordage are that it stretches less, will surge more readily around a winch or capstan, and does not fuse when heated (i.e. when being surged under strain or used as a check stopper.

(2) Sisal Rope. This rope is made from the Agave Sisalana plant, which is a member of Ihe cactus pldnf. It is grown in Brazil, Malagasy. Kenya, Tanzania, Haiti and Java; when new and unfiedled if is hairy, and of a pale straw color. New sisal is as strong as manila, but is not as flexible, durable or resistant to wear and weather, its advantages over man-made fiber ropes are similar to those outlined for manila.

B. POLYPROPYLENE CORE (SFC)

Polyamide, polyester, polypropylene and polyethylene all fall into the polymer group. Polyamide is produced from coal whereas the remainder are produced from oil. Most man-made fibers are made from either continuous filaments, or yarns of staple fibers, but polypropylene ropes can be manufactured from multifilament, monofilament, staple or film-fiber. Details are as follows:

(1) Staple. These fibers vary in length and the processing machine on which they are to be used determines this length. For rope-making the staple length varies between 150mm and 1300mm. Although weaker than continuous filament cordage of equivalent size and material, staple spun cordage is ideal in applications where a good grip is required.

(2) Multi filament. These yarns are composed of a number of very fine filaments of circular cross-section twisted together, each filament being continuous throughout the yarn length.

(3) Monofilament. These are usually circular in cross-section and are continuous throughout their length. Micrometer-type gauges are used to measure their diameter, which, for rope making, can range from 0.125mm upwards.

(4) Film-fiber. Film-fiber is composed of fibrils produced by longitudinal splitting when an extruded tape or ribbon is twisted into a yarn.

General Characteristics :

Polypropylene. This cordage is nearly twice as strong as manila of equivalent size and is the lightest in weight of the man-made fibers. It stretches up to 44% before parting. Used within its safe working load it will stretch 17% of its length. It retains its strength when wet and has a low water absorption. It will float indefinitely in water. The melting point is 160-170°C. The working temperature range is -40° to +80°C. Polypropylene has high resistance to acids and alkalis. multi filament and monofilament polypropylene is not normally used for load-bearing ropes.

PREFORMED WIRE ROPE

Preformed wire rope are also called low tension wire rope.

In the stranding process the initially straight wires are forced into a helical or double-helical form. Therefore, the wires in a rope are always under tension even in an unloaded rope. Such a rope must be sealed very tightly left and right of the joint before cutting the rope because otherwise the free ends of the wires will spring open. By using a "preforming tool" the wires and strands can be deformed during the stranding strongly and plastically so they are laying nearly without tension in the rope, the rope now is preformed. The rope makers consider such ropes to be "dead". Preformed ropes can be cut much easier, also secured by seizing of course, than non-preformed ropes. Preformed ropes differ from the standard, or non-preformed ropes, in that the individual wires in the strands and the strands in the rope are preformed, or pre-shaped to their proper shape before they are assembled in the finished rope.

The preforming operation removes the natural tendency of the wires and strands to straighten, and causes them to retain their proper positions.

Broken rope ends do not untwist, as do the ends of the non-preformed ropes. This increases the salvage value of broken ropes.

They are substantially free from liveliness and twisting tendencies. This makes installation and handling easier, and lessens the likelihood of damage to the rope from kinking or fouling. Preforming permits the more general use of Lang lay and wire core constructions.

Removal of internal stresses increase resistance to fatigue from bending. This results in increased service where ability to withstand bending is the important requirement. It also permits the use of ropes with larger outer wires, when increased wear resistance is desired.

COMPACTION

What is Compacted Wire Rope? Compacted wire rope refers to a standard rope which has undergone a process whereby the rope is either passed through rollers on a special machine (unit) to compress the rope. The compacting process can be applied to individual strands during the manufacturing process of the rope; this enables either inner strands, outer strands or both to be compacted. A simple/ standard compacted rope has a normal inner core but compacted outer strands, which flattens the surface and increases the contact area of all strands.

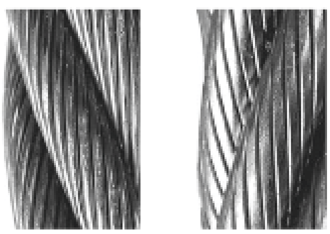
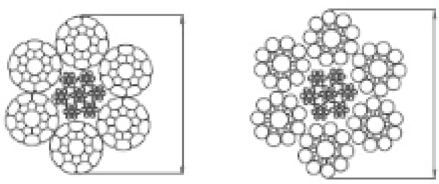


Fig. 18 Compacted & Uncompacted Strand



Compacted Rope
Minimum Breaking Load

Convectional Rope
Minimum Breaking Load

Fig. 19 Compacted & Uncompacted Strand Cross Section

The strands of standard wire ropes are round but after undergoing the compacting process the wires and strands become flattened, thereby creating a much smoother rope with a smaller diameter.

Advantage of Compacted Rope

- Higher Breaking Load Strength
- High Bend Fatigue Resistance
- Smaller Diameter
- Good Crush Resistance
- Excellent Resistant to Wear and Abrasion
- Easier to Handle
- Handle Very Heavy Loads
- Occurrence of Wire Breakage is Minimal

Thorough lubrication of wire ropes, not only during manufacture, but throughout their working life is of great importance to prevent both corrosion and fatigue caused by excessive internal friction. The greatest care is exercised at manufacture to ensure that the ropes are properly lubricated before despatch. Fibre cores receive special attention and the individual fibers of which they are composed, are impregnated with a suitable lubricant prior to spinning. The wires of the rope are also throughly lubricated at stranding and both the fibre core and strand receive a further dressing at closing. Lubrication condition should be verified on a regular basis and before rope installation, to detect possible grease anomalies. In case of doubt, rope should be cleaned from surface contaminants and properly relubricated.

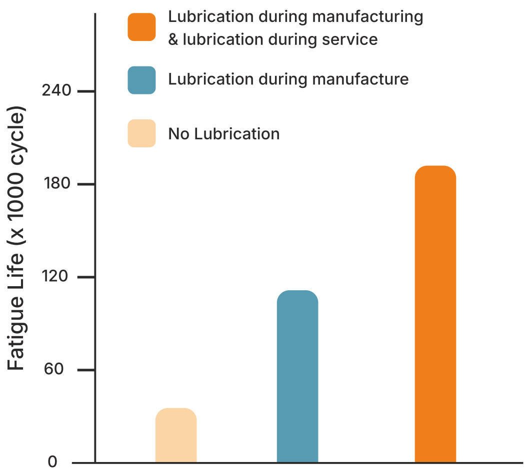


Fig. 20 : Fatigue Vs. Lubrication

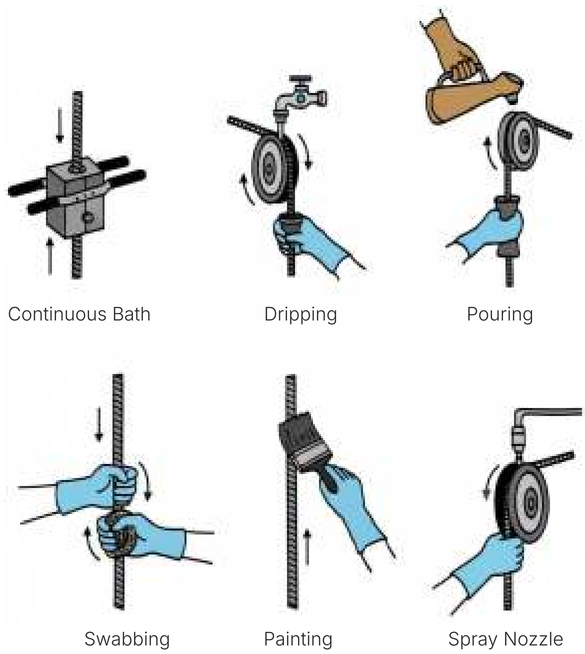


Fig. 21 : Lubrication Method

Type of Lubrication	Lubrication Method		Suitable on Wire Rope	Appearance (Type of Grease)	Note
No Lubricant	No Lubrication Little heavier then on strand Loose Wire		Galv. Strand Galv. W/R Stainless A/C		No Grease
Dry	Closing	No lubrication	Galv. A/C Break Strand Galv. W/R	Transparent (Dry)	A rust inhibiting oil us used to prevent corrosion during transit and storage. Non-tacky to hand touch
	Stranding	Min. possible application / very tight wipe as possible			
	Core	Little heavier than on strand. Loose wipe			
A-1	Closing	No lubrication	Galv. A/C Galv. W/R	Yellowish-Brown (Petro-chemgrease)	For general application of Galvanised Wire Rope
	Stranding	Min. possible application / tight wipe as possible			
	Core	Little heavier than on strand.			
A-2	Closing	No lubrication	Galv. Strand Galv. W/R Stainless A/C	Yellowish-Brown (Petro-chemgrease)	For general application of Galvanised Wire Rope. Slightly oily to the touch
	Stranding	Light application by dropping method. Internal lubrication is accomplished loose wipe			
	Core	Heavier than on strand. No Wipe			
A-3	Closing	No lubrication	Galv./Ungalv. Wire Rope	Yellowish-Brown (Petro-chemgrease)	For general application of Ungalvanised Wire Rope. Lightly tacky to hand touch
	Stranding	Applied during stranding by dropping method & the strand is lubricated again by running it through a bath of lubricant			
	Core	Heavier Application. No Wipe			
A-4	Closing	Applied during closing by dropping method	Galv./Ungalv. Wire Rope	Yellowish-Brown (Petro-chemgrease)	Wire Rope valley is filled with lubrication, for special usage of Wire Rope against corrosion
	Stranding	Applied during stranding by dropping method & the strand is lubricated again by running it through a bath of lubricant			
	Core	Little heavier than on strand.			
B	Closing	No lubrication	Galv./Ungalv. Wire Rope	Black (Asphaltum Grease)	For special usage and long term storage where maximum protection against corrosion
	Stranding	Light application by dropping method, internal lubrication is accomplished. Loose Wipe.			
	Core	Heavier Application. No Wipe			
C	Closing	No lubrication	Ungalv. Wire Rope	Black (Asphaltum Grease)	Lubrication sets up to a medium hard consistency. Ideal for oilfield construction equipment & logging use. Lightly tacky to hand touch
	Stranding	Applied during stranding by dropping method & the strand is lubricated again by running it through a bath of lubricant			
	Core	Heavier Application. No Wipe			
D	Closing	Heavier Application No Wipe after the "bath" application	Ungalv. Wire Rope	Black (Asphaltum Grease)	Lubrication sets up to a medium hard consistency. Ideal for oilfield construction equipment & logging use. Lightly tacky to hand touch
	Stranding	Applied during stranding by dropping method & the strand is lubricated again by running it through a bath of lubricant			
	Core	Heavier Application. No Wipe			
Non-Tacky C & D	A special Non-Tacky grease is applied by the same method as in the above C & D type		Ungalv. Wire Rope	Black (Solid Asphaltum Grease)	For special purpose lubrication to meet very hard consistency under typical climate. No wet. No. Drips. Dry to hand touch

Wire rope is much less resilient, and therefore much less tractable. It resists being bent, does not absorb turns readily, and is therefore much more liable to kinking and snarling, and tends to spring out of a coil, or off a drum or bollard. If handled correctly however, it can be used for most of the purposes to which cordage is put, but bends and hitches should not be made in it.

Coiling and Uncoiling A rope laid out straight will have no tendency to twist or turn either way, whether its lay is left- or right-handed, and from this position it can be stowed on a reel or coiled down. When stowed on a reel, or hauled off a reel, a rope will not develop any twists or turns in its length. When coiling down a rope however, the part of the rope remaining uncoiled will be given one twist or turn as each loop in the coil is formed. When coiling down a rope the end should be kept free to allow the uncoiled length to rotate and thus keep it free from becoming snarled up with kinks or turns. Similarly, a rope which is run off a coil will acquire a twist or turn for every loop in the coil, but if the end is kept free the rope will usually free itself of these turns when hauled out straight.

Fig. 22 : Mistakes in Coiling Down

One method of avoiding these turns, should the end of the rope not be free, is to turn the coil round while coiling down the rope, thus turning the coil into a reel. Another method, as when coiling direct from a reel, is to allow as long a length as possible between reel and coil; this length will absorb the turns until the end of the rope is free from the reel, and so can be freed of its turns. Similarly, when coiling down a rope which is led through a block, the coil should not be made too near the block. otherwise a slight check may cause a kink to develop in the rope as it is running through and thus choke the luff (Fig. 22).

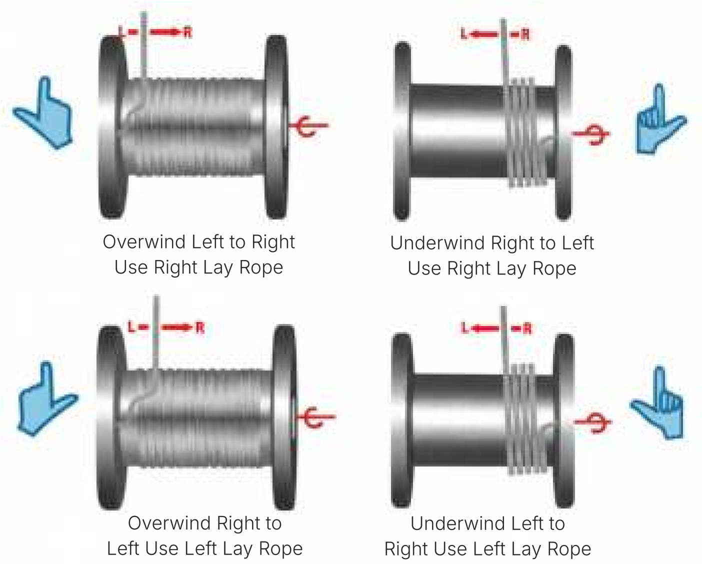


Fig. 23 : Winding of Ropes in Reel

Coiling Down (Fig. 22). Rope will snarled if the length is sufficient and the turns correspond with the lay of the rope; if the turns are against the lay, however, it will quickly become snarled. For this reason, rope of right-hand lay is always coiled down right handed, and rope of left-hand lay is always coiled down left-handed.

To Coil a Rope for Running (Fig. 24). Lay the rope as straight, begin coiling it down close to where the standing part is made fast and lay each loop flat upon the other below it until the bare end is reached. The size of the loops should be as large as stowage space permits. The running part is now underneath the coil, so turn the coil over and the rope should then run out freely when required. Remember that the running part or end part should always be on top of any coil.

Opening a New Coil (Fig. 25). To open up a new coil of rope of less than 48mm diameter, The user should roll it over until the outside end of the rope is at the top and pointing directly at him. The user should then turn the coil over towards their left and lay it flat on its side. The lashings are now cut and the inner end of the rope is pulled out from the center (Fig. 25). The rope will then leave the coil correctly and can then be coiled down. With rope of 48 mm diameter or larger, the twisting involved in the preceding method is not acceptable and the coil must be unreeled in the opposite way to that in which it was made up. The coil should be placed on a turntable, or slung so that it can be revolved (Fig. 25). Cut the lashings and haul the rope off from the outside. If this method is not possible, stand the coil on its end, and lap the rope off the top of the coil, turn by turn. As each turn is removed, revolve the end of the rope to take out twists.

Fig. 24 : To Coil a Rope Running

Cutting off a Length of Rope from a New Coil. The required amount of rope is hauled from the coil, as Wire rope, especially long lengths of it, should be stowed on reels, but where this is not practicable it must be coiled down. When coiling down it is therefore all the more necessary to have the uncoiled length free to revolve. Where this is impossible, an alternative is to use left-handed loops, called Frenchmen, in the coil (Fig. 26)

Fig. 25 : Opening a New Coil

These Frenchmen serve to counteract the twists put in by coiling down right-handed. Frenchmen are also necessary when coiling down a wire rope of which some portions have contracted a left-hand set (as will occur when a rope belayed left-handed round a bollard has been subjected to strain). Such portions will resist being coiled right handed and each loop must be allowed to become a Frenchman. It is wise to stand clear when rope is being hauled off a coil containing Frenchmen; as such turns are very likely to jump off. A coil of wire rope should always be well stopped to prevent the coils from springing out of place. The best way to run out a coiled down wire is shown in (Fig. 27)

To Unreel or Uncoil a New Rope. New wire ropes are supplied either in machine wound coils or on cable drums (reels). They must be taken off the coils or drums in the correct manner, or kinks will quickly develop. A small coil can be rolled along the deck, but if space does not permit, or the rope is heavy, place the coil on a turntable and lash down two strong battens crosswise on the top of the coil (Fig. 28). This will prevent the rope springing up over the top of the coil and kinking. Then cut the stops and haul the rope off the coil as it rotates on the turntable.

Fig. 26 : A Frenchman

To unreel the rope from a drum, pass a shaft through the drum and support the shaft at either end, thus allowing the drum to revolve; then cut the outer stops and unreel the rope off the drum (Fig. 29).

To coil down a small rope from a drum, up-end the drum as shown in (Fig. 30) and lap the rope off the top of the drum, lapping off each turn anti-clockwise. The twist put IN the rope as each turn is lapped off is cancelled automatically by coiling the rope down clockwise.

To Cut off a Length of Wire Rope. The rope should be very firmly whipped about 25 mm on each side of the position at which it is to be cut, then placed on the top of a Dollard or similar hard surface. The strands should then be cut with a hammer and cold chisel or with a wire-cutter. Whenever a length of rope is cut off a coil or a drum, the coil or drum should be clearly marked, indicating either the length cut off or the length remaining.

Fig. 27 : Running Out a Coiled Down Wire

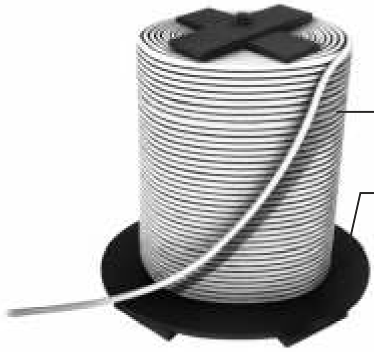


Fig. 28 : Uncoiling a New Wire Rope

Fig. 29 : Unreeling a New Wire Rope

Fig. 30 : Lopping off and Coiling Down a Small Wire Rope

Kinking and Crippling.

Because of its construction and comparative lack of flexibility, wire rope requires more care in handling, if carelessly handled it may suffer serious damage through kinking and crippling.

a. Kinking.

Any loop or turn in a wire rope can all too easily be pulled into a kink, which permanently damages it. If a kink is seen to be about to develop it should be removed as indicated in (Fig. 31) and no attempt should be made to pull it out in the manner shown in (Fig. 32)

Fig. 31 : The Right Way to Remove a kink in Wire Rope

Fig. 32 : The Wrong Way to Remove a kink in Wire Rope

b. Crippling (Bad Nips)

(Fig. 33). If a wire rope is bent at too acute an angle, or led over a sharp edge, it will be seriously damaged by distortion of its strands, which may result in a permanent kink or even in the rope parting. A rope so led is said to form a bad nip and this results in it being crippled. To prevent crippling, a wire rope, which will come under strain, should never be led through a shackle or eye plate to alter the direction of its lead.

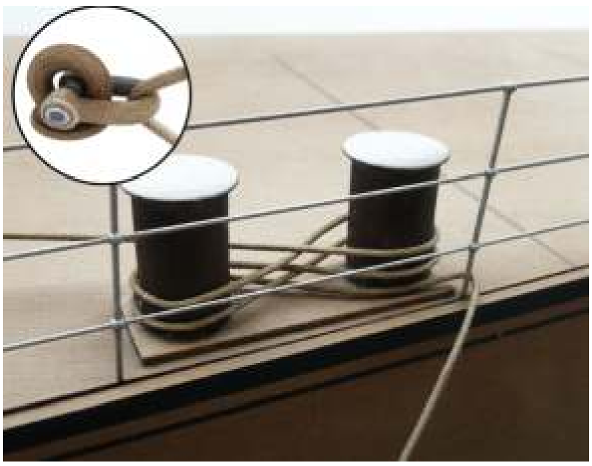


Fig. 33 : Example of Bad Nips (Leads)

In addition, it should not be round a bollard or drum of a diameter less than thirteen times the diameter of the rope; and if it has to run through a block, the diameter of the sheaves should be at least twenty times the diameter of the rope.

Rope Inspection Summary

Any wire rope that has broken wires, deformed strands, variations in diameter, or any change from its normal appearance, must be considered for replacement. It is always better to replace a rope when there is any doubt concerning its condition or its ability to perform the required task. The cost of wire rope replacement is quite insignificant when considered in terms of human injuries, the cost of down time, or the cost of replacing broken structures.

Wire rope inspection includes examination of basic items such as:

(1) Distortion of Strands.

This is the result of damage by kinking, crushing, serious crippling round a bad nip, or other mistreatment. If likely to cause the strands to bear unequal stresses, they must be considered as reducing the strength of the rope by 30%; and should they be sufficiently serious to cause the heart to protrude, the rope must be discarded. A crushed rope may be restored to some extent by the careful use of a mallet.

(2) Flattening of Some of the Outer Wires by Abrasion.

These flats are easily seen because the abrasion gives the flattened wires a bright and polished appearance, but they do not affect the strength of the rope unless. they are very pronounced. Flats, which extend to three- quarters of the diameter of the wires, will reduce their cross-sections - and therefore their individual strengths - by 10%, and as only a limited number of wires will be affected the loss in strength of the whole rope will be very small. (These flats must not be confused with flattening of the whole rope, which indicates distortion of the strands and is therefore much more serious).

(3) Broken Wires.

These are usually the result of fatigue and wear, and mostly occur in crane wires. It is generally accepted that a wire rope is coming to the end of its useful life when one wire of any strand breaks. To deal with a broken wire, grip the broken end with a pair of pliers and bend the wire backwards and forwards until the wire breaks inside the rope between the strands, where it can do no harm. A rope should be discarded if more than 5% of its wires are broken in a length equal to ten times the diameter of the rope; for example a 24mm diameter, 6X24 wire rope should be discarded if seven broken wires are found in a length of 240mm. Because of the danger to handlers, berthing wires should be discarded if any broken wires are discovered.

(4) Corrosion. Wire rope can be corroded by:

(a) The action of damp on the wires from which the galvanising has worn off; if this occurs to the inner wires first it causes rust to fall out of the rope and is therefore easily detected.

(b) The action of fumes and funnel gases, which attack the outside wires, the effect then becomes visible on inspection.

(c) Contact with acid, which soaks into the heart and attacks the inside wires; this is not necessarily noticeable on the outside of the rope and can be the cause of parting without warning.

(5) Lack of lubrication is a frequent cause of corrosion.

When a wire rope is under tension it stretches and becomes thinner, and during this process the individual wires are compressed and friction is set up; the fiber heart and cores are also compressed, releasing oil to overcome the friction. A wire rope of outwardly good appearance, but with a dry powdery heart or core, has not been properly maintained and should be treated with caution.

(6) Effect of Extreme Cold.

When subjected to extreme cold a wire rope may become brittle and lose its flexibility, and an apparently sound rope may part without warning. The brittleness is not permanent and the rope will regain its resilience in a normal temperature, but the potential danger should be remembered when working wires in very cold climates.

DIAGNOSTIC GUIDE TO COMMON WIRE ROPE DEGRADATION

Made Symptoms	Possible Causes	Possible Causes
Fatigue	Wire break is transverse - either straight across or Z shape. Broken end will appear grainy.	Check for rope bent around too small a radius; vibration or whipping; wobbly sheaves; rollers too small; reverse bends; bent shaft; tight grooves; corrosion; small drum & sheaves; incorrect rope construction; improper installation; poor end terminations. (In the absence of other modes of degradation, all rope will eventually fail in fatigue.)
Tension	Wire break reveals a mixture of cup and cone fracture and shear breaks.	Check for overloads; sticky, grabby clutches; jerky condition; loose bearing on drum; fast starts, fast stops, broken sheaves flanges; wrong rope size & grade; poor end terminations. Check for too great a stain on rope after factors of degradation have weakened it.
Abrasion by Wear	Wire break mainly display outer wires worn smooth to knife edges thinness. Wire broken by abrasion in combination break.	Check for change in rope or sheaves size; change in load; overburden change; frozen or stuck sheaves; soft rollers, sheaves or drum; excessive fleet angle; misalignment of sheaves; knife improperly attached fittings; grit & sand; objects imbedded in rope; improper grooving.
Abrasion by Fatigue	Reduced cross-section is broken off square thereby producing a chisel shape.	A long term condition normal to the operating plus Fatigue process.
Abrasion by Operation	Reduced across-section is naked down plus tension as in a cup and cone configuration. Tensile break produces a chisel shape.	A long term condition normal to the operating plus Operating process.
Cut or Gauged	Wire ends are pinched down, mashed and / or cut in a rough diagonal shear-like manner	Check on all the above conditions for mechanical or rough Wire abuse, or either abnormal or accidental forces during installation.
Torsion or Twisting	Wire ends show evidence of twist and / or cark-screw effect.	Check on all the above conditions for mechanical abuse or either abnormal or accidental forces during installation.
Mashing	Wires are flattened and spread at broken ends.	Check on all the above conditions for mechanical abuse or either abnormal or accidental forces during installation. (This is common occurrence on the drum.)
Corrosing	Wires surfaces are pitted with break showing evidence either of fatigue tension or abrasion.	Indicates improper lubrication or storage, or a corrosive environment.

The following is a fairly comprehensive listing of critical inspection factors. It is not, however, presented as a substitute for an experienced inspector. It is rather a user's guide to the accepted standards by which ropes must be judged.

(1) Abrasion

Rope abrades when it moves through an abrasive medium or over drums and sheaves. Most standards require that rope is to be removed if the outer wire wear exceeds of the original outer wire diameter. This is not easy to determine and discovery relies upon the experience gained by the inspector in measuring wire diameters of discarded ropes.

(2) Rope stretch

All ropes will stretch when loads are initially applied. As a rope degrades from wear, fatigue, etc. (excluding accidental damage), continued application of a load of constant magnitude will produce varying amounts of rope stretch. A stretch displays three distinct phases: Phase 1. Initial stretch, during the early (beginning) period of rope service, caused by the rope adjustments to operating conditions (constructional stretch).

Phase 2. Following break-in, there is a long period-the greatest part of the rope's service life-during which a slight increase in stretch takes place over an extended time. This results from normal wear, fatigue, etc.

Phase 3. Thereafter, the stretch occurs at a quicker rate. This means that the rope has reached the point of rapid degradation; a result of prolonged subjection to abrasive wear, fatigue, etc.

(3) Reduction in rope diameter

Any marked reduction in rope diameter indicates degradation. Such reduction may be attributed to excessive external abrasion internal or external corrosion loosening or tightening of rope lay inner wire breakage rope stretch ironing or milking of strands in the past, whether or not a rope was allowed to remain in service depended to a great extent on the rope's diameter at the time of inspection. Currently this practice has undergone significant modification

Common Rope Characteristic:

After an initial reduction, the diameter soon stabilizes. Later, there will be a continuous, albeit small, decrease in diameter throughout its life. Core deterioration, when it occurs, is revealed by a more rapid reduction in diameter and when observed it is time for removal. Deciding whether or not a rope is safe is not always a simple matter.

Because criteria for removal are varied, and because diameter, in itself, is a vague criterion.

(4) Corrosion

Corrosion, while difficult to evaluate, is a more serious cause of degradation than abrasion. Usually, it signifies a lack of lubrication. Corrosion will often occur internally before there is any visible external evidence on the rope surface. Usually, a slight discoloration because of rusting merely indicates a need for lubrication. Severe rusting, on the other hand, leads to premature fatigue failures in the wires necessitating the rope's immediate removal from service.

When a rope shows more than one wire failure adjacent to a terminal fitting, it should ' be removed immediately. To retard corrosive deterioration, the rope should be kept well lubricated. In situations where extreme corrosive action can occur, it may be necessary to use galvanized wire rope.

(5) Kinks

Kinks are permanent distortions caused by loops drawn too tightly. Ropes with kinks must be removed from service.

(6) "Bird Caging"

Bird caging results from torsional imbalance that comes about because of mistreatments such as sudden stops, the rope being pulled through tight sheaves, or wound on too small a drum. This is cause for rope replacement unless the affected section can be removed.

(7) Localized Conditions

Particular attention must be paid to wear at the equalizing sheaves. During normal operations this wear is not visible. Excessive vibration, or whip can cause abrasion and/or fatigue. Drum cross-over and flange point areas must be carefully evaluated. All end fittings, including splices, should be examined for worn or broken wires, loose or damaged strands, cracked fittings, worn. or distorted thimbles and tucks of strands.

(8) Heat Damage

After a fire, or the presence of elevated temperatures, there may be metal discoloration, or an apparent loss of internal lubrication; fiber core ropes are particularly vulnerable. Under these circumstances the rope should be replaced.

(9) Protruding Core

If, for any cause, the rope core protrudes from an opening between the strands the rope is unfit for service and should be removed.

10) Damaged End Attachments

Cracked, bent, or broken end fittings must be eliminated. The cause should be sought out and corrected. In the case of bent hooks, the throat openings -measured at the narrowest point-should not exceed 15% over normal nor should twisting be greater than 10".

(11) Peening

Continuous pounding is one of the causes of peening. The rope strikes against an object such as some structural part of the machine, or it beats against a roller, or it hits itself. Often, this can be avoided by placing protectors between the rope and the object it is striking.

Another common cause of peening is continuous working-under high loads--over a sheave or drum. Where peening action cannot be controlled, it is necessary to have more frequent inspections and to be ready for earlier rope replacement. Figure 24 shows the external appearance of two ropes, one of which has been abraded and the other peened. Also shown are the cross-sections of wires in both conditions.

(12) Scrubbing

Scrubbing refers to the displacement of wires and strands as a result of rubbing against itself or another object. This, in turn, causes wear and displacement of wires and strands along one side of the rope. Corrective measures should be taken as soon as this condition is observed.

(13) Fatigue Fracture

Wires that break with square ends and show little surface wear, have usually failed as a result of fatigue. Such fractures can occur on the crown of the strands, or in the valleys between the strands where adjacent strand contact exists. In almost all cases, these failures are related to bending stresses or vibration.

If diameter of the sheaves, rollers or drum cannot be increased, a more flexible rope should be used. But, if the rope in use is already of maximum flexibility, the only remaining course that will help prolong its service life is to move the rope through the system by cutting off the dead end. By moving the rope through the system, the fatigued sections are moved to less fatiguing areas of the reeving.

(14) Broken Wires

The number of broken wires on the outside of a wire rope are an index of (a) its general condition, and (b) whether it must be considered for replacement. Frequent inspection will help determine the elapsed time between breaks. Ropes should be replaced as soon as the wire breakage reaches the permissible number. Such action must be taken without regard to the type of fracture.

(15) Electric Arc

Rope that has either been in contact with a live power line or been used as "ground in an electric welding circuit, will have wires that are fused, discolored and/or annealed, and must be removed. On occasion, a single wire will break shortly after installation. However, if other wires break at that time, there is no need for concern. On the other hand, should more wires break, the cause should be carefully investigated. On any application, valley breaks-i.e., where the wire fractures between strands-should be given serious attention. When two or more such fractures are found, the rope should be replaced immediately. Note, however, that no valley breaks are permitted in elevator ropes. It is well to remember that once broken wires appear-in a rope operating under normal conditions-a good many more will show up within a relatively short period.

Breaking In A New Wire Rope

A new wire rope requires careful installation and close adherence to following all the appropriate procedures previously noted. After the rope has been installed and the ends secured in the correct manner, the mechanisms should be started carefully and then permitted to run through a cycle of operation at very slow speed. During this trial operation, a very close watch should be kept on all working parts-sheaves, drums, rollers-to make certain that the rope runs freely, and without any possible obstructions as it makes its way through the system. If no problems appear in running the rope, the next step should include several run-throughs of the normal operational cycle under light load and at reduced speed. This procedure allows the component parts of the new rope to make a gradual adjustment to the actual operating conditions.

Wire Rope and Operations Inspection

It is essential to maintain a well-planned program of periodic inspection. Frequently, there are statutory and/or regulatory agencies whose requirements must be adhered to, but whether or not these exist in a given locale, the wire rope user can be guided by the suggested procedures that follow.

Abrasion, bending and crushing represent the ABC's of wire rope abuse, and it is the primary goal of good inspection practice to discover such conditions early enough so that corrections can be made, or ropes replaced safely and with minimum effort. When any sudden degradation indicates a loss of original rope strength, a decision must be made quickly as to allowing the rope to remain in service. But such a decision can only be made by an experienced inspector. And his determination will be based on

Discard Criteria for Steel Wire Ropes

Single-layer or multi-layer winding: for multi-layer winding, a greater number of wire breaks is allowable.

- Ordinary lay or lang ́s lay design: contrary to the point- like contact in the case of an ordinary lay rope, lang's lay ropes are characterized by surface contact between the strands.·
- Drive mechanism group: see DIN 15020, sheet 1 - § 4.1.
- Maximum number of wire breaks: 6 x rope diameter or 30 x rope diameter (the area where the critical number occurs is decisive).

Inspection Criteria:

1) Diameter
2) Length of lay
3) Number of broken wires
4) Corrosion
5) Kinking, crushing, cutting
6) Impropriety
7) Heavy wear
8) Limited areas
9) End connections
10) Lubrication

DISCARD CRITERIA:

a) The nature and number of broken wires
b) Localized grouping of wire breaks
c) Valley wire breaks
d) Wires breaks at a termination
e) The rate of increase of wire breaks
f) Decrease in rope diameter
g) Local decrease in diameter
h) The fracture of strands
I) Corrosion (Extern, Internal, Fretting)
j) Waviness
k) Basket deformation
l) Core or strand protrusion or distortion
m) Protruding wires in loops
n) Local increase in rope diameter
o) Flattened portion
p) Kink or tightened loop
q) Bend in rope
r) Damage due to heat or electric arcing

The individual degrees of deterioration should be assessed, and expressed as a percentage of the particular discard criteria. The cumulative degree of deterioration at any given position is determined by adding together the individual values that are recorded at that position in the rope. When the cumulative value at any position reaches 100 %, the rope should be discarded.

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