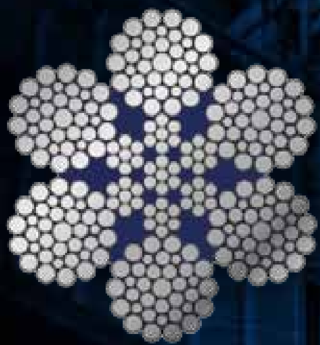
Technology explained

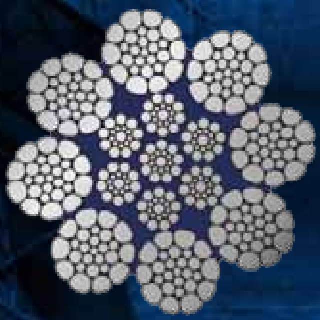
Wire rope constructions are available in a wide variety on the global markets, though only a limited number of constructions are applied in general. Criteria like Minimum Breaking Force, Bending Fatigue and Torque make us select either a 6 strand, an 8 strand or a multi strand rope. These three main categories of rope take 90% share of the total global consumption. Kiswire manufactures all these categories of rope from 10 to 180 mm nominal diameter, up to maximum units of 600 metric tons weight, in all possible versions and lay-outs.

Please, click here below for a standard Product Data Sheet, which is supplied along with our commercial offers. This Product Data Sheet, at the same time, is a guide how to order a wire rope. It is a check list. It contains most of the technical rope criteria.



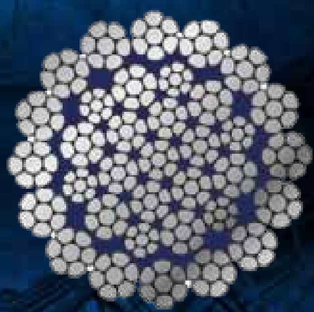
N6x36WS+IWRC

PDF



N8x31WS+IWRCX

PDF



HYROPE 40xK7

PDF

Kiswire does not keep stocks of wire rope, hence every order is made to the specific demand of the customer. This feature provides us the possibility to customize every rope production, if necessary, enabling us to optimize compatibility to application.

Wire rope production

Our wire rod is produced by a few selected and approved Steel Mills, such as Posco, NSC and Arcelor. Kiswire stocks extensive volumes of rod in order to be able to produce the wire ropes instantly after receipt of the customer's order.

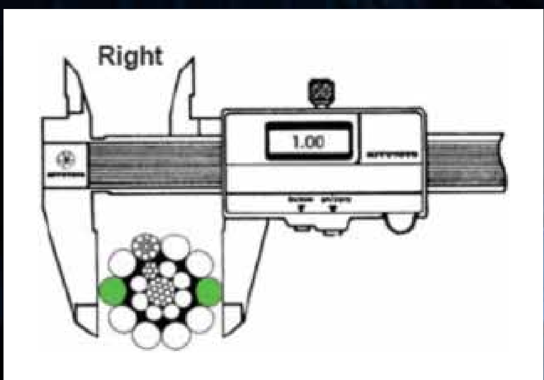
Stages of production are (1) cleaning, pickling, shaving of the wire rod, (2) pre-drawing and patenting of the rod, (3) drawing the rod to wire, (4) galvanizing or aluminizing of the wire (optional), (5) drawing to final specified wire diameter, (6) stranding of wires into strand, (7) closing the strands around a core into a wire rope.

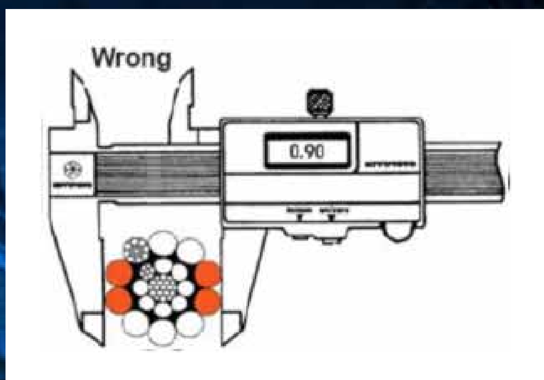



Diameter of rope or strand

Given the fact that most of all ropes and strands are used on devices as winches and sheaves, the diameter of a rope or strand shall fit the grooves of the drum(s) and the sheaves.
It is therefore essential for the correct processing of wire rope production to know the precise groove dimensions (pitch) of drums and sheaves the rope is used on.

Diameters of rope or strand are :
Nominal diameter – the diameter for identification only
Actual diameter – the actual measured diameter





Diameter tolerance

To manufacture a wire rope or strand one needs quality tolerances, such as a tolerance on the nominal diameter.

We know design diameters, such as :

Off tension diameter
the diameter as it is delivered on the manufacturer's reel to the customer.

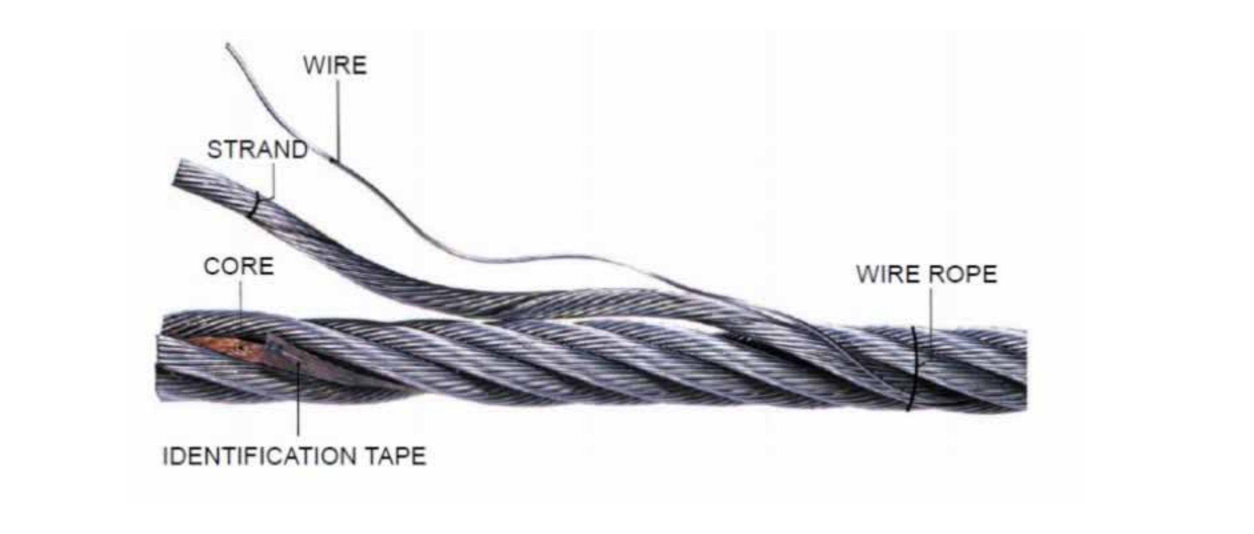
Machine tension diameter
the diameter as it is measured right after the closing point on the closing machine.

Under tension diameter
the diameter measured under a certain amount of tension/load.

Nominal length and tolerance

Once the nominal length of a rope has been indicated, the manufacturer is held to a minimum tolerance of 0 – the rope shall not be shorter than its nominal length. The usual maximum plus length is 5% to 2.5% of the nominal length.
Customer and producer can agree differently.

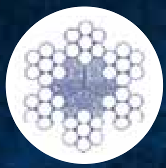
Wire Rope constructions and categories



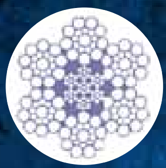
Diameter tolerance

To categorize wire rope types/constructions, several Standards identify Classes (categories)
Here are the wire rope Classes :

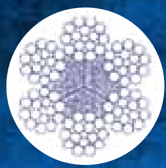
6x7 Class



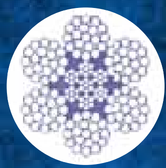
6x19 Class



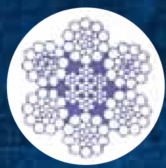
6x19Seale



6x21Filler

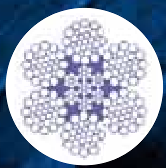


6x25Filler

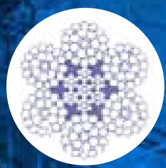


6x26WS

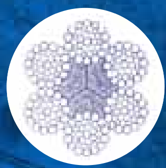
6x37 Class



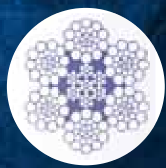
6x36WS



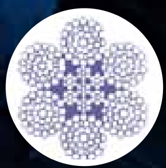
6x36SF



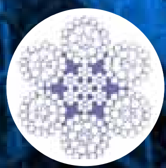
6x36WS



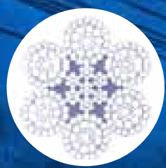
6x31FS



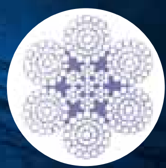
6x41Warr/Seale



6x41Seale Filler

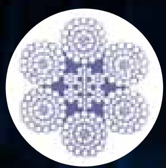


6x46Seale Filler

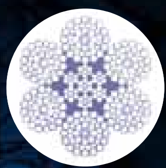


6x491FS

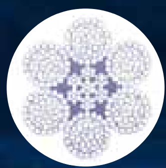
6x61 Class



6x55Filler Seale

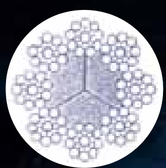


6x57SFiller Seale

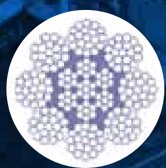


6x61Filler Warr/Seale

8x19 Class



8x19Seale



8x25Filler

Tensile grades

The industry recognizes different Classes of tensile strength for wires used to make wire rope with. The EN Standard indicates the following Classes or Grades :

1. 1570 N/mm2
2. 1770 N/mm2
3. 1960 N/mm2
4. 2060 N/mm2
5. 2160 N/mm2 (2158)
6. 2360 N/mm2 (2354)
7. 2550 N/mm2

Kiswire produces wire in all above indicated tensile grades. It is also usual to make a wire rope of a combination of tensile grades (Dual Tensile) in order :

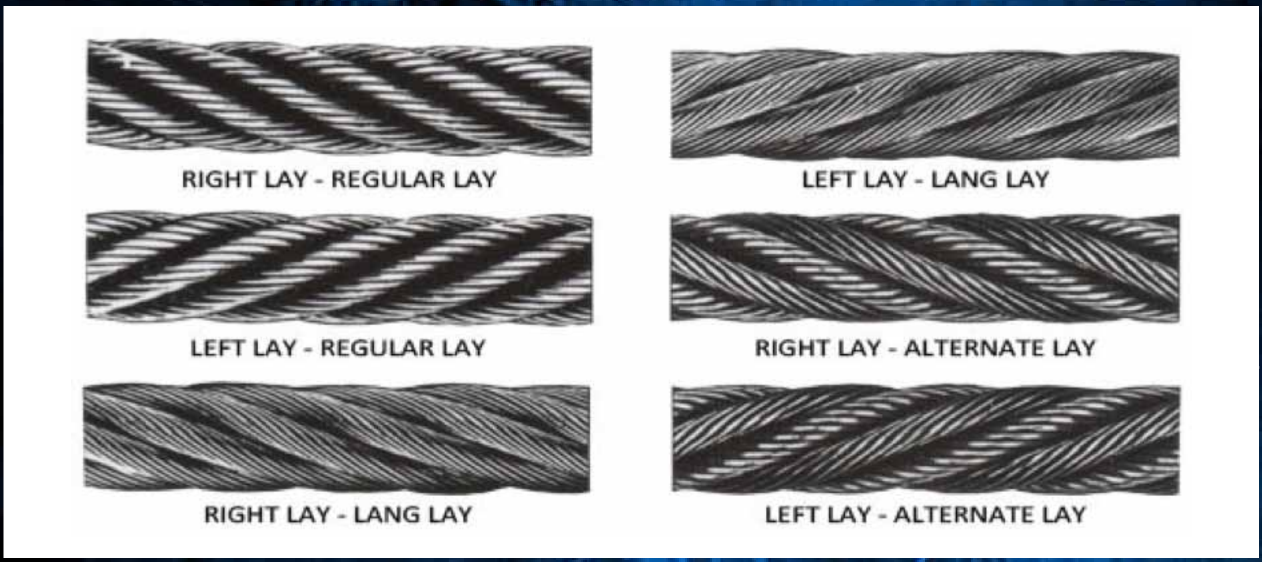
8. To facilitate higher ductility between rope and drum/sheave surfaces
9. To facilitate the demanded breaking force

Type of lay

Wire ropes are usually laid in 4 main types of lays, i.e.

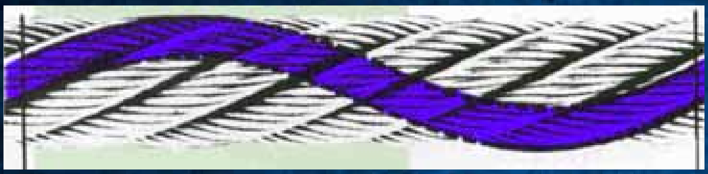
1. Right regular
2. Left regular
3. Right Lang
4. Left Lang

Another, though seldom applied type of lay, is the Alternate laid rope.



Lay length or pitch of wire rope or strand

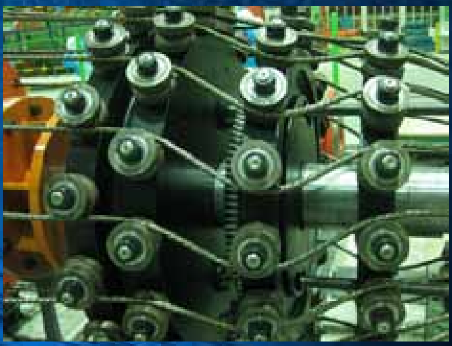
Rope lay length : is the distance a strand makes, doing one complete lay in the rope.
Strand lay length : is the distance a wire makes, doing one complete lay in the strand.



Preforming

Preforming of wire rope is a process whereby each strand is given the helical shape the strand will have when laid into a rope. See below photo. Preforming wire rope is a technology applied since the early 1970's.

Advantages of preforming are (1) less internal friction in the rope, enhancing a better bending fatigue performance (service life) (2) less torque and (3) better constructional stability.



preforming on a closing machine

Minimum Breaking Force (MBF)

Or Minimum Breaking Load (MBL). We could compare the MBF of a wire rope with the top speed of a car. It only says something about the highest strength of the rope, but nothing about its quality or ability to perform. Though the MBF is one of the main criteria for wire rope selection.

In industrial Standards the MBF values have been laid down. A wire rope that was manufactured in compliance with such Standard has to comply with the values of the Standard. The EN Standard - European Norm - is the most modern and leading Wire Rope Standard in the world these days. The API Standard, being almost in conformity with the EN Standard is a typical popular Oil and Gas market Standard. Kiswire designs its ropes according to the EN Standard as a rule. Kiswire ropes, complying with other Standards, are well available. We can design and work with almost all existing Standards.

Safe Working Load or Working Load Limit

The demanded Safe Working Load (SWL) or Working Load Limit (WLL) in combination with a required Safety Factor, determine the MBF of a wire rope. A 250 Tf hoisting capacity crane and a Safety Factor of 4, requires a rope with a MBF of 1.000 Tf.

Calculated Breaking Force and Spinning Loss

is the design force of a rope, calculating the strength of all individual component wires before the wires are spun into the helical shape of the rope. By spinning the wires and strands a so called spinning loss of strength occurs. A regular spinning loss is approx. 20%. Hence, a rope with a MBF of 100 Tf will have a CBF of 125.

Actual Breaking Force

Or, Actual Breaking Load (ABL)
That is the load a wire rope breaks on during a break test.
As long as the ABL is at least as high as the MBL the rope complies with the Standard. In reality, the ABL of a wire rope exceeds the MBL by 2 to 10%. Kiswire break tests all wire ropes after production, prior to the delivery.

Efficiency Factor

Friction forces in the rope due to bending over sheaves cause a reduction of strength of the rope. This friction is caused by conversion of the rope from a straight position into a bent position and back as well as the axial turning of the rope over the sheave while loaded. The strength loss is approx.. 2%, i.e. the efficiency factor is 0.98.

Bending Fatigue

The higher the number of cycles a wire rope achieves, the higher its bending fatigue resistance. Obviously, any wire rope user wants a rope that has a long service life, i.e. a rope that scores a large number of (bending) cycles.

The factors which impact a rope's bending fatigue are :
1. The load/tension applied on the rope
2. Drum and sheave diameters (D/d ratios)
3. The number of sheaves and their position (D/D distance and possible Reverse Bendings)
4. Velocity of operations (acceleration/deceleration)
5. Tensile of the wires

In equation: **Ft x D/d x ∑S x ∑B x D/D [x-y] x V x TS = ∑ cycles**

Obviously, one shall use the right type of rope for the application in the first place. Then, any wire rope shall be lubricated.

Bending Fatigue research in laboratory environment shows pure theoretical results, though useful. The dynamic field however shows us often reality outcomes, which in combination with the theory, guides us through the complex world of wire rope in use.

Surface Pressure

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.
As a matter of fact, 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

An indicative equation to calculate the surface pressure between rope and groove is

$$P = \frac{2xTf}{Dxd}$$

Assumed that the rope fits well into the groove. The arc of contact between rope and groove is not a calculating factor.
All arcs count equally.

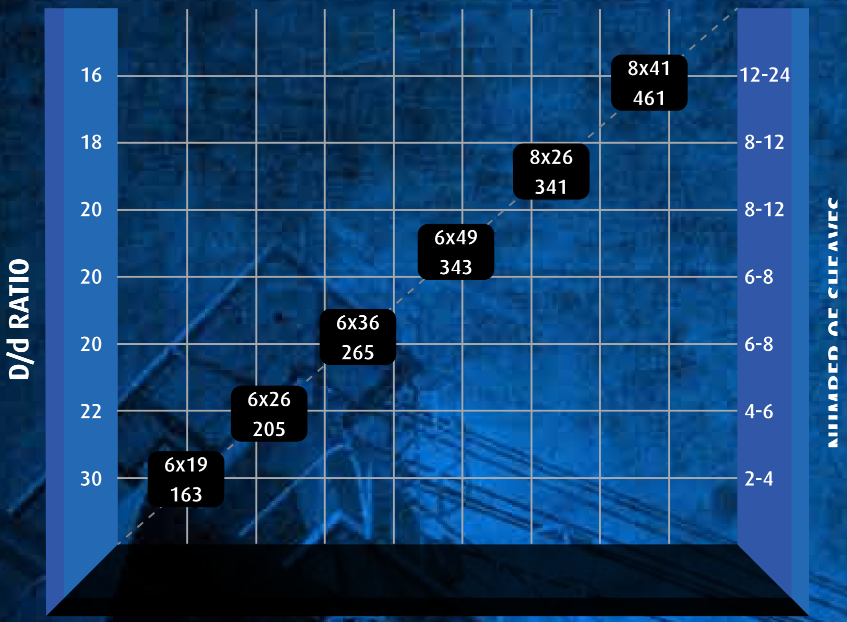
P = pressure (kg/cm²)
Tf = rope tension (kg)
D = diameter of sheave or drum (cm)
d = diameter of rope (cm)

PDF: Technical Data Sheet 2

Flexibility and Wear

More wires in a given diameter wire rope make the rope more flexible and provide a better bending fatigue performance. At the same time, quite the opposite is due as to its resistance to wear – contact of wire rope with sharp/hard edges.
For this reason, most of the wire rope constructions have larger (thicker) outer wires than their inner wires.

The challenge is to attempt finding the optimum rope construction for the application. In this respect, the phenomena bending fatigue and wear are initial wire rope design criteria.



Constructions indicated are: 6x19S+7x7 (163 wires), 6x26WS+7x7 (205 wires), 6x36WS+7x7 (265 wires), 6x49WS 7x7 (343 wires), 8x26WS+7x19S (341 wires), 8x41WS+7x19S (461 wires)

The figures in the diagram – D/d ratios/ number of sheaves against rope constructions – are indicative.

For the benefit of a good wire rope choice for a particular application several other criteria need to be exercised as well.

D/d ratios

The ratio between the Diameter of the Drum or Sheave and the diameter of the rope is of crucial influence on the bending fatigue life of a rope. A bench mark D/d ratio of a 6x36WS+IWRC construction is 20 (20 x diameter of rope = diameter of sheave/drum). Every 10% increase or decrease of D/d ratio effects the achievable number of bending cycles by 20%. A disproportional mission.

Weight and unit weight

The weights of several types of wire rope are listed in several Standards. The EN Standard appears to be ruling for most of the wire rope producers. Our catalogues therefore show the EN values mainly. Another Standard in the Oil and Gas industry is the API 9A.

The weight per meter x the length in meters is the net unit weight of a rope. Adding the weight of the reel plus packaging gives the gross unit weight.

Torque of wire rope

Due to the fact that the component wires and strands are twisted in a helical shaped rope (in order to make a rope bendable) the phenomenon torque arises. Since the component wires and strands are deformed from their original parallel structure into the helical shape any wire rope has, all component wires want to go back to their parallel structure when the helical rope is put under load.
The higher the helical deformation, the higher the torque.
And, the more component material is twisted into the same direction (right or left) in the rope, the higher the torque into the reversed direction. Hence, a Lang's lay construction rope develops more torque than a regular lay rope, because all wires and strands are laid in the same direction, either right or left.
Torque values are calculated by a formula, given the torque factors of each type of construction. 90% of all wire ropes produced and applied on the planet are :

6 strand ropes - torque factor 0.068
8 strand ropes - torque factor 0.082
Multi strand low spin ropes - torque factor < 0.02

Flexural and Bending Stiffness or Rigidity

Flexural Stiffness or Bending Stiffness of wire rope is the resistance against bending deformation.

The equation is :
E x I x 10/6 = K in N/m^2

E is the Stiffness Factor in N/mm2 (factors are available for different constructions of rope). I is the Second Moment of Inertia, i.e. the nominal diameter of the rope. K is the Stiffness in N/m^2.

Axial Stiffness and E-modulus

Axial Stiffness of a wire rope is the resistance to deform (lengthening or compression) over a certain length The formula to calculate the Axial Stiffness of a rope is :
EA = E-Modulus x Cross Sectional Area of the rope.

Note : the e-modulus is a property of the component material of a rope, expressing its resistance to elastic, non-permanent deformation under tension or compression.
whilst axial stiffness is a similar value, though of the structure, i.e. the wire rope.
Stiffer material has a higher modulus and the other way around.

Hockling of wire rope

Hockling of a wire rope is the appearance of waviness in the rope due to a combination of factors like torque, tension, amount of twist, speed of tensioning and (sudden) relieve of tension and friction reducing matters as rope lubrication and rope galvanizing.

Commonly the amount of tension in a wire rope, causing torque, distributes the torque unevenly throughout the rope. The part of the rope under permanent tension suffers least of hockling, whereas the dead end part is usually most effected.

Wire ropes with a higher torque characteristic are more sensitive to hockling than ropes with a lower torque value.

Fill Factor of rope

Determines the MBF of a wire rope in combination with the tensile strength of the individual wires used. The fill factor is the amount cross sectional area compared to the circumscribed area of the rope, given by the diameter.
A higher cross sectional area means a higher fill factor means a higher breaking force of the rope. Fill factors of wire rope vary from 60 to 80% approx.

Kiswire Factors Wire Rope

Rope Type	Metallic Area Factor	Fill Factor f	E-Modulus 20% MBL	Initial Permanent Elongation	Torque Factor at 20% MBL		Torque/Turn at 20% MBL	MBL efficiency D/d 20 load <2% MBL	Minimum recommended D/d ratio	Nominal lay length of rope
	C	%	kN/mm2	%	%		Degrees	%	X	X rope dia
					Ordinary	Lang's				
N2^{e} 6x36WS+ IWRC	0,48	59	100	0,1	6,8	7,0	60	97	20	6,5
N2^{e} 6xK36WS+ IWRCP	0,54	68	108	0,75	6,8	7,0	60	97	20	6,5
N2^{e} 8x26WS+ IWRC	0,48	59	93	0,1	8,2	8,4	85	98	18	6,5
N2^{e} 8xK26WS+ IWRC	0,54	68	98	0,75	8,2	8,4	85	98	18	6,5
N2^{e} 6xK36WS+ IWRCP	0,54	69	108	0,75	6,8	7,0	60	97	20	6,5
N2^{e} 8xK26WS+ IWRCP	0,54	69	98	0,75	8,2	8,4	60	98	18	6,5
N2^{e} Hyrope 35xK7	0,54	70	108	0,1	1,2	1,5	0,5	98	20	6,0
N2^{e} Hyrope 40xK7	0,54	70	108	0,1	0,7	0,9	0,5	98	20	6,0
N2^{e} Hyrope 55xK7	0,54	70	98	0,1	1,4	1,7	0,5	98	20	6,0
N2^{e} Spiral Strand	0,59	78	155	0,01	0		n/a	n/a	n/a	n/a
N2^{e} Locked Coli SSP	0,60	78	165	0,005	0		n/a	n/a	n/a	n/a

Notes: All figures are avergae; for specific data, please consult Kiswire. IWRCP = rope with plastic infill

Ovalisation of wire rope (radial stability)

When wire rope drives in the groove of a drum or sheave under tension, it tends to ovalize partly. A rope with a high fill factor, a high cross sectional area, a plasticated IWRC, i.e. a solid, constructional stable type of rope shows the lowest ovalisation = the highest radial stability. Unstable rope constructions tend to be more vulnerable on multi-layer spooled drums than ropes with a high fill factor.

Compacting wire rope

… is done by pulling the individual wire rope strands through a dye, which has a smaller diameter than the diameter of the strand. A strand with a diameter of 20 mm is squeezed down through the dye to a diameter of for instance 18 mm (10% compaction) keeping the strength of the 20 mm strand. When all component strands have been compacted they are closed into a rope around a core (IWRC). A 10% compaction results in a wire rope with approx.. 10% higher breaking force compared a similar, non-compacted rope in the same diameter.

Regular compacting ratios vary from 5 to 20% of the diameter of the strand. The average ratio in the industry is 10 to 13 %.

Advantages of compacted wire rope versus regular round strand wire rope are :

1. More metallic area, higher fill factor
2. Higher breaking force than regular round strand ropes
3. Better constructional stability
4. Higher resistance to drum crushing and interlocking
5. Better diameter control during production
6. Better bending fatigue performance – more bending cycles achievable

Compaction roller

Rounded

Compacted

Metallic area of a wire rope

Is the sum of the cross-sectional areas of individual wires in a wire rope or a strand.
The equation is **A = d2 x factor**

Metallic Area factors of different types of rope are available on request.

Example calculation of a 76 mm rope in the construction 35xK7 is :
76 x 76 x 0.54 = 3.119 mm^2

Design Factor or Safety Factor of wire rope

Is the ratio between MBF and the WLL of a rope. Commonly, the designer of the device a wire rope shall be used on designs the maximum load the device is expected to carry. The ratio between these two criteria is the Design Factor or Safety Factor. A regular Safety Factor is 5. A wire rope with a MBF of 100 tons : 5 makes a WLL of 20 tons.

Constructional length extension

When a rope is loaded, constructional lengthening due to the bedding down of the all 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, its fill factor, the load, 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.

Length extension due to overloading of a rope, more than the yield point of the material, causes permanent extension (deformation) 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.

Back Tension on storage reels when spooling

The spooling from the storage reel on to the crane winch shall be done with a certain amount of back tension in order to get the wire rope tight in the grooves of the winch drum. Slack rope layers shall be avoided at any cost. The amount of back tension depends on the size of the rope and its strength (MBL – Minimum Breaking Load). Commonly a back tension of 1 to 2% of the rope's MBL is applied. Upon ordering a wire rope one shall agree on the specs of the storage reel with the producer, i.e. the amount of back tension the reel shall be compatible with.

Remember to wind the rope from the storage reel on to the crane winch drum in the same bending direction. So, from top to top or from bottom to bottom.

Training of a wire rope

Training of a wire rope prior to its actual use is recommended. By loading the rope to 5% of its MBL and running it 3 times in and out from its winch/sheave device, the rope components bed down in its designed structure by which the rope's elastic and constructional behaviour is improved.
Training of rope increases the number of achievable bending cycles.

HYROPE Wire Rope management guide

See the Wire Rope Management Guide at the top of the Home page

---

Slewing cranes and impact on rope turn

If the upper part of a crane slews in a certain degree and the hoisting wire rope is on the traction winch in the static bottom part of the crane, we assume there will be a certain degree of rope turn along with the slew direction of the upper crane part. Dynamic field tests shows us the following equation to calculate the rope turn.

Equation only available upon personal request.

Alumar® zinc/aluminium wire coating

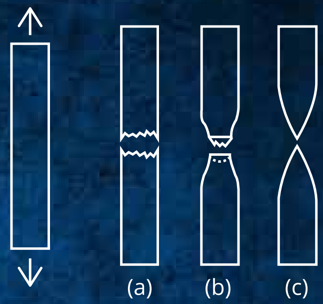
Traditionally, wire rope wires are galvanized (zinc coated) according to the EN Standard Galvanizing type B. This coating gives x grams of zinc per m2 wire. Zinc protects the steel from corrosion.

Alumar® zinc/aluminium coating is equally applied to the wire in terms of grams per m2, however, Alumar coated wires protect the steel wire 3 times better and longer from corrosion than B galvanized wires. Salt Spray tests are available upon request.

Ductility

Ductility is a solid material's ability to deform under tensile stress; this is often characterized by the material's ability to be stretched into a wire. Ductility is especially important in metalworking, as materials that crack, break or shatter under stress cannot be manipulated using metal-forming processes such as hammering, rolling, and drawing.

Read for metal-forming also a wire rope in operation, whereby the rope stresses and compresses permanently by bending over drums and sheaves under load. Rope component wires with a fine ductility are essential to a good rope performance.



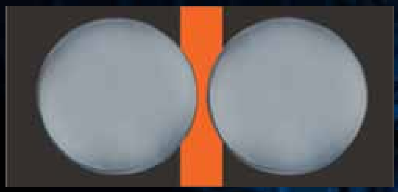
(a) Brittle fracture
(b) Ductile fracture
(c) Very ductile fracture

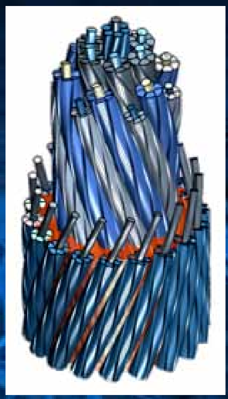
Wire rope with plastic infill

Are wire ropes of which the IWRC or inner strands are extruded with HDPE (high density polyethylene). At the time of closing the strands around this extruded core the HDPE is softened by heat, which enhances the strands to lay down in a bed of PE shaped around the strands and wire rope core. This HDPE 'bed' is a buffer between the steel components of the rope, i.e. a soft, protective, anti-friction layer between the strands and between the strands and the core (IWRC).

Plastic infilled ropes

1. less friction cause less internal wear
2. Show higher constructional stability
3. Prevent water and dirt to penetrate into the core
4. Lubricant remains under the PE layer
5. Ask for consult ...




Wire rope lubricants

During the manufacturing of wire rope, i.e. during the closing of the wires into a strand, lubricant is applied to provide the inside and outside of the strand with a lubricant. The same process goes for the IWRC of the rope. A wire rope therefore is lubricated entirely, inside and outside, when delivered.

The main function of wire rope lubricant is to reduce internal friction of the wire rope in use. The achievable number of bending cycles between a lubricated rope and a not lubricated rope is 100 versus 40, respectively.

Another friction reducing factor is the zinc coating on wires. Galvanized wire ropes generate lower internal friction than not galvanized wire ropes. The zinc layer acts as a lubricant.

The secondary function of lubricant is to protect the rope from corrosion, temporarily.

Operating temperatures of the best available wire rope lubricants vary from minus 50 to plus 120 degrees Celsius.

Re-lubricating a wire rope in the field is a delicate matter. Realistically, a proper re-lubrication is hardly possible and therefore not efficient. The best option in this respect is to spray fluid, penetrating lubricant on the rope, hoping the lubricant gets inside the rope to a certain extend. Other methods of re-lubricating are equally efficient. Upon request a specific advise is available.

Pitch of drums and sheaves

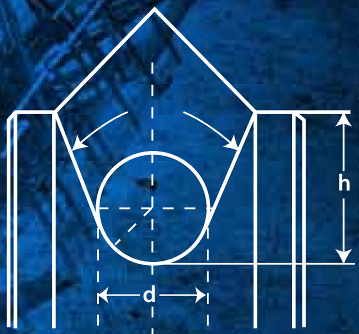
Given the pitch of a drum or sheave groove for a wire rope, the rope's off tension diameter shall ideally be 1% smaller than the pitch. Obviously, wire ropes with a larger diameter than the groove pitch would not fit and complicate the spooling/installation of the rope and worse, the rope would not function on the drums and sheaves. A rope that is too big would not fit into the grooves, causing each layer to grate with the neighboured layer until unrepairable damage occurs. After all, the rope length would not fit on the drum..

Contrarily, a wire rope with a too small diameter for the groove pitch would equally not function. One of the things happening here is the rope being spooled on a multi-layer drum would sink away between the gaps of the underlaying layer. These gaps are a result of a too small diameter rope.

It is therefore essential for the correct processing of wire rope production to know the precise groove dimensions (pitch) of drums and sheaves the rope is used on.

The industry knows the following diameters :
Nominal diameter. Off tension diameter. Under tension diameter.

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)



Sheaves

Amongst others, sheaves are used to direct a wire rope into the directions one wishes. Wire ropes bend over sheaves in a certain degree/arc. The use of sheaves feature :

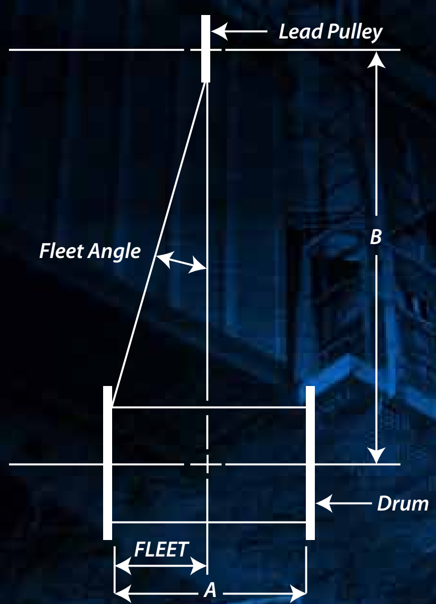
(1) The less sheaves/bends, the better bending fatigue performance of the rope.
(2) The larger the D/d ratio – the ratio between the diameter of the sheave (D) and the diameter of the rope (d) – the better bending fatigue performance of the rope.

Wire rope sheaves are made of steel or plastic. Steel sheaves and wire rope have more friction with each other, causing abrasive wear and/or wire breaks on the surface of the rope. This wear on the outside of the rope functions as an indicator of the wear inside of the rope. Plastic sheaves tend to leave less visible wear on the outside of a wire rope.

Plastic sheaves cause less wire breaks and/or wear in the outer wires of the rope during use. This visibly better rope condition requires a strict discard procedure for ropes used with plastic sheaves. NDE testing is a recommendation.

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.



Hardness of rope and groove

An important factor in respect to surface pressure between rope and grooves is the hardness of steel of both the rope and the groove. The wire rope hardness is commonly little higher than the groove hardness in order not to damage the wire rope in the first place. A damaged wire rope is more critical as to safety than a damaged sheave. On the other hand, a soft sheave groove wears quicker under the running of the rope in it, which leaves tracks in the groove. Such tracks often damage the rope again.

Hardness of Wire Rope		
Tensile grade rope wire EN	Approximate API equavalent	Approximate Hardness Brinell
1570 N/mm2	PS	415
1770 N/mm2	IPS	460
1960 N/mm2	EIPS	475
2160 N/mm2	EEIPS	490

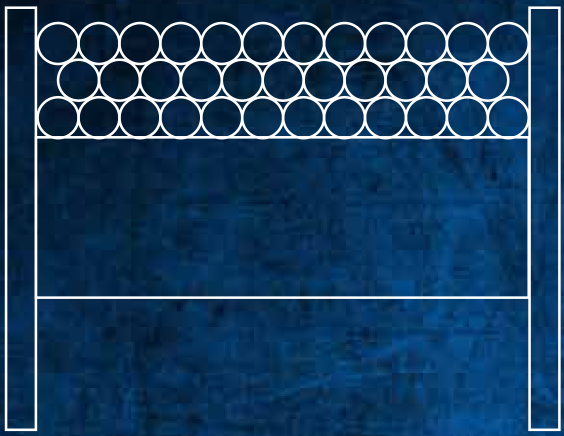
Recommended Sheave Groove hardness Alloy Steel is 250 to 300 Brinell

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. Swivels shall not be used with 6 and 8 strand ropes.
Then again, it is often recommended to use a swivel on rotation resistant, multi-strand wire ropes.

Swivels are available in different types, i.e. Closed body swivels Deepwater HD swivels, CR swivels, and more.

Lebus rope spooling system



PDF: Data Sheet 8 Lebus

Discard criteria

The ISO 4309 Standard describes discard criteria for wire ropes on the basis of visible broken wires in the rope. In the below graph we list a few Kiswire constructions and their relevant broken wire discard criteria.

We recommend to have deteriorated wire ropes with several visible broken wires checked upon their quality by experts.

ISO 4309 - 2010 Discard criteria wire rope by visable broken wires - a summary

Application of Wire rope	Rope construction	RCN Number	Load bearing wires	Allowable broken wires Single layer spooling Regular lay rope		Allowable broken wires Multi layer spooling Regular and Lang lay rope	
				6xd/e	30xd/e	6xd/e	30xd/e
Drill Line	N 6x19S	02	51/75	3	6	6	12
Drill Line	N 6x26WS	06	101-120	5	10	10	19
Drill Line	N 6x31WS	08	121/140	6	11	11	22
Anchor/Mooring	N 6x36WS	09	161/180	7	14	14	29
Riser Tensioner	N 6x41WS	09	201/220	9	18	18	38
Anchor/Mooring	N 6x49WS	09	221/240	10	19	19	38
Boom Hoist	N 6x26WS	09/11/13	208/288	10	21	21	42
Main Hoist	HYR 35xk7	23-1	112	3	5	5	10
Main Hoist	HYR 40xk7	23-2	126	3	6	6	13

RCN numbers

The above guidance document wire rope discard criteria introduces a system whereby any rope construction, existing or yet to be introduced to the market, can be categorised by a rope category number, or RCN, that is directly linked to the individual discard criteria covering visible broken wires.

Packaging of wire rope

All Neptune and Hyropes are delivered on standardized steel reels with cradle. Depending on the size of the wire rope unit (length and diameter) that has to be stored on the reel, the Kiswire reels have different details such as centre shaft hole, pin holes, barrel. Drawings of our reels are available. Our reels are designed and manufactured to take a regular back tension for spooling. In the event the customer wishes reels of a nonstandard specification, we design and deliver these as well.

Certification

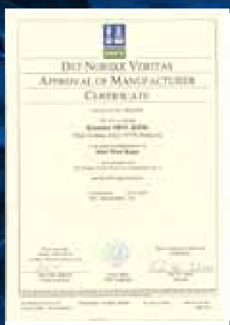
Kiswire manufactures its products in compliance with high Standards, like EN and API.

Our Management Systems have been certified by DNV.

Almost all Oilfield Ropes are supplied under Class of the various Classification Bureaus, like ABS, DNV, LLOYDS, BV and many others.


Certificate of Registration
API Specification Q1


ABS
Certificate of Design Assessment


Det Norske Veritas
Approval of Manufacturer Certificate


ABS
Certificate of Manufacturing Assessment


Management System Certificate

Strain Aging of steel

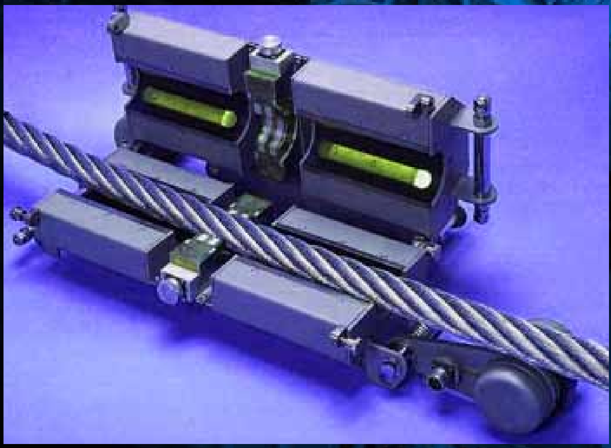
PDF: Data Sheet 9 strain aging

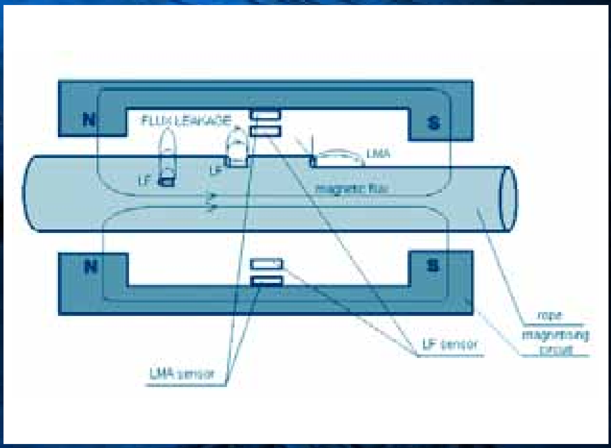
NDE - Non-Destructive testing Wire Rope

In order to assess the quality of a wire rope internally, beyond visibility, we nowadays avail of a method to see inside a wire rope by making a Magnetic Flux track of the rope. This NDE or NDT scan detects broken wires, loss of metallic area, and other internal rope distortion.

The most effective way of using this technology is to have a NDE scan made of the newly produced wire rope, which then later can be compared with the scans made after use in the field. This way, quality differences can be noticed the easiest way.

Kiswire/Neptune Hyrope offers NDE/NDT scans both of new ropes as well as ropes in use on site.



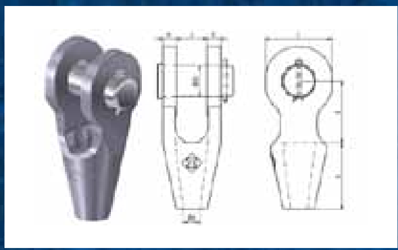


Rope end fittings

Oilfield ropes are mostly delivered with resin cast sockets, like the CR (Chain Rope) sockets, the OSS (Open Spelter) sockets and the CSS (Closed Spelter) sockets. As a rule, we supply the OSS sockets in the Bolt/Nut version.

Custom made Lebus Sockets can be supplied as well.
Just like any other requested rope termination.

PDF: CR Socket



PDF: OS Socket

PDF: CS Socket

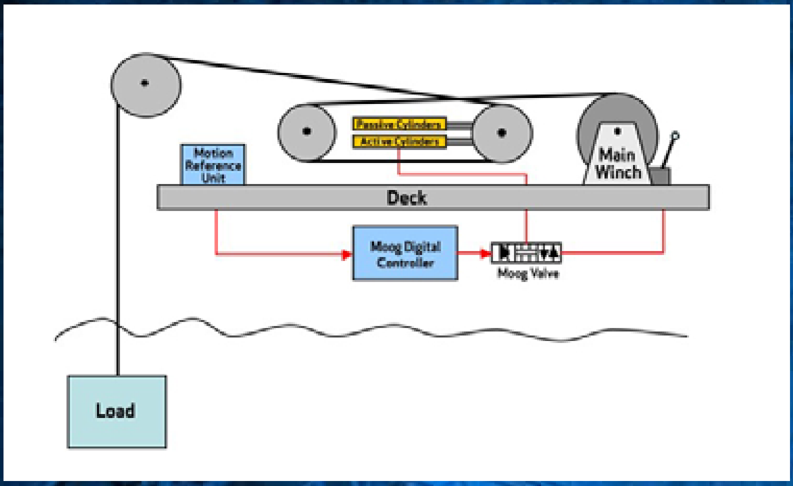
HYMOOR sockets

A forged socket with stiffener for a HYMOOR LTM spiral strand.

Active Heave Compensation

is a technology used on wire rope operated devices and systems, such as cranes, to reduce the influence of waves and swell on the lifting/hoisting system. Cranes and subsea hoisting, operating offshore, are often equipped with AHC systems. Using these AHC systems, a wire rope is constantly running up and down the AHC sheaves over a certain length. This causes additional bending fatigue on that particular part of the rope.

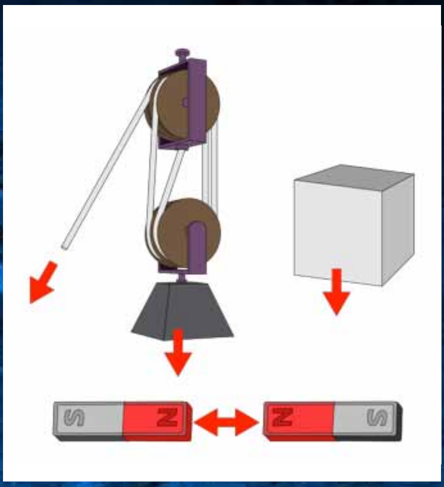
Adequate consult selecting a type/construction wire rope for an AHC operated system is recommended.



Force is Mass x Acceleration

In physics, a **force** is any interaction that, when unopposed, will change the motion of an object.[1] In other words, a force can cause an object with mass to change its velocity (which includes to begin moving from a state of rest), i.e., to accelerate. Force can also be described by intuitive concepts such as a push or a pull. A force has both magnitude and direction, making it a vector quantity. It is measured in the SI unit of newtons and represented by the symbol **F**.

Forces are also described as a push or pull on an object. They can be due to phenomena such as gravity, magnetism, or anything that might cause a mass to accelerate. (Material Scientist))



Momentum or Linear Momentum is the product of the Mass and Velocity of an object. In equation : p = mv

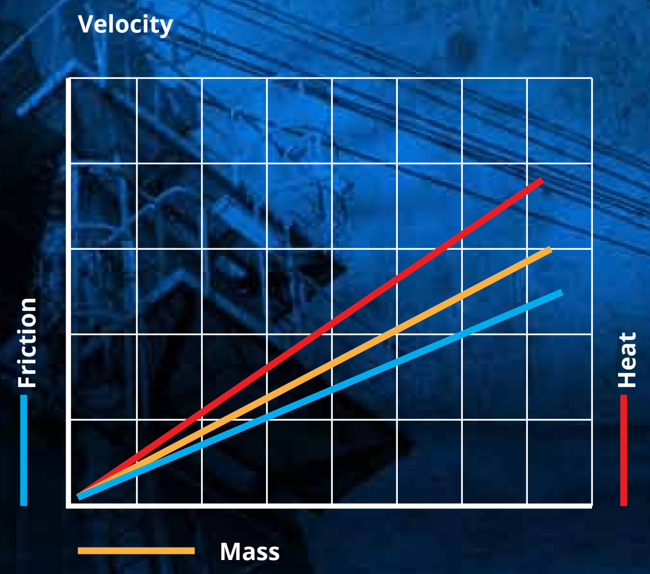
Inertia is the resistance of any physical object to any change in its state of motion. In equation : F = ma F is the net force applied, m is the mass of the body, and a is the body's acceleration.

Mass in Physics is more than just the Weight of an object. However, in the Wire Rope environment we take the Weight of an object as its Mass.

Kinetic Energy of an object is the energy that it possesses due to its motion. Moving an object by a Force from its rest to a certain velocity the object gains (kinetic) energy. It takes the same amount of force to decelerate the object to a state of rest. In equation : K = 1/2 mv 2

Geometry is a science concerning Shape, Size, Figures and Space. A dominant mathematical science. The design of Wire Rope is based on geometric principles.

Friction is the Force resisting motion between elements (material) when it is subjected to deformation. Friction between surfaces of material converts Kinetic Energy into **Thermal Energy** (heat). Friction of materials causes Wear of these materials.



Abrasion (mechanical) is the process of scuffing, scratching, wearing down, marring or rubbing away. Abrasion of material is usually not wished. Lubrication of materials can reduce abrasion effects.

Transport

We transport our ropes all over the globe to almost any destination. Kiswire manages Logistics to flow material efficient and in time to its point of production to its point of 'consumption'. All versions of Incoterms are practised by us, every day.

Warranty

‘A Warranty Term is a vote of confidence between manufacturer and customer’.

All Kiswire products are designed and manufactured according to the World’s highest Standards. Our Warranty Terms guarantee their great performances.

Wire rope workshops

We give wire rope workshops and lectures. Please, contact us for a session.