KISWIRE LTD.

HEAD OFFICE:
475 Mangmi-2dong, Sooyoung-ku, Busan, Korea
Tel. 82 51 760 1700 / Fax. 82 51 757 7379

SEOUL OFFICE:
20th Fl, Jangkyo Bldg. 1, Jangkyo-Dong Chung-Ku, Seoul, Korea
Tel. 82 2 316 6114 / Fax. 82 2 316 6115

KISWIRE EUROPE BV
Kleine Landtong 21 4201 HL Gorinchem The Netherlands
Tel. 31 183 66 60 60 / Fax. 31 183 66 50 21

KISWIRE TRADING INC.
460 Bergen Boulevard # 120 Palisades Park, NJ. 07650 U.S.A
Tel. 1-201-461-8895 / Fax. 1-201-461-8021

KISWIRE JAPAN CO(TOKYO)
Ohtori Bldg., #7F 4-5 Oodenma-Cho, Nihonbashi Chuo-Ku, Tokyo, Japan
Tel. 81-3-3808-2839 / Fax. 81-3-3808-2835

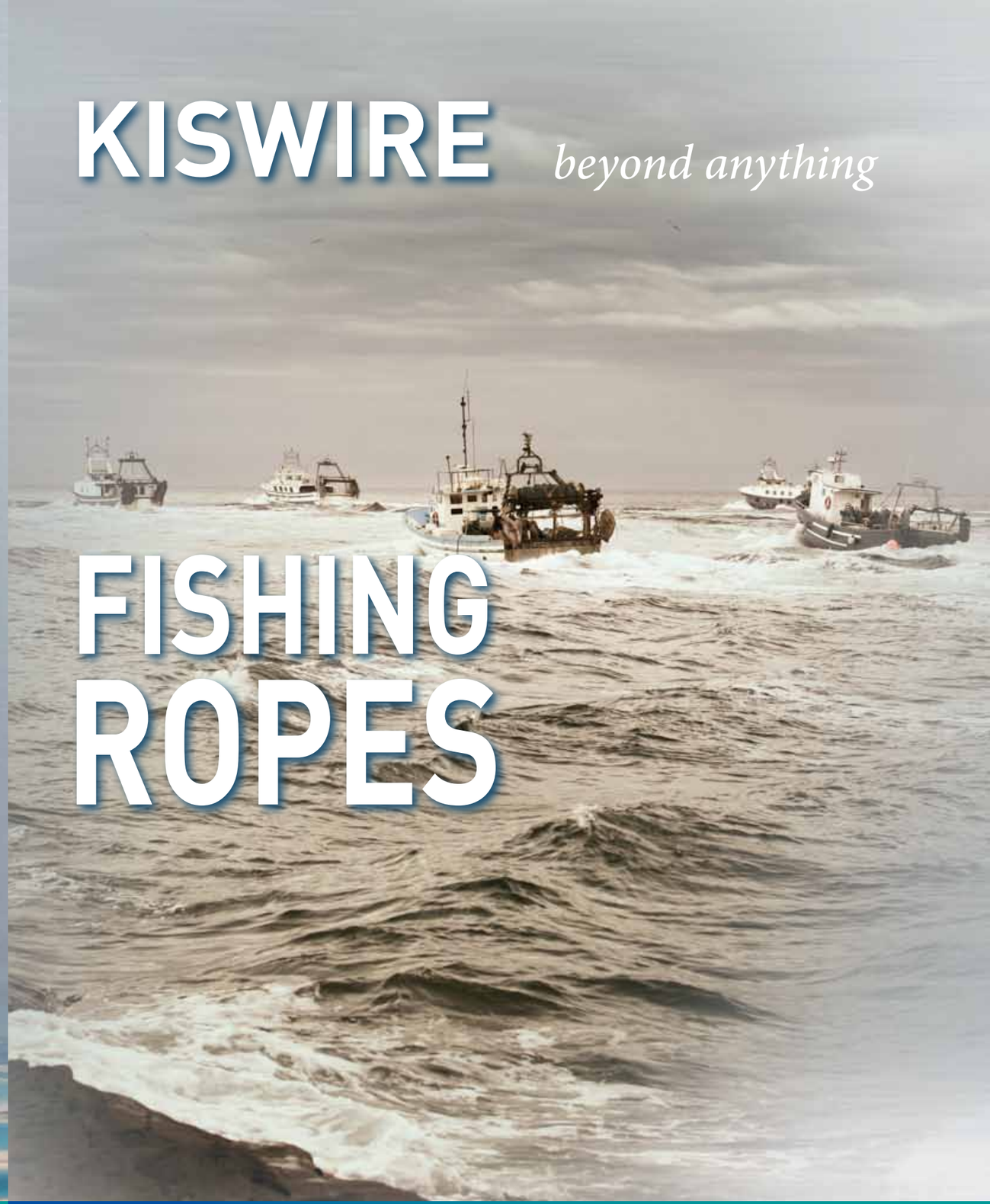
KISWIRE SDN. BHD.
No. 33, Jalan Senyum, Kampung Wadihana,
80300 Johor Bahru, Johor, Malaysia
Office Tel. : +607-340-4000
Office Fax : +607-331-0475

KISWIRE

ALUMAR® and SEAMAR® Trawl and Purse Ropes

KISWIRE

beyond anything



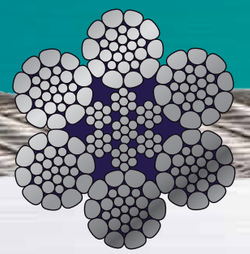
FISHING ROPES

KISWIRE

ALUMAR® and SEAMAR® Trawl and Purse Ropes

KISWIRE

beyond anything



KISWIRE is the largest producer of wire ropes in the world, manufacturing a wide and deep range of ropes for a great variety of industries on the planet. A dedicated and innovative FISHING ROPES range is supplied to ship owners from Japan to Ecuador, from Cape Town to Hammerfest, from Guam to New Foundland.

Every order is custom made in our factories in Korea and Malaysia. Our unique ALUMAR® - aluminised fishing ropes – program is the most used type of all. The patented ALUMAR® wires, of which the ropes are made, can extend the life time of a fishing rope considerably compared to common galvanized ropes. The Alumar coating on the wires protect 3.8 times longer and better from corrosion !

Our standard range of Trawl and Purse Ropes is called SEAMAR®. Outstandingly galvanized fishing ropes in a variety of constructions, like 6x19S and 6x26WS, in round strand and compacted version.

ALUMAR® aluminised Trawl and Purse Ropes

We, human beings, owe TECHNOLOGY for most of our comfort and wellbeing. We research, attempt and innovate. We create new Technology and along with that we build and produce new things and products. And once these new products have become a common part of our lives, it takes us to places we had never seen before. Technology opens gateways to entirely new horizons.

The KISWIRE Fishing Rope Technology by which our Trawl and Purse Ropes are made is one of the highest available in the world.

Aluminised Ropes

Aluminised Ropes

Within our Fishing Ropes program, the Alumar coated ropes are the most popular amongst the fishing fleet owners. ALUMAR® fishing ropes are made of the finest raw materials available, featuring excellent mechanical characteristics : resisting to wear and abrasion, sustaining superb ductility, outstanding performance through constructional stability, and more. ALUMAR® fishing ropes have proved to be able to perform 4 times longer than common galvanized ropes.

4x longer

4x longer

ALUMAR® and SEAMAR® Trawl and Purse Ropes come in 6x19S and 6x26WS construction, with fibre or steel core (IWRC). Different specially developed lubricants are applied on our fishing ropes in order to minimize friction and to optimize service life.

Plastic Infilled Ropes

Plastic infilled ropes

A plastic layer filled in between the strands and the core of a rope neutralizes the effects of internal friction and stress outstandingly. Besides, the plastic infill improves the stability of the wire rope. It will be less sensitive to deformation.

Lubricants

Lubricants

ALUMAR® and SEAMAR® Trawl and Purse Ropes are made of wires in different tensile grades, in order to enjoy the best ductility and the highest Minimum Breaking Load. The applied versions tensile grades are (1) Dual Tensile 1570/1770, (2) 1770 and (3) Dual tensile 1770/1960.

Dual Tensile

Dual Tensile

The spooling of ropes on multi-layer drums is improved considerably by compacting the ropes. So called compacted strand ropes have a smoother surface/outer wires, which enhances ropes on drums to slide smoother along each other. It reduces the risk of interlocking of the rope layers.

Compacted Ropes

Compacted Ropes

Compacted strand ropes besides carry higher breaking loads – MBL.
See more details about it on the enclosed data sheets.

Packaging

Packaging

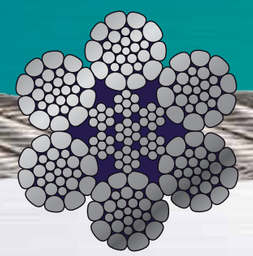
All ALUMAR and SEAMAR ropes are packed on rigid wooden or steel reels, seaworthy wrapped with oil paper and polyethylene cloth for full protection from external factors.

Kiswire

beyond anything

SEAMAR

ALUMAR



• High performance Fishing Ropes • Best protection against corrosion

• Excellent ductility • Solid construction • Dual Tensile design

SEAMAR® Trawl & Purse Ropes									
construction	6x19Seale+PP/6x26WS+PP core					6x19Seale+IWRC/6x26WS+IWRC			
round strand	diameter	weight	MBL	MBL	MBL	weight	MBL	MBL	MBL
	nominal mm	100 m	Seamar 1570/1770	Seamar 1770	Seamar 1770/1960	100 m	Seamar 1570/1770	Seamar 1770	Seamar 1770/1960
		kg	kN	kN	kN	kg	kN	kN	kN
	8	23.5	34,8	37.4	40.0	26.2	37.5	40.3	43.1
	10	36.7	54,4	58.4	62.5	40.9	58.2	63.0	67.5
	12	52.8	78,4	84.1	90	58.9	84.3	90.7	97.5
	14	71.9	107	114	122	80.2	115	124	133
	16	94	139	150	161	105	149	161	173
	18	119	176	189	203	133	189	204	219
	20	147	218	234	251	164	234	252	270
	22	178	263	283	303	198	282	305	327
	24	211	313	336	360	236	336	363	389
	26	248	368	395	423	276	396	426	457
	28	288	427	458	492	321	459	494	530
	30	332	490	528	565	370	527	570	611
	32	376	557	598	640	419	602	645	692
	34	426	631	678	727	475	682	731	730
	36	476	705	757	810	530	763	817	876

ALUMAR® Trawl & Purse Ropes									
construction	6x19Seale+PP/6x26WS+PP core					6x19Seale+IWRC/6x26WS+IWRC			
round strand	diameter	weight	MBL	MBL	MBL	weight	MBL	MBL	MBL
	nominal mm	100 m	Alumar 1570/1770	Alumar 1770	Alumar 1770/1960	100 m	Alumar 1570/1770	Alumar 1770	Alumar 1770/1960
		kg	kN	kN	kN	kg	kN	kN	kN
	8	23.5	34,8	37.4	40.0	26.2	37.5	40.3	43.1
	10	36.7	54,4	58.4	62.5	40.9	58.2	63.0	67.5
	12	52.8	78,4	84.1	90	58.9	84.3	90.7	97.5
	14	71.9	107	114	122	80.2	115	124	133
	16	94	139	150	161	105	149	161	173
	18	119	176	189	203	133	189	204	219
	20	147	218	234	251	164	234	252	270
	22	178	263	283	303	198	282	305	327
	24	211	313	336	360	236	336	363	389
	26	248	368	395	423	276	396	426	457
	28	288	427	458	492	321	459	494	530
	30	332	490	528	565	370	527	570	611
	32	376	557	598	640	419	602	645	692
	34	426	631	678	727	475	682	731	730
	36	476	705	757	810	530	763	817	876

SEAMAR® Trawl & Purse Ropes									
construction	6xK19Seale+PP/6xK26WS+PP core					6xK19Seale+IWRC/6xK26WS+IWRC			
Compacted	diameter	weight	MBL	MBL	MBL	weight	MBL	MBL	MBL
	nominal mm	100 m	Seamar 1570/1770	Seamar 1770	Seamar 1770/1960	100 m	Seamar 1570/1770	Seamar 1770	Seamar 1770/1960
		kg	kN	kN	kN	kg	kN	kN	kN
	8	26	38,4	41.2	44.1	30	42	45	48.2
	10	41	59,9	64.2	69	46	64	68	73
	12	59	86,3	92.5	100	67	92	99	106
	14	81	117	125	134	91	125	134	145
	16	106	153	164	176	119	164	176	189
	18	134	194	208	224	151	208	223	240
	20	166	240	257	276	186	257	275	296
	22	201	290	311	334	226	311	334	359
	24	239	345	370	397	267	370	397	426
	26	281	405	434	466	316	434	466	500
	28	326	470	504	540	366	504	540	579
	30	374	539	578	620	420	578	620	665
	32	425	614	659	707	478	660	708	759
	34	481	694	744	798	538	745	797	854
	36	538	775	831	891	605	835	893	957

ALUMAR® Trawl & Purse Ropes									
construction	6xK19Seale+PP/6xK26WS+PP core					6xK19Seale+IWRC/6xK26WS+IWRC			
Compacted	diameter	weight	MBL	MBL	MBL	weight	MBL	MBL	MBL
	nominal mm	100 m	Alumar 1570/1770	Alumar 1770	Alumar 1770/1960	100 m	Alumar 1570/1770	Alumar 1770	Alumar 1770/1960
		kg	kN	kN	kN	kg	kN	kN	kN
	8	26	38,4	41.2	44.1	30	42	45	48.2
	10	41	59,9	64.2	69	46	64	68	73
	12	59	86,3	92.5	100	67	92	99	106
	14	81	117	125	134	91	125	134	145
	16	106	153	164	176	119	164	176	189
	18	134	194	208	224	151	208	223	240
	20	166	240	257	276	186	257	275	296
	22	201	290	311	334	226	311	334	359
	24	239	345	370	397	267	370	397	426
	26	281	405	434	466	316	434	466	500
	28	326	470	504	540	366	504	540	579
	30	374	539	578	620	420	578	620	665
	32	425	614	659	707	478	660	708	759
	34	481	694	744	798	538	745	797	854
	36	538	775	831	891	605	835	893	957

KISWIRE

beyond anything

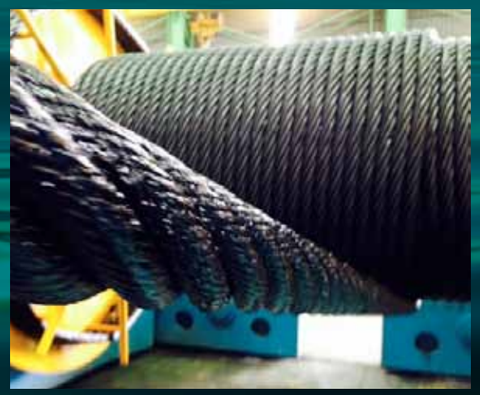
Engineering Ropes

The Fishing sector obviously uses Trawl and Purse Ropes in the first place, but secondary there is a need for Engineering Ropes, like 6x36WS types. We call these ropes Engineering Ropes. Ropes for winches, cranes, hoists and other applications.

Kiswire Engineering Ropes are made in accordance with several International Standards, such as EN, ISO and API. Their quality is outstanding, featuring

- **high breaking loads versus low weights**
- **great constructional stability**
- **high resistance to fatigue, abrasion and wear**
- **great resistance to drum crushing**
- **long life performance**

The table shows a diameter range from 10 to 48 mm.
Beyond that diameter, i.e. 50 to 180 mm,
we speak of Neptune® Offshore Ropes.
Catalogues are available.



KISWIRE Engineering Ropes

KISWIRE® Engineering Ropes							
	6 x36 Class + IWRC				6x36 Class + Fibre Core		
diameter	weight	MBL	MBL	MBL	weight	MBL	MBL
	100 m	1770	1960	2160	100 m	1770	1960
	kg	kN	kN	kN	kg	kN	kN
8	26,2	40,3	44,7	49,2	23,5	37,4	41,4
10	40,9	63,0	69,8	76,9	36,7	58,4	64,7
12	58,9	90,7	100,0	111,0	52,8	84,1	93,1
13	69,1	106,0	118,0	130,0	62,0	98,7	109,0
14	80,2	124,0	137,0	151,0	71,9	114,0	127,0
16	105	161	179	197	94	150	166
18	133	204	226	249	119	189	210
19	149	228	253	279	133	212	235
20	164	252	279	308	147	234	259
21	198	305	338	372	178	283	313
22	236	363	402	443	211	336	373
24	276	426	472	520	248	395	437
26	321	494	547	603	288	458	507
28	370	570	631	695	332	528	585
30	419	645	715	787	376	598	662
32	475	731	810	892	426	678	750
34	530	817	904	997	476	757	838
36	592	914	1.012	1.114	532	846	939
38	654	1.010	1.120	1.230	587	935	1.040
40	723	1.115	1.235	1.360	649	1.033	1.145
42	792	1.220	1.350	1.490	711	1.130	1.250
44	867	1.335	1.480	1.630	779	1.240	1.370
46	942	1.450	1.610	1.770	846	1.350	1.490

beyond anything

Technical Data Sheet 1

Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

Extreme strength and excellent ductility

KISWIRE is one of the largest and most specialized wire drawers in the world nowadays, featuring the making of wire qualities for high end markets, such as valve springs, and other automotive and aerospace applications. These N2 non rotating wire ropes are made of KISWIRE patented high ductile wires, guaranteeing an incomparable ratio between strength and flexibility, bending fatigue life and abrasion.

Length extensions

When a rope is loaded, constructional lengthening due to the bedding down of all the component wires in the rope, occurs. The precise lengthening due to constructional stretch is hard to calculate, as it depends on a variety of factors, such as : the type of construction of rope, the load amount, the frequency of loading. For a fact, wire rope with fibre cores lengthen more than those with steel cores, since steel cores perform a better bearing for the strands.

As a guidance, we can say that ropes with fibre cores lengthen due to constructional bedding from 0.25% of rope length to 2%, whereas steel core ropes lengthen from 0,125% to 1%.

Elastic length extension occurs due to the physical lengthening of steel under load. The more steel in a rope, the higher the lengthening. Elastic lengthening is not permanent. The precise elastic lengthening of a rope depends again on the same factors as given in the above chapter on constructional lengthening. To determine the exact elastic lengthening one would have to carry out sample tests. For approximate figures however, Hook's formula can be applied.

$$\frac{WL}{EA} = \text{mm lengthening}$$

W = load applied in kg
L = rope length in mm
E = elastic modulus in kg/mm²
A = circumscribed rope area in mm²

Length extension due to overloading of a rope, more than the yield point of the material, causes permanent extension. Another plastic lengthening of a rope occurs due to wear of wire to wire and strand to strand. Both phenomenon's demand attention whether the rope can be maintained or shall be rejected.

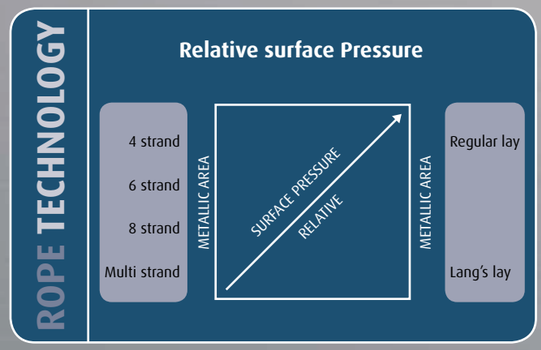
beyond anything

Technical Data Sheet 2

Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

Surface pressure – between ropes and drum/sheave grooves

When a ropes passes the groove of a sheave or a drum, pressure between the 2 surfaces occurs, due to radial forces. The working life of a rope depends partly on the amount of this surface pressure. Much pressure causes more deterioration and fatigue. Here are some main criteria as to surface pressure. The more metallic area of the rope in contact with the groove, the lower the relative pressure will be. (1) Lang's Lay Wire Ropes have a **line contact** with the surface of sheaves and drums, whereas, Regular Lay Wire Ropes have **point contact** with the same. Hence, Lang's Lay Wire Ropes have more metallic area in contact with the sheave or drum than a Regular Lay Wire Rope. Assume, the absolute surface pressure is 100, while the contact metallic area of a regular lay wire rope is 20, the relative surface pressure becomes 100 : 20 = 5 Assume, the absolute surface pressure is 100, while the contact metallic area of a Lang's lay wire rope is 25, the relative surface pressure becomes 100 : 25 = 4



types of lay versus surface pressure

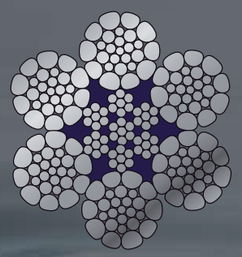
Be aware that Lang's lay wire ropes must be fixed at both ends of the rope, due to high torque characteristics. (2) 8 strand (versus 6 strand wire ropes) have more metallic area to be in contact with sheaves and drums. (3) Multi strand ropes expose the highest amount of groove contact. (4) Compacted ropes have an improved groove contact, hence compacted ropes show better surface pressure figures than regular round strand ropes.

www.kiswire.com

Technical Data Sheet 3

Kiswire is the largest wire rope producer in the world. Annually, about 130.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

Crushing and abrasion features
By compacting our ropes the resistance to crushing improves substantially. Especially on multi layer drums, wire ropes could interlock between the different layers. By compacting a wire rope, one makes the surface of the outer layers (outer wires) of the rope more flat. This flatter surface leaves the rope with less grip to get hold of. Consequently, layers slide more smooth along each other.



Swivels
Just to avoid safety risks with rotating loads when they are lifted, the idea of using swivels has arisen. Basically, the use of a swivel interferes with the regular behaviour of a rope in such a way, that it often distorts the rope construction, and causes premature rope failure. Hence, the use of swivels shall be avoided or used in consult with a wire rope engineer. Particularly, a swivel shall not be used when installing a rope. Then again, it is recommended to use a swivel on non rotating wire ropes.

Sockets
Many a rope is equipped with a rope termination. One of the most safe and secure rope terminations is a socket. The proper socket connection guarantees a 100% breaking load efficiency with the rope. Sockets come in 3 main types, i.e. the open spelter socket, the closed spelter socket and the special chain/rope socket, especially designed for the offshore industry. Apart from these regular products, sockets can be custom made for any special application. Today, most sockets are connected to the rope by casting them with a polyester based resin.

ALUMAR® aluminised ropes
The aluminizing of steel wire and steel wire ropes is made by KISWIRE under the brand name ALUMAR®. We apply this technology for about 10 years now, it started in 1999. Initially, the ALUMAR technology was developed for products applied in the aviation and car industry – the core demand was to extend the life time of the wires by sustaining the steel wire quality ! Apart from many different kinds of improvement we could establish in this respect, it was obvious that an important improvement was to be made by protecting the wires from corrosion as long as possible. The ALUMAR zinc/aluminium coating was developed as an alternative for the regular galvanizing of wire. Many tests have been done in the meantime, showing that the ALUMAR wires stay corrosion free 3,8 times longer than galvanized products. Third party Salt Spray Tests are available.

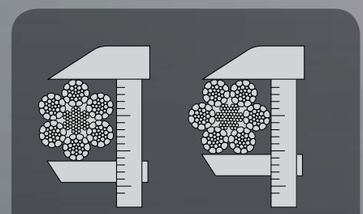
The offshore industry, both oil and gas as well as fishing, could benefit from ALUMAR ropes substantially, as sea water is a corrosive environment.

See specific catalogues of our low spin and non rotating Crane Ropes for detailed data.

Technical Data Sheet 4

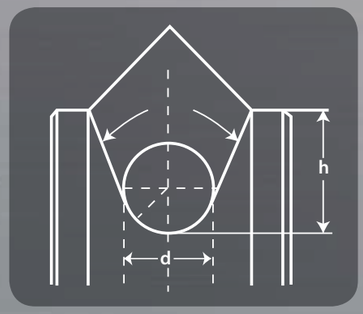
Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

Measuring diameter

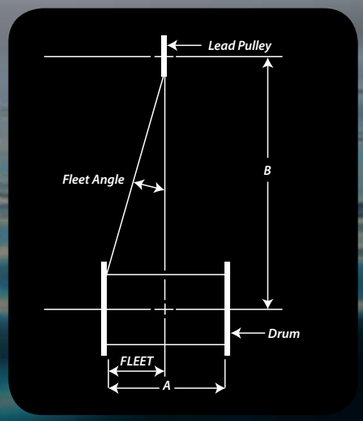


Hardness of rope and groove
An important factor in respect to surface pressure between rope and grooves, is the hardness of both the rope and the groove material. Groove hardness shall be slightly higher than the hardness of the wire rope. The other way around will cause damage to the grooves, which in return will damage the wire rope seriously. Formula to calculate surface pressure are available.

Groove dimensioning
Groove radius ® : minimum = 0.53 to 0.535 x d and maximum = 0.55 x d
Groove dept (h) : 1.5 x d
Throat angle : 35 to 45 degrees
(for normal applications)



Fleet angles
The angle under which a rope moves between a drum and a sheave shall be between 0.5 and 2.5 degrees. Fleet angle is calculated from the sheave centre to the flanges of the drum. Too small or too big fleet angles cause the rope spool improperly. Either layers pile up on top of each other or layers leave gaps between each other on the drum. Too small fleet angles may cause the interlocking of the rope layers, which causes serious damage to the rope. In order to reduce this interlocking risk, compacted ropes are recommended. Compacted ropes have smoother surfaces than regular round strand ropes, which enhances a smoother sliding of ropes against each other.



Kiswire
www.kiswire.com

Technical Data Sheet 5

Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

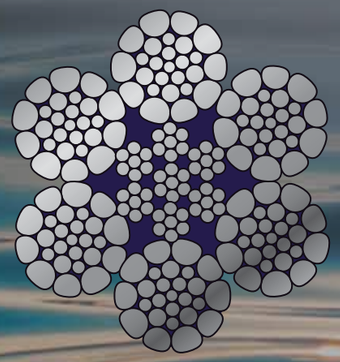
Spinning loss

In the beginning there was a parallel laid bundle of wires to lift or to pull, to move load. But the parallel bundle could not be bent over drums or sheaves.
Hence, one twisted or spinned the bundle into a helical shape in order to bend the bundle, the rope. The parallel bundle of wires had a strength (MBL) which was the sum of each individual wire (calculated breaking load) In case of the spinned rope spinning loss occurred. The average spinning loss is 18%. Calculated breaking load minus spinning loss is minimum breaking load.

Constructional torque and axial stiffness

Torsional torque occurs due to the above spinning.
When a spinned rope is put under load, the individual wires want to return to their original parallel laid shape. When the load is taken off the rope, all components return to their helical, spinned shape. This phenomenon implies that all ropes untwist or turn out under load and turn in again when load is released. Torsional torque is one of the most crucial issues related to the design, choice, use of wire rope.

Torsional torque is a phenomenon that goes with wire rope as rain and water ; any wire rope type except the perfect non rotating ones show torsional torque under load.
The amount of torque depends on the amount of load, type of construction and lifting speeds.
As a guide line torque values for each type of rope are available. Our N2 35X7 and 35x19S and 35x26WS have been indicated on the leaflets of these ropes. The same theory goes for axial stiffness. Data is shown in the tables of each catalogue.



Average torque factors for the following rope constructions are :

4x39WS+IWRC	torque 0.022
6x36WS+IWRC	torque 0.068
8x36WS+IWRC	torque 0.082
35xK7/40xK7/55xK7	torque 0.0065
35xK26WS.	torque 0.0050

Technical Data Sheet 6

Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

Fatigue by bending

Almost any wire rope when used is bent over drums and sheaves. The number of bends (1), the types of bends (curves) (2), the load applied (3), the dimensions of the drums and sheaves (4), fleet angle, reeving arrangement, groove profile, are impacting factors on the service life of a rope. Ideal wire rope circumstances hardly exist. One shall attempt to create the best possible circumstances in order to optimize rope's service life and performance.

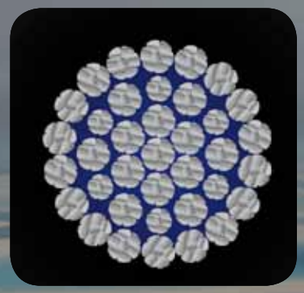
(1) The higher the number of bends of a rope, the higher its fatigue.

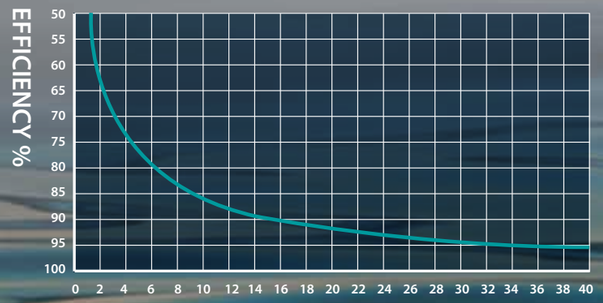
(2) Counter direction bends of rope in an installation complicate the performance of a rope substantially. The higher stress in the rope caused by complicated bends, shorten its service life and performance quality.

(3) The amount of load charged on a rope is of great impact on its service life. Within the maximum load allowed of 20% of the MBL of the rope, lower loading improves the fatigue life of the rope disproportionally.

A 10% less loading would result in a 20% better outcome. Be aware, that other issues are of impact as well. For instance, acceleration and deceleration (speed) of the rope. The slower the movement of a rope, the easier its going, the less risk on complications.

(4) The larger the drum and sheave bends, the better the performance and the longer the service life of the rope.





STRENGTH EFFICIENCY OF WIRE ROPE
WHEN BENT OVER PINS OR SHEAVES OF VARIOUS SIZES

$$\frac{D}{d} = \frac{\text{diameter of pin (or sheave)}}{\text{nominal diameter of rope}}$$

Kiswire
www.kiswire.com

Kiswire

beyond anything

Technical Data Sheet 7

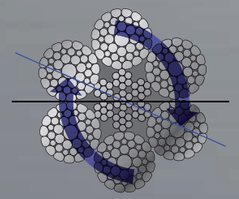
Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

Axial stiffness (EA)

In more common terms Axial Stiffness is the (non) flexibility of a rope.
We calculate the stiffness or flexibility as follows :

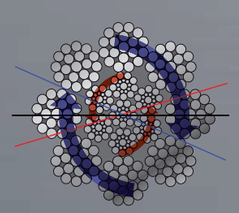
E x A x 10/4

E = the apparent modulus of the rope in kN/mm²
A = the cross sectional area of the circumscribed circle in mm², based on the nominal rope diameter.



6x37 Class E modulus in kN/mm² is 58.86.
The same in compacted version is 63.77 kN/mm².

For example :
the EA for a 6x36WS+IWRC 76.2 mm wire rope is :
58.86 x 4560 x 10/4 = 268 MN (MN = Meter/Newton)



Flexural Stiffness (EI)

Flexural Stiffness is the Bending stiffness of a rope. It is calculated as follows :

E x I x 10/6

E = the stiffness in N/mm2 (see below table)
I = the Second Moment of Area of the rope (d/6)
(d is the nominal diameter)
Stiffness Factors of 6x37 Class are :
6x36 (15.6) 6xK36 (18.8) 6x41 (14.5) 6xK41 (17.6) 6x49 (12.6) 6xK49 (14.4)

For example :
the EI for a 6x36WS+IWRC 76.2 mm wire rope is : 15.6 x 76.2 x 10/6 = 526 N/m2

The above stiffness values are due for new wire rope, with little or no load applied.

Kiswire
www.kiswire.com

beyond anything

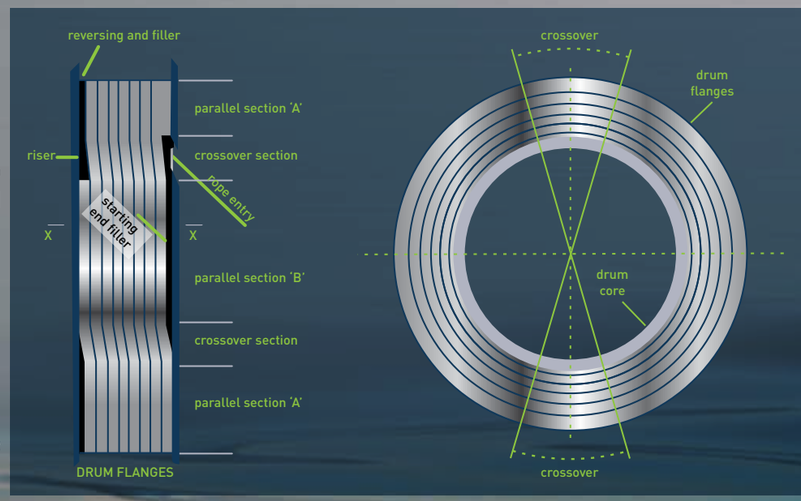
Technical Data Sheet 8

Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

LEBUS ROPE SPOOLING SYSTEM

The Lebus spooling system is designed for any hoisting and winching application that uses multiple layers of wire rope on a drum. The geometry of Lebus grooving, coupled with Lebus know-how, ensures that your wire rope spools smoothly onto and off the rope drum under total control - a dependable performance every time. Every Lebus drum is custom engineered. It is designed and produced specifically to meet the application for which it is used.
The groove pattern is engineered to suit the rope's length, diameter and construction type.
The Lebus system keeps the spooled rope in a uniformed pattern, evenly distributing the load between the individual layers of rope. This prevents lower layers being crushed or pinched by upper layers. Independent field tests have proved over the years that the Lebus system can extend rope life by more than 500%.

GEOMETRY
With the Lebus system, the continuous groove in the drum is parallel to the flange except for two crossover points on each revolution where the groove moves across the drum half a pitch to give a full pitch of movement for each revolution. With Lebus grooving it is possible to calculate exactly the direction of the forces that the rope imposes on the drum because the spooling is totally controlled. This is not possible with any other spooling system.



Kiswire
www.kiswire.com

KISWIRE

beyond anything

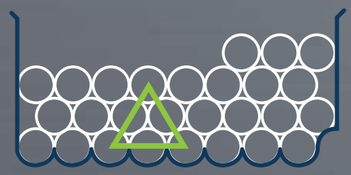
Technical Data Sheet 8

SPLIT SLEEVES

It is not always necessary to purchase a new drum. Lebus can supply its grooving system on outer sleeves that can be bolted or welded onto your old drum, no matter how old or worn it is. Lebus split sleeves can also be an economic option for new drums. If in future a different type or size of wire rope is used, the sleeve can be taken off and replaced with a new sleeve engineered for the new application. The Lebus system is so flexible that it can be individually adapted to any existing or new hoist system, even in extreme operating conditions and high loadings. The Lebus system can be installed either during the manufacturing process or later onsite. The cost benefit of the technology speaks for itself.

ROPE DRUMS, SPLIT SLEEVES AND SPOOLING ACCESSORIES

Rope drums - rope drums with grooves cut directly into them (with or without bolted or welded flanges, as required).
Split sleeves - machine-grooved split sleeves, supplied in two sections that can be placed over smooth ungrooved drums.
Split sleeves are a good solution for retrofitting and for applications where drums may require replacing in future



GROOVED SLEEVES

Sleeves are used to prevent damage to a drum. It is usually cheaper to replace a worn out sleeve instead of replacing or repairing the complete drum assembly. That is why grooved sleeves have become so popular.
The LeBus Grooving System involves a product made specifically for use on any or all types of hoisting drums requiring the use of wire rope or electro-mechanical cable. The LeBus grooves are made for the purpose of properly seating a specified size of wire rope and the proper movement of and spacing of the cable from flange to flange.

The material is supplied in cylindrical form, either from steel, fiberglass, or aluminum to fit over any existing or new drum core. Sizes range from 3 inches to over 18 feet in diameter and 4 to144 inches (or more) in width. The grooved cylinders are split in halves for easy installation either by welding or bolting to an existing drum core. After the installation has been accomplished, the grooves supplied by LeBus set a pattern whereby a repetitive action of layer to layer spooling can be controlled regardless of the number of layers or drum speed, size and load on the drum.

The primary purpose of the LeBus Spooling System is to spool wire rope or cable onto hoisting drums in a true and correct manner. In most spooling operations, you never encounter severe spooling problems when spooling only one layer of cable on your drum. In all other cases, your trouble will begin when you start the second layer and from there on up through your last layer.

Technical Data Sheet 8

The LeBus System is the only system on the market that can eliminate the 360o continuous cross winding of the cable as found on smooth drums.
The LeBus System cuts down the cross winding to approximately 20% of the circumference of the drum while 80% of the wraps are parallel with the flanges. In view of this pattern, each layer of wire rope then becomes the groove pattern for each succeeding layer.

Another benefit is increased wire rope life. Since the wire is not "cutting in" and scrubbing on itself, the true pyramid stacking pattern promotes long rope life.
Next are faster operations.
By eliminating manual spooling or mechanical devices, a drum with LeBus grooving can be operated at higher speeds.

The LeBus pattern puts the same number of coils on each layer thereby eliminating the "cutting-in" of the cable. This severe scrubbing action can cause the wire rope to fail prematurely. The LeBus System is the only known method that can accomplish this feat. Therefore it creates a much safer environment.

Flexibility is an asset that cannot be overlooked. The sleeve can be added to the smooth drum either during original manufacturing or after the hoist is in the field.

Wire rope savings - Wire Rope is expensive. Anything that promotes the increased life of the rope can be a huge cost saving.
In order for the LeBus system to operate properly, certain parameters must be met. First, the drum flanges must be perpendicular to the drum barrel at all times, even under loaded conditions. Second, there must be sufficient tension on the wire rope to hold the wire firmly in the groove and keep it from skipping grooves or "back tracking". Third, the fleet angle must be kept between ¼° and 1 ¼° (If the parameters are such that this cannot be held, then a LeBus Fleet Angle Compensator can be used). This insures that the rope enters the grooving pattern at the most optimum angle for spooling. Fourth, the rope must go to a fixed point that is centered with the drum width. Last, the rope must retain its consistent and round shape even under maximum loading conditions. Given these conditions, a LeBus grooved sleeve should spool KISWIRE ropes in multiple layers without any problems.

KISWIRE
www.kiswire.com

beyond anything

Technical Data Sheet 9

Technical Data Sheet 9

Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

STRAIN AGING

High Carbon Wire Rod

To reach higher as-drawn wire strengths for applications such as prestressed concrete tendons, higher starting rod strengths are required in the as-rolled condition. High strengths in pearlitic steels are obtained by maximizing the carbon level, and by producing as fine of a pearlite spacing as possible. The upper limit to the carbon level that can be used is dependent on the process capability of a given steel mill. The formation of a continuous grain boundary carbide film, usually in the segregated center of a billet or bloom cast steel, will determine the maximum carbon level that can be used. Typical maximum carbon levels for these applications are 0.82 to 0.85%. Since lead patenting is no longer a competitive alternative because of costs, additional strength is achieved by adding hardenability elements such as Mn and Cr to match hardenability to the controlled cooling capabilities of the rod rolling process. The objective is to produce a fine pearlite similar to a lead patented structure.

With the limitations of the rod cooling process compared to lead patented rods, strengths will still fall short of lead patented rods. Additional strengthening is achieved by precipitation hardening of the soft constituent of pearlite, the ferrite. Vanadium is widely used as a pearlite strengthener in eutectoid CMn steels for wire rod applications. Strength increases of 10 to 16 MPa per 0.01% V added are reported. The high solubility of the vanadium allows additions over 0.10% V to be added with predictable strengthening results. Because of this predictability, vanadium is the element of choice to be used as the strength control element when refining steel to specific strength levels. Direct drawn wire applications that require maximum strength, such as prestressed concrete tendons, tire bead wire, and wire rope are common applications of vanadium micro alloyed pearlitic steels with eutectoid carbon levels.

In addition, the addition of Vanadium will remove nitrogen from solid solution as V(C,N). Nitrogen in solid solution contributes to strain aging during wire drawing, resulting in reduced ductility of the finished wire. Higher ductility, usually measured by the wire torsion test, is reported using vanadium micro alloyed steels in direct drawn wire applications. Again, vanadium changes the nitrogen from an undesirable element to an integral part of the alloy system.

Strain Age

Strain ageing is associated with strain that results from plastic deformation which is more commonly known as cold working. Steel is an alloy of iron and carbon and contains other alloying elements which provide it with specific performance characteristics. Severe cold working of steel causes the migration of carbon atoms in the iron crystals and the segregation of these atoms at dislocations in the steel causes a reduction in ductility of the steel. The ageing process is a function of temperature and time and

occurs very slowly at ambient temperature but very rapidly at the 450-460°C temperatures of the galvanising process. Severe cold working of steel can be caused by hole punching in thicker sections, tight radius bending or rebending.

It should be noted that it is not the hot dip galvanising that is the cause of accelerating the strain ageing of the steel, but the heat of the process, so strain age embrittlement can be induced in any severely cold worked steel by heating and the tendency to embrittlement by strain ageing will always be present and its manifestation will simply be a matter of time.

Avoiding Strain Age Embrittlement

To avoid the risk of strain aging embitterment, the following design criteria should be followed :

- use a bend radius of 3 times the diameter of the steel wire
- avoid cold strain. Bend and/or work the steel hot. When galvanizing, anneal at 650-815 degrees Celsius

It is these two effects, the increased strength and reduction in ductility and toughness from cold strain followed by an additional strength increase and toughness loss through aging, that are the primary elements in strain aging.

Kiswire
www.kiswire.com

beyond anything

Technical Data Sheet 9

Practical comments

Until not so long ago, the world was not familiar with the phenomenon, called strain aging, occurring in wire rope. As far as science shows us, much of cause of strain aging in wire rope could be due to the increase of tensile strengths of the wires used, during the past decades. Was a 1570 N/mm² tensile the benchmark until 1975, since then it became 1770 until the nineties, whereas the standard tensile strength today, is 1960 N/mm².
The regular tensile strength is 1960, however, we see that much of the wire ropes are required with high(er) breaking strengths than 1960 grades allow. Hence, tensile grades of 2060, 2160 and 2.300 have become quite common, meanwhile.

The need of these high strength ropes (and tensiles) are the result of the industry's wish to design small, light and ethical cranes, devices, and appliances.

One of the main possible causes of susceptibility for strain aging, is a high carbon content in steel. A high breaking strength rope requires high carbon steel wires.
Details of the metallurgical chemistry, relating to strain aging and high carbon content, is given in above text.

KISWIRE, expert wire drawer

Of the total volume of delivered wire, being one million tonnes per year, 140.000 tonnes of wire rope, 400.000 tonnes of high ductile, oil tempered wire for the car industry, is produced. Another 500.000 tonnes of wire is made for the tyre industry and the conductor industry. Out of the 400.000 tonnes of car industry wires, 200.000 tonnes high carbon, high ductile, non strain aging susceptible, wire is drawn.
All wire rope is made to specific ordering. KISWIRE does not stock wire rope.

Conclusion and recommendation

Factors, which effect the susceptibility to Strain Aging of Wire Rope:

1. The chemical content of the steel used for the drawing of the wires (this chemical content impacts the mechanical characteristics of the wire)
2. Manufacturing process of steel.
3. One can minimize the risk of steel wire to strain age by choosing materials which are less susceptible to the phenomenon.
5. High(er) tensile strengths tend to be more susceptible to strain aging
6. Research and experience show that less than a promillage of all wire rope suffer from strain aging. Do not exaggerate the risks.
7. Average loss of strength by strain aging is under 5%
8. In the event, wire rope is stored longer than 12 months, one could break test the rope, prior to using it.

Kiswire
www.kiswire.com

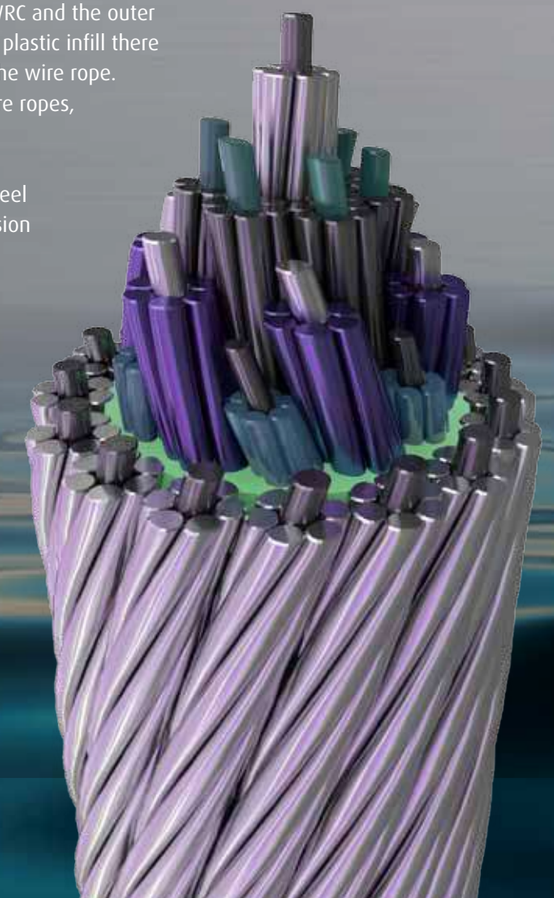
Technical Data Sheet 10

Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire is specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, in literally all corners of the world. The offshore industry is one is a main market for Kiswire since 25 years, meanwhile.

WIRE ROPE WITH PLASTIC INFILL

To make things easy, let's call the plastication of a IWRC (wire rope core) PLASTIC INFILL

- Plastic infill improves the **STABILITY** of wire rope always, regardless the construction. This makes a wire rope less sensitive for deformation.
- Secondary, a plastic infill enhances the **COHERENCY** of the different rope parts, such as (1) the strands and (2) the IWRC (core). It is essential that wire ropes are a 100% coherent entity. If that would not be the case, loads could be absorbed unequally over the different parts, which would certainly end a rope's service life, prematurely.
- Plastic infill avoids internal wear and friction between the IWRC and the outer strand layers, plus friction between the strands. Hence, with plastic infill there will always be a better resistance to **WEAR** and **FATIGUE** of the wire rope. More bending cycles will be obtained with plastic infilled wire ropes, regardless the construction.
- The plastic infill avoids water and dirt to enter the layer of steel wires (IWRC) which lays under the plastic infill. Hence, corrosion from the inside (invisible) will be less or not occurring.
- Overall, a plastic infill would improve the service life of a wire rope due to higher **FATIGUE, STABILTY** and **COHERENCY** features by 125 to 200 %, provided the right type of rope is applied for the right application, and the wire rope is not coming to the end of its service life due to other causes.



Kiswire
www.kiswire.com

Kiswire

beyond anything

Kiswire is the largest wire rope producer in the world. Annually, about 140.000 tons of wire rope is delivered, worldwide. For decades, Kiswire has been specializing in the development and production of wire rope. Meanwhile, the company has acquired a reputable and leading position in a great variety of markets, all over the world. The fishing industry is a main market for Kiswire since 25 years, meanwhile.

Food is essential to survive, that is why we hunt, farm and fish, since ... the very beginning of life. By hand, a spear, arrow, knife, axe, a net. Today, we trawl giant nets through the depths of the oceans on steel wire ropes to catch fish. 1000 kg or 400.000 kg of fish per day, depending on type of trawler or seiner. Nets hanging on ropes of 10 up to 40 mm diameter, able to carry loads of 100 to 200 tons.

KISWIRE designs and produces such ropes for the fishing fleets in all corners of the world. In 2005, our ALUMAR® aluminium coated trawl warps were awarded the best trawl rope available, by the W.A.T.O.