

# Handling Brochure



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for specialty wire ropes/general purpose ropes

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## Notes

### INSTALLATION INSTRUCTIONS

In time, all steel wire ropes will need to be replaced due to their limited service life, which is normally significantly shorter than the service life of the application.

**The installation process** differs between the applications. However, regardless of the type of application, the following instructions should be followed to avoid consequential rope damage in advance:

- **Avoid counter-bending**, pay attention to the direction of feed and return spooling.
- **Maximize distance** between first incoming sheave and rope reel (>6 m)
- Always **install a swivel** between pull-in rope and the new rope.

**The rope installation** must be carried out with the necessary care and work safety.

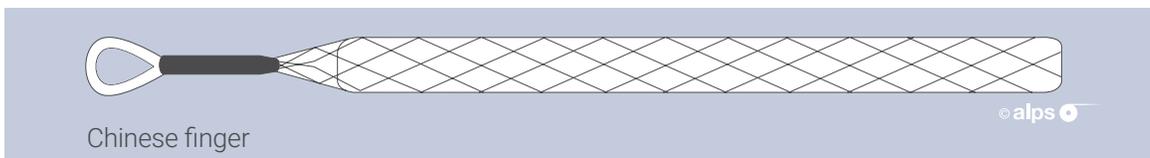
Before installing the rope, the rope construction and the direction of lay with the winch drum and the rope system should be analyzed. Condition and dimensions of the rope grooves in drums and rope sheaves must be checked to ensure that they comply with the specifications. If the new rope is used with an auxiliary rope of lower diameter, a non-rotating rope design or a synthetic rope construction can be selected.

When pulling in a new rope with the old rope, the ends should be connected with a swivel. Twists from the old rope can occur during the pulling process and will be eliminated by the swivel.



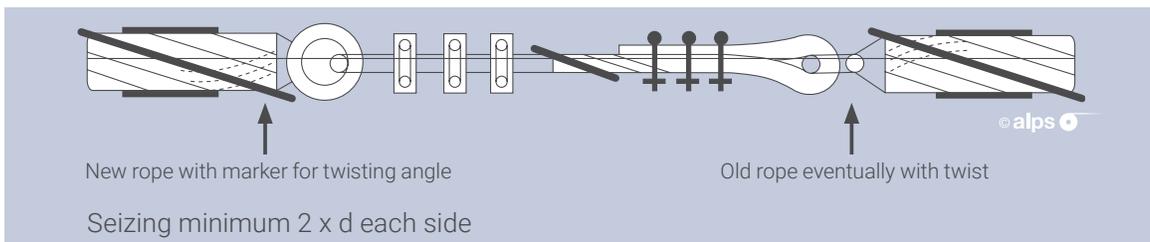
Before each rope change, sheaves must be checked for suitable groove profiles, negative impressions and ease of movement such as groove geometry and general condition of rope drum.

### New rope and old rope with the same diameter



Chinese finger

### Connecting rope with rope clamps according to EN 13411-5



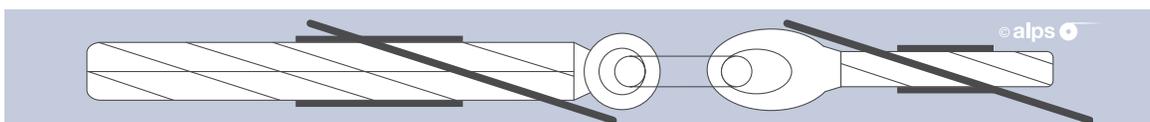
New rope with marker for twisting angle

Old rope eventually with twist

Seizing minimum 2 x d each side

Only ropes with same lay direction!

### Pulling rope with smaller diameter

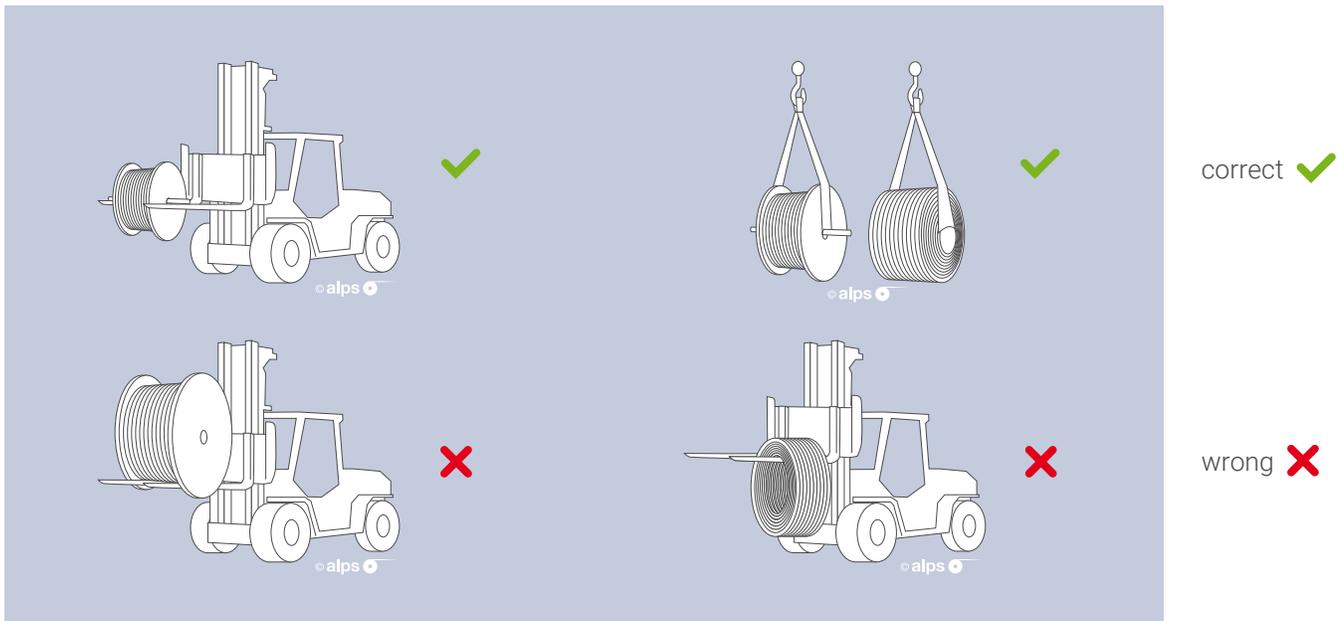


# GENERAL INFORMATION for specialty wire ropes / general purpose ropes

## UNLOADING AND TRANSPORTING

The handling of wire rope reels requires a certain degree of caution. The reel should therefore be unloaded from the loading area either by means of a forklift, where the reel is lifted by means of a sufficiently dimensioned

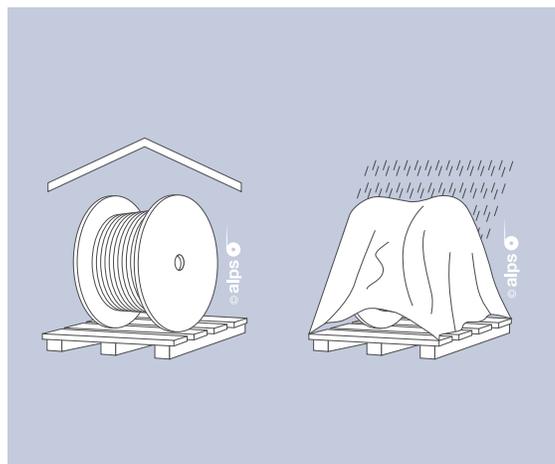
shaft as attachment points for the forks, or by means of an overhead crane as described in the picture below. The wound reel of wire rope should be moved as described before. Reels can easily be knocked over by the forklift which may damage both the reel and wire rope, so it is not advisable to do so.



## STORAGE

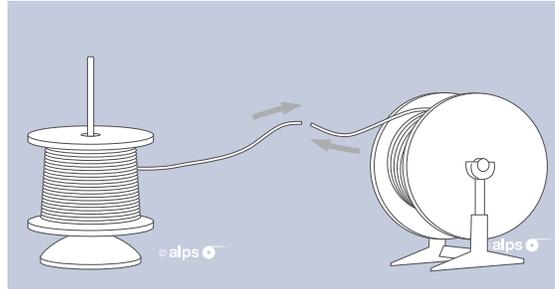
After unloading, the reel must be stored in the correct manner. It is important that the reel is always supported with a pallet to protect it from soil moisture. In addition, storage should take place in a covered area where the rope is protected from the weather.

In all situations the reel must be protected from direct rain and sunlight. Even if the storage is only short-lived, the measures described above must be applied.

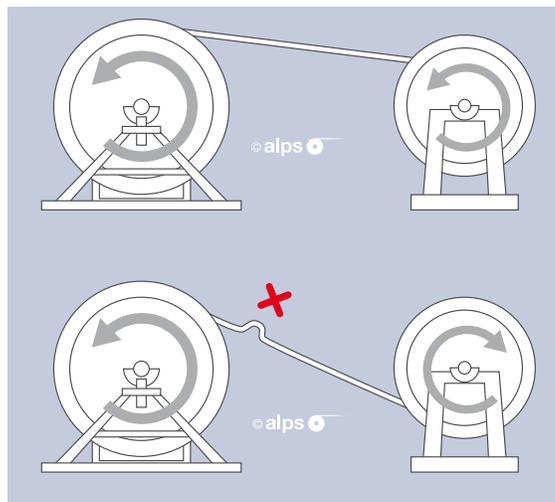


## HANDLING

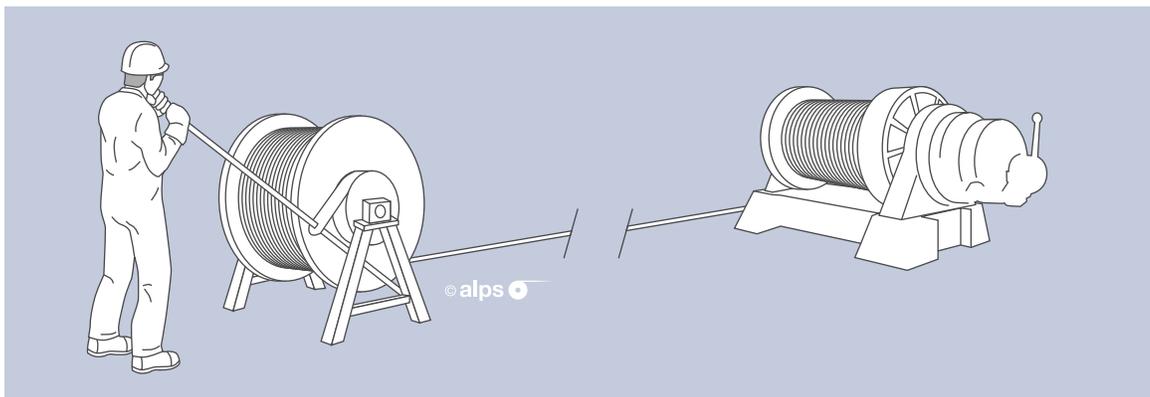
Suitable devices are required to spool the defined rope length onto a drum or to bring the rope into the reeving system. Thus, turntables or reel stands, as shown in the picture, provide optimal conditions for installing the rope.



For ropes that are **wound onto drums**, it is also important that the correct winding direction is maintained and that the rope is **installed with a pre-tension**. If the rope leaves the reel from the top, it must also be wound onto the drum from the top. **Always reel from top to top or bottom to bottom** otherwise the result will be rope damage which can make the rope unusable. The **pre-tensioning** of the rope to be installed ensures rope safety and an ideal spooling pattern on the drum. This pre-tensioning is obligatory, as the rope can be easily destroyed during the first hoist operation with load if it is spooled loosely onto the drum.



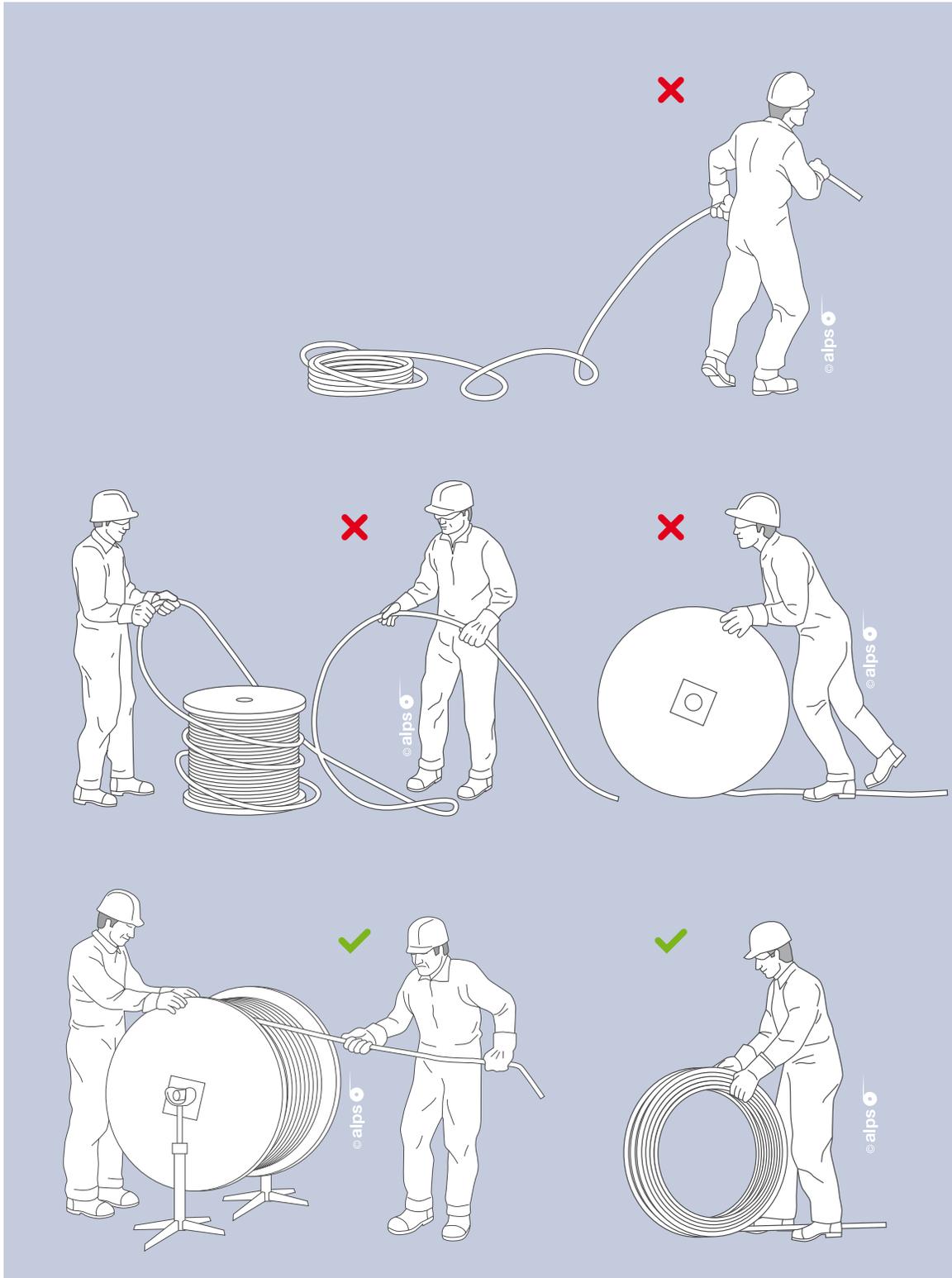
According to the standard, **a pretension equivalent to at least 2.5% to 5%** of the minimum breaking load should be applied. Often these values cannot be achieved with the given devices, therefore the motto here is "the more the better". The following figure shows the correct winding direction and a winding process in which the reel is braked.



# GENERAL INFORMATION

for specialty wire ropes / general purpose ropes

The following picture shows correct and incorrect general rope unwinding methods.



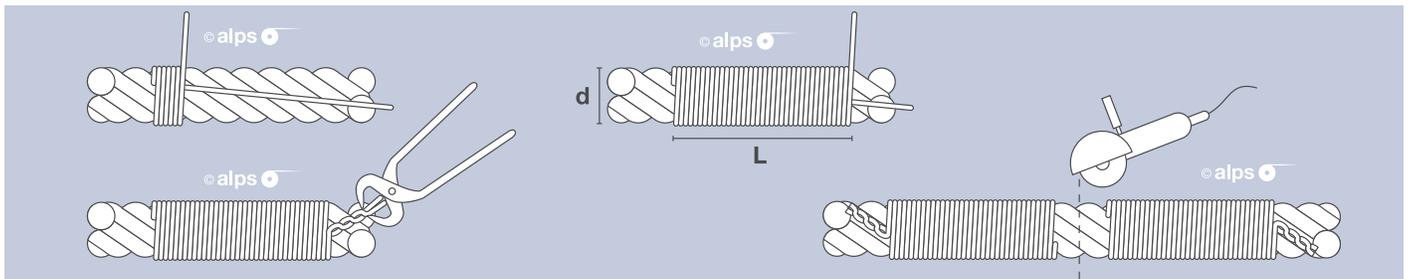
wrong ❌

wrong ❌

correct ✅

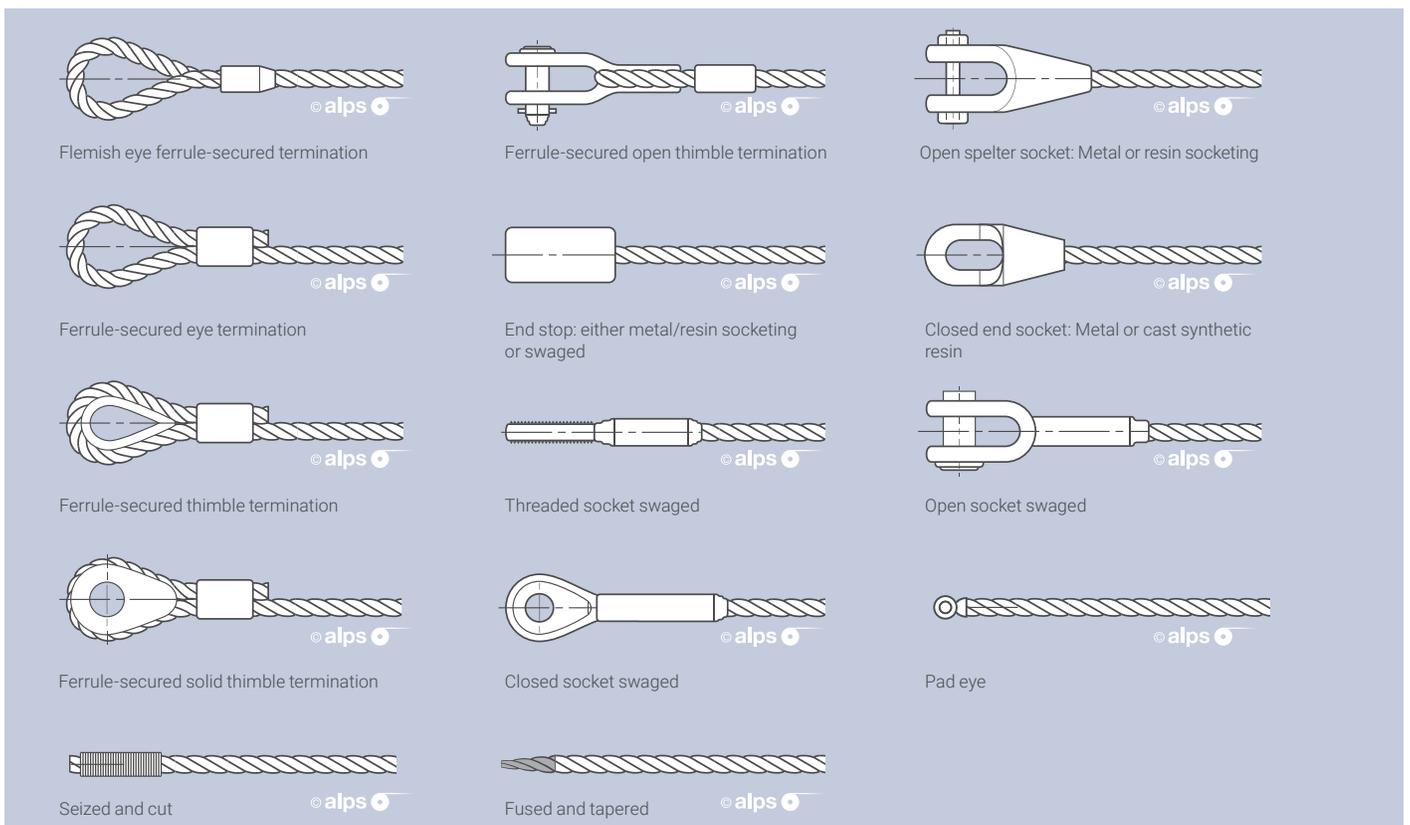
## CUTTING

Steel wire ropes consist of many strands closed in a helix and due to this structure ropes must be secured against untwisting. This is usually ensured by welding the ends together or by attaching a suitable end connection. If the rope is to be shortened from its original length, it must be secured on both sides of the desired cutting point. The pictures below shows the use of seizing wire, which must be applied in order to secure. The length of the joint is defined as follows:  **$L = 2 \times \text{rope diameter } d$**



## ROPE END CONNECTIONS AND ROPE ENDS

The connections listed below are commonly used in the rope industry. The selection of the correct end connection depends on the type of rope and application.



# Correct rope inspection

## WHY ROPE INSPECTION?

Ropes in rope drives are open gears which are exposed to external influences but also have common signs of wear. Above all however, the service life of a rope is limited. Once the rope has reached its discard criterion, it has also reached the end of its service life. The rope's discard state must be detected early enough to avoid accidents such as a rope break. This detection requires regular rope inspections, which document the percentage of rope life left before it is ready to be discarded.

### **A meaningful rope inspection should consider the following points:**

- General visual inspection (places requiring increased attention)
- Diameter measurement with a suitable tool and at different strategic positions
- Measurement of rope lay length
- Evaluation of degree of corrosion, if any
- Inspection and classification of the most frequently stressed rope zone for wire breaks
- Measurement of the groove diameters located in the rope drive
- Evaluation of the amount of lubricant on the rope surface.

Such inspections must be carried out on a regular basis. The intervals of the different

tasks mentioned may vary. **A visual inspection should be carried out daily, but the diameter for example should be measured monthly or quarterly**, depending on the load and on the frequency of use.

## GENERAL VISUAL INSPECTION

With a general visual inspection, obvious damage such as cracked strands or errors in the reeving should be detected at an early stage and, if possible, repaired before the start of operation. In this case, places near the end connection or places that could get into contact with the crane must be inspected with increased attention. This inspection should be carried out carefully by the crane operator.

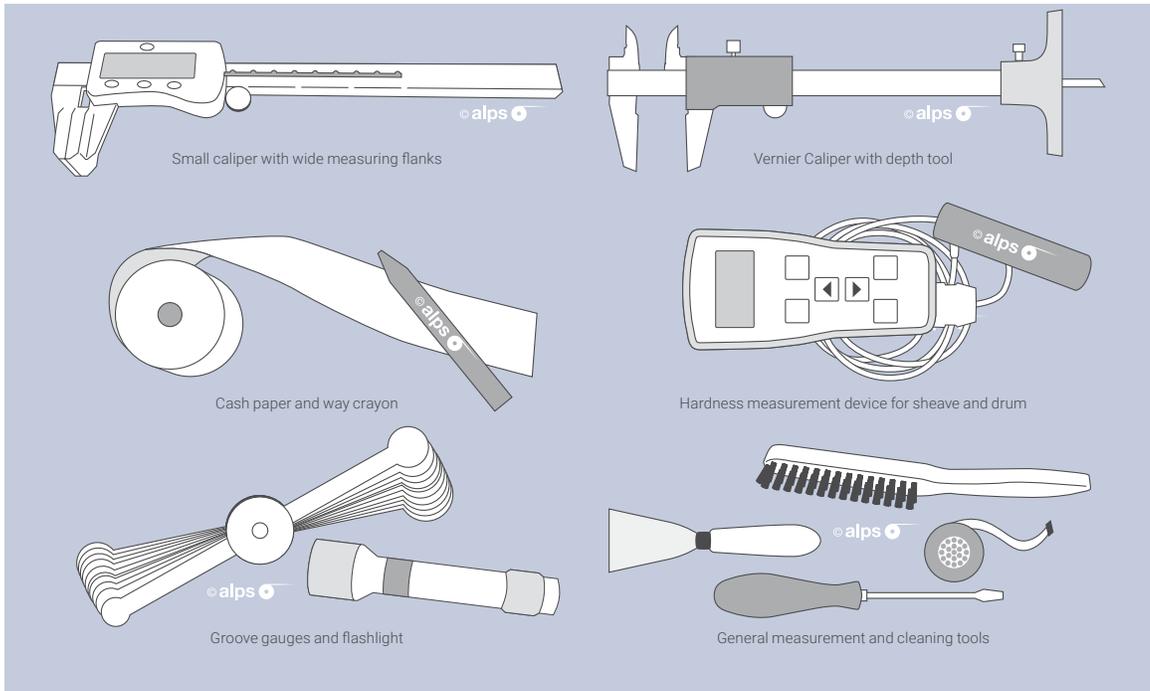
## REGULAR INSPECTION

The regular inspection must be carried out by a competent person. The complete crane system should be monitored and maintained.

### **Practical examples**

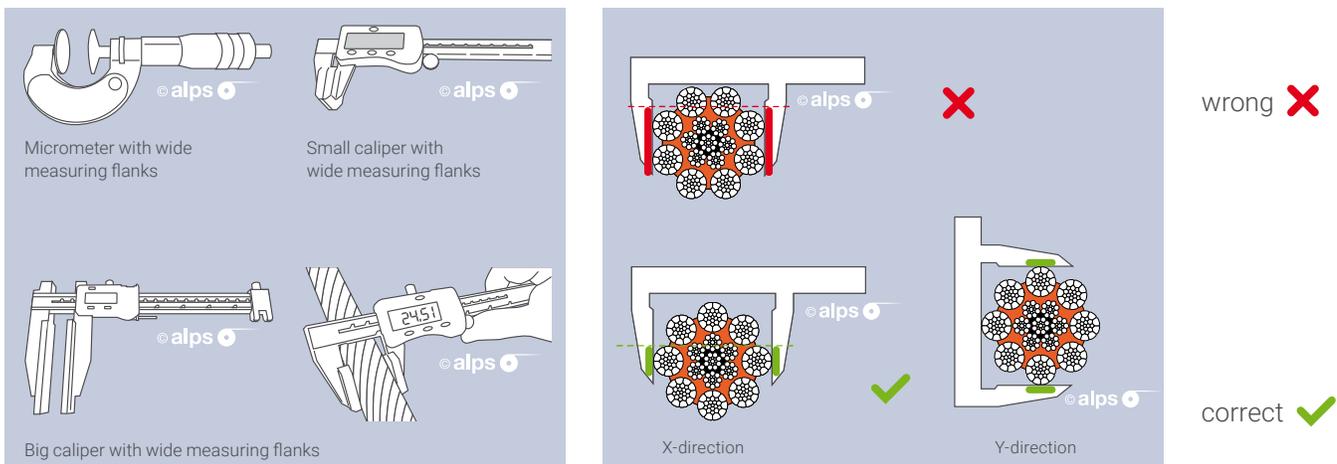
- Measurements to be carried out on a quarterly basis: Diameter and lay length
- **Annual measurements: groove size, sheave depth, hardness of sheaves and drum (optional)**

## TOOLS



## DIAMETER MEASURING

Measuring the diameter of a wire rope during operation provides information on the wear and the diameter reduction. However, an increased diameter may also occur to a structural change. The diameter of the rope should always be determined with the aid of suitable measurement equipment. Small calipers with wider measurement flanks are advantageous here. The following pictures display suitable measuring equipment.



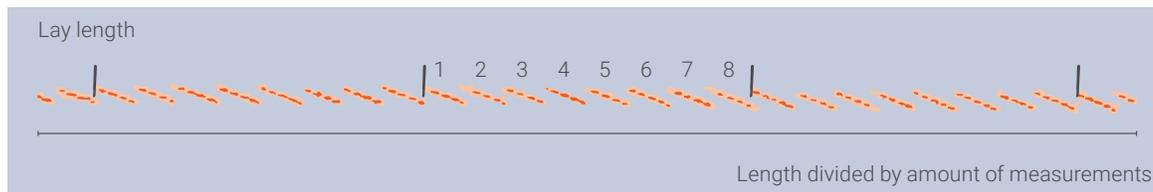
# GENERAL INFORMATION for specialty wire ropes / general purpose ropes

## LAY LENGTH MEASURING

An indication of whether a rope has been twisted by force or has generally undergone an unnatural twist can be found in a resulting change of lay length. In order to measure the lay length, the following utensils are required. A negative of the rope surface is created with the help of a cash register roller and a wax crayon. In this process, a cash register paper must be placed on the rope surface while a wax crayon is moved across with downwards pressure. As a result, there is an impression

of the rope strands on the paper. In order to determine the lay length of the rope a certain number of impressions must be counted. Here the number of outer strands are known (in the picture above there are 8 outer strands).

The distance from the beginning of the first strand and the end point, the beginning of the ninth strand, gives the lay length in mm or inches. It is recommended to **count at least three measurements and divide the total length by three parts** in order to reduce measuring errors (see picture).



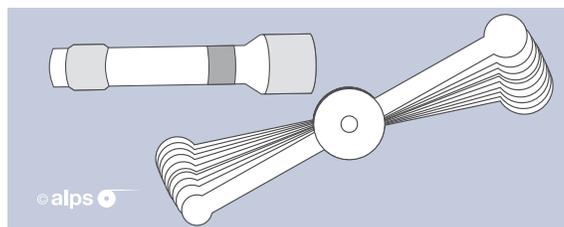
## SHEAVE GROOVE PROFILE MEASURING

A rope inspection includes not only the inspection of the rope itself, but also of the sheaves in which the rope runs. Special measuring equipment is required to measure the groove diameter:

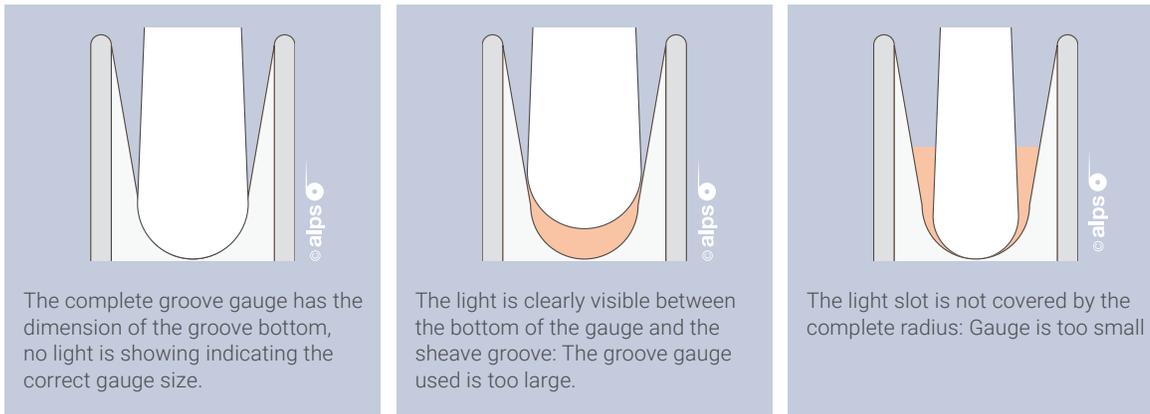
Such groove gauges are available upon request from Alps™. The values indicated on the gauge are actual values and not, as it is sometimes the case, target values.

The flashlight serves as an aid to determine the exact measurement. Here the gauge in the groove is illuminated from behind. If light shines through on the sides between the gauge and the sheave, this indicates, that the used gauge is too large. If there is no light visible at the complete radius of the gauge, the correct groove size corresponds to the gauge size used.

Groove gauges and a flashlight.



The following pictures show the different scenarios that can occur during measurement.



R = groove radius  
d = Nominal rope diameter

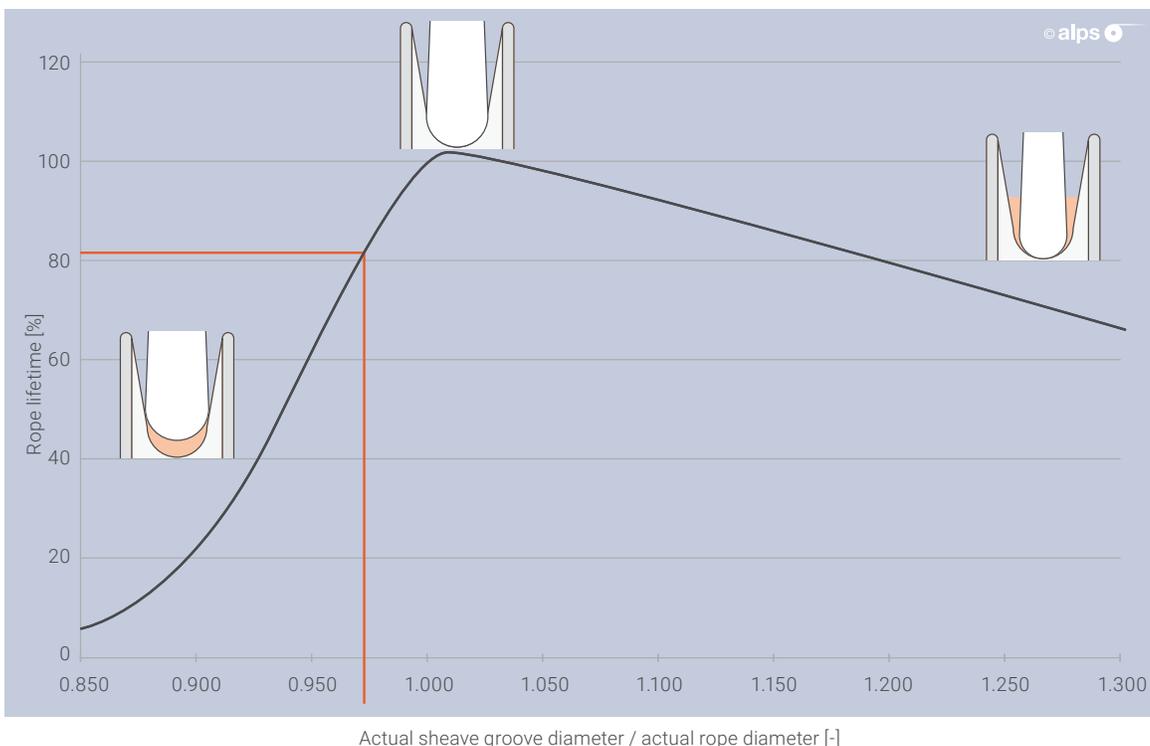
According to the standard, the groove radius R should be between  $0.525 \times d$  and  $0.550 \times d$ , the optimum groove radius is  $0.5375 \times d$ .

**Example:**

For a rope with a nominal diameter of 0.87 inch (22 mm), the following values apply:

- Minimum allowed groove diameter: 0.91 inch (23.10 mm)
- Optimum groove diameter: 0.93 inch (23.66 mm)
- Maximum allowed groove diameter: 0.95 inch (24.20 mm)

The following diagram shows the effect on rope service life with different groove size ratios.



**Example:**

Rope with an actual diameter of 0.89 inch (22.66 mm) working in a groove with an actual diameter of 0.87 inch (22 mm) experiences a service life loss of approx. 20%.

$$\frac{22.00 \text{ mm}}{22.66 \text{ mm}} = 0.97$$

$$\frac{0.87 \text{ inch}}{0.89 \text{ inch}} = 0.97$$

# GENERAL INFORMATION

for specialty wire ropes / general purpose ropes

## GROOVE DEPTH

According to **ISO 16625**, the groove depth should be **no greater than 1.5 times the rope diameter** and in addition, the bottom of the groove must be circular.

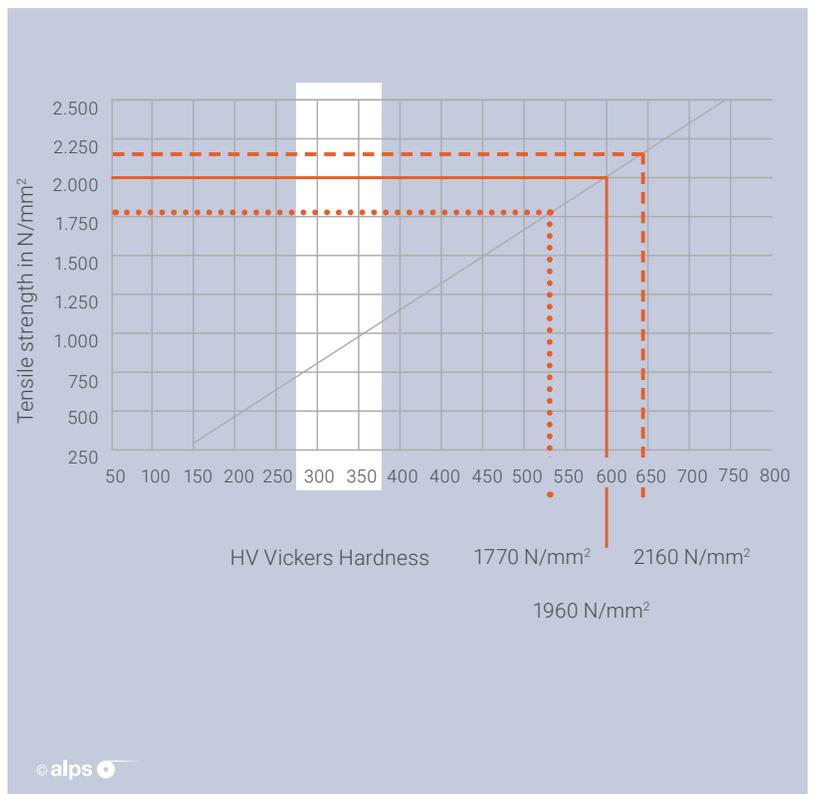
The maximum permissible depth until the sheave has to be replaced due to wear must be specified by or obtained from the sheave manufacturer. This value must be observed at all times as disregarding it can result in serious accidents as a result of material failure.



## MATERIAL HARDNESS

Ropes usually have different strengths, tensile grades such as **1770 N/mm<sup>2</sup>**, **1960 N/mm<sup>2</sup>** or **2160 N/mm<sup>2</sup>** are common. The diagram to the right shows the respective degree of hardness in HV (Vickers Hardness) for the corresponding strength class. **The hardness of the sheaves and drum should be between 300 - 350 HV**. This is due to the fact that rope sheaves that are too soft absorb the pure wear of the system and thus the discard criterion of the rope is more difficult to detect.

If the used rope sheave or rope drum has a higher hardness value, this does no harm to the system, but involves higher hardening costs.



## DIAMETER REDUCTION

The rope **diameter** of a working rope **is reduced** over its entire service life. This is caused by **abrasion and wear** and is evaluated according to the following table and classified up to the point of discard maturity.

			Uniform decrease in diameter (expressed as percentage of nominal diameter)	Severity rating	
				Description	%
Single-layer rope with fibre core	6xS17 / 6xS19 / 6xS21 6xW19 / 6xW22 6xF21 / 6xF25 / 6xF29 6xWS26 / 6xWS31 / 6xWS36	Fiber	Less than 6 % 6 % and over but less than 7 % 7 % and over but less than 8 % 8 % and over but less than 9 % 9 % and over but less than 10 % <b>10 % and over</b>	– slight medium high very high <b>Discard</b>	0 20 40 60 80 <b>100</b>
Single-layer rope with steel core or parallel-closed rope	6x7 6xS17 / 6xS19 / 6xS21 6xW19 / 6xW22 6xF21 / 6xF25 / 6xF29 6xWS26 / 6xWS31 / 6xWS36 7x7 / 7x19 8xF25 / 8xF29 / 8xF37 8xWS26 / 8xWS31 / 8xWS36  verostar 8 veropro 8 veropro 8 RS veropower 8 veropro 10 verotech 10 verosteel 8	Steel IWRC IWRC IWRC Steel IWRC IWRC	Less than 3.5 % 3.5 % and over but less than 4.5 % 4.5 % and over but less than 5.5 % 5.5 % and over but less than 6.5 % 6.5 % and over but less than 7.5 % <b>7.5 % and over</b>	– slight medium high very high <b>Discard</b>	0 20 40 60 80 <b>100</b>
Rotation-resistant rope	35x7 18x7 19x7  verotop verotop S verotop E verotop P verotop XP vero 4	35x7 18x7 19x7	Less than 1 % 1 % and over but less than 2 % 2 % and over but less than 3 % 3 % and over but less than 4 % 4 % and over but less than 5 % <b>5 % and over</b>	– slight medium high very high <b>Discard</b>	0 20 40 60 80 <b>100</b>

# GENERAL INFORMATION for specialty wire ropes / general purpose ropes

## WIRE BREAKS

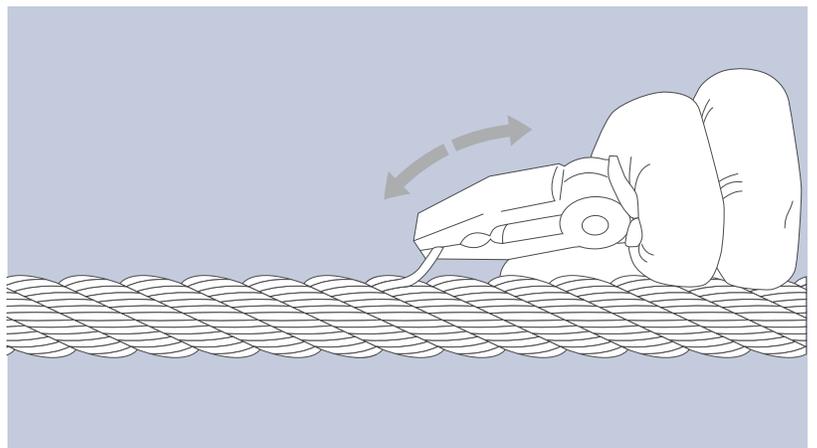
Wire **breaks on the rope surface** are caused by bending stress on the rope when running over sheaves. The number of wire breaks over a defined length **must not exceed a certain number** corresponding to its design and subsequently to the RCN (Rope Category Number), otherwise it **must be discarded** immediately.

### Discard GP Ropes - Visible broken wires

Alps™ high performance wire rope construction	Total number of load-bearing wires in the outer layer of strands in the rope	Rope category number (RCN) (ISO 4301)	Number of visible broken outer wires					
			Sections of rope working in steel sheaves and/or spooling on a single-layer drum (wire breaks randomly distributed)				Sections of rope spooling on a multi-layer drum	
			Classes M1 to M4 (ISO 4301-1:1986) or class unknown				All classes	
			Ordinary lay		Lang lay		Ordinary and Lang lay	
			Over a length of				Over a length of	
			6d	30d	6d	30d	6d	30d
6x19	114	04	5	10	2	5	10	20
6x26	156	06	6	13	3	6	12	26
6x36	216	09	9	18	4	9	18	36
6x26 COMPACTED	156	06	6	13	3	6	12	26
6x36 COMPACTED	216	09	9	18	4	9	18	36
19x7	84	23-1	2	4	2	4	4	8
6x19 (DRILL LINES)	114	04	5	10	2	5	10	20
6x31 (TUBING LINES)	186	08	8	16	4	8	16	32
6x7 (SAND LINES)	42	01	2	4	1	2	4	8
7x7	42	01	2	4	1	2	4	8
7x19	114	04	5	10	2	5	10	20
1x7	6	-	-	-	-	-	-	-
1x19	8	-	-	-	-	-	-	-

## REMOVAL OF PROTRUDING WIRES

Some wire breaks may cause the wire to protrude from the rope. This wire can damage neighboring wires when it runs over the sheave again causing secondary wire breaks. With the help of pliers and continuous back and forth bending of the protruding wire, it can be removed and is no longer a danger to neighboring wires.



Whereas the distribution of wire breaks does **not seem to follow a certain pattern**, the shown standard **cannot be applied** to wire breaks caused by contact with the steel structure.

### Number of permitted wire breaks for non-rotation resistance ropes

verope® high performance wire rope construction	Nominal rope diameter d (mm) <sup>7</sup>	Number of load-bearing wires in the outer strands	Rope category number RCN acc. ISO 4309	Number of visible broke wires acc. ISO 4309 <sup>1</sup>					
				Relevant rope parts see footnote <sup>2</sup>				Relevant rope parts see footnote <sup>3,4</sup>	
				Class M1 to M4 or class unknown <sup>5</sup>				All classes M1 to M8	
				Ordinary lay		Lang lay		Ordinary lay and lang lay	
				Over a length of				Over a length of	
				6 x d <sup>5</sup>	30 x d <sup>5</sup>	6 x d <sup>5</sup>	30 x d <sup>5</sup>	6 x d <sup>5</sup>	30 x d <sup>5</sup>
verostar 8 veropro 8 veropro 8 RS verosteel 8	till 42	208	09	9	18	4	9	18	36
	43 to 48	248	11	10	21	5	10	20	42
	above 48	288	13	12	24	6	12	24	48
veropower 8	till 40	208	09	9	18	4	9	18	36
	41 to 46	248	11	10	21	5	10	20	42
	above 46	288	13	12	24	6	12	24	48
verotech 10 veropro 10	above 10	260	11	10	21	5	10	20	42

### Number of permitted wire breaks for rotation-resistance ropes

verope® high performance wire rope construction	Total number of load-bearing wires in the outer layer of strands in the rope	Rope category number (RCN) (ISO 4309)	Number of visible broken wires acc. ISO 4309			
			Relevant rope parts see footnote <sup>2</sup>		Relevant rope parts see footnote <sup>3,4</sup>	
			Over a length of		Over a length of	
			6 d	30d	6 d	30d
vero 4	144	22	2	4	4	8
verotop XP	96	23-1	2	4	4	8
verotop S verotop S+ verotop E	112	23-2	3	5	5	10
verotop P	126	23-3	3	5	5	11

Notes: 1) Please note that a counted broken wire always has two ends. 2) Shall be applied exclusively to those sections of rope running only over steel sheaves and / or spooling on a single-layer drum. For single layer spooling ordinary lay ropes have to be used. The wire breaks are randomly distributed. 3) Shall be applied exclusively to those sections of rope spooling on a multi-layer drum. 4) The values are valid only in conjunction with footnote 3 and apply to deterioration that occurs at the cross-over zones and interference between wraps due to fleet angle effects. Note: These values do not apply to those sections of rope running only over sheaves but do not spool on the multi-layer drum. 5) d = Nominal rope diameter 6) Twice the number of broken wires listed may be applied to ropes on mechanisms whose classification is known to be M5 to M8. 7) Other rope diameters on request.

## EXTERNAL CORROSION

Ropes in particular environments or with a high lifetime start to corrode. The standard distinguishes different corroding levels. The following pictures shows the different levels according to **ISO 4309**.

### Guideline to rate the intensity of the corrosion

1. Beginning of surface oxidation, can be wiped clean, superficial – **Rating: 0% towards discard**



2. Wires rough to touch, general surface oxidation – **Rating: 20% towards discard**



3. Surface of wire now greatly affected by oxidation – **Rating: 60% towards discard**



4. Surface heavily pitted and wires quite slack, gaps between wires – **Discard immediately**



# Typical rope failures

## Examples of various types of damage to the rope



Protruded wires of inner rope



Strand protrusion/distortion



Flattened portion



Core protrusion – Single layer rope



Basket deformation



External wear



External corrosion



Enlargement of external corrosion



Crown wire breaks



Valley wire breaks



Protruded IWRC of rotation resistant rope



Kink

# Re-lubrication

## LUBRICANTS

Alps™ generally uses two types of lubricants: wax- and oil-based lubricants. The selection of the basic lubricant depends on the application, rope type and environment.

There are also lubricants that are used in areas that have special requirements such as water solubility, drip resistance or nature conservation guidelines. It can be said that the variety of lubricants is as diverse as the number of different applications. In order to increase rope service life and protect the rope interior, **the lubricant film on the rope surface must remain constant**. Lubricant is usually lost during operation and must be re-applied with regular re-lubrication. The lubricant used for re-lubrication needs to be compatible with the lubricant used during production.

If you are uncertain, which lubricant can be used for re-lubrication, don't hesitate to contact us, we are happy to assist you.

## PREPARING

The rope must be prepared so that the re-lubrication and the newly applied preservative fulfil its full function. Applying the new lubricant without removing the existing lubrication, which is often dried out and has lost its lubricating effect, defeats the purpose of the operation. In addition, a rope that is free of surface dirt should be inspected more closely to detect possible defects.

There are several ways to **remove the existing lubricant** from the rope surface. One way is by using a cleaning system which removes the contamination from the rope surface by means of rotation.

Another conventional method to remove the lubricant from the rope surface is by the use of steel wire brushes.

The lubricant is simply scraped off the rope surface by relative movements. The more lubricant removed from the surface, the better the effect of the new lubricant. This method requires a great deal of force and is time-consuming, depending on the rope length. However, if no other method is available, this procedure is very acceptable.

## LUBRICANT QUANTITY

In general, we recommend that the rope should be **relubricated 10 times over its entire service life**. For applications with a comparable short service life (e.g., due to high and rapid wear), re-lubrication must be carried out as required.

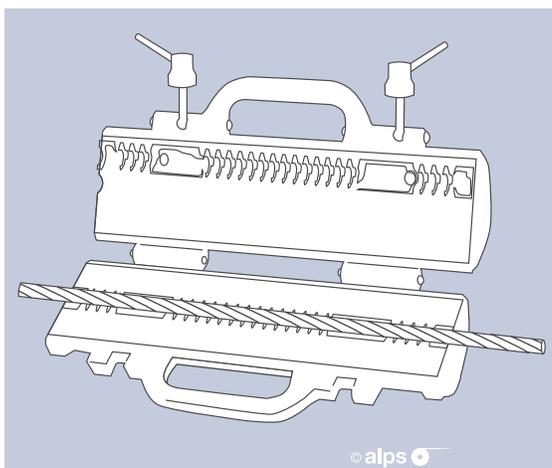
The amount of re-lubricant to be applied can be determined using the following equation:

$$\frac{\text{Rope weight} \frac{\text{kg}}{\text{m}} \times \text{Rope length m}}{100} = \text{Amount of lubricant kg}$$

## APPLICATION AND DIFFERENT METHODS

After the old lubricant has been removed from the rope surface, the new lubricant can be applied. Various methods and procedures exist.

There are several companies that offer complete re-lubrication solutions. In the first method, the principle differs only in appearance. The rope is enclosed by a sleeve (often made of cast iron). In the sleeve there is a cavity into which the lubricant is forced under high pressure. Excess lubricant is removed at the end by means of a wiper.



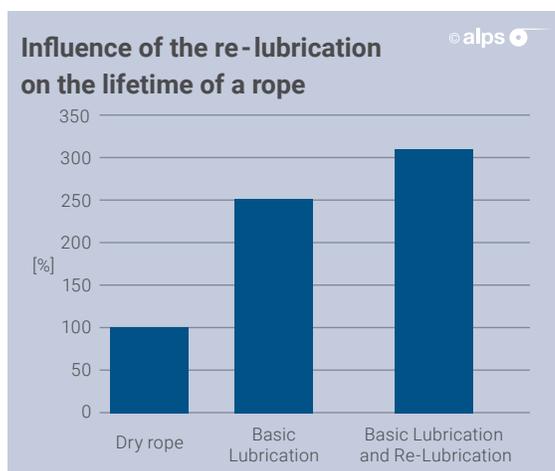
Many applications, such as container gantry cranes, have automatic lubricant spraying devices, that continuously re-grease the rope. This type of re-lubrication occurs when, for reasons of time or cost, the system cannot be shut down or the need of lubricant is increased. This device can easily be retrofitted by companies offering this service.

**AlpsLube60™ exceeds all the lubrication requirements.**



Another and most cost-effective method is **manual application**. Here, either atomizer systems using compressed air or simple tools such as brushes or rags can be used. With this method, care must be taken to ensure uniform application. Both – too much and too little lubricant, is counterproductive, an even film of lubricant is the best way to achieve the best results. For diameter ranges between 10 mm - 30 mm there are lubricants in spray cans for post-conservation.

The practical aerosol cans allow an even mist to settle on the rope. The propellant gas in the can flies away and leaves pure lubricant on the rope.



# GENERAL INFORMATION for specialty wire ropes / general purpose ropes

The following formula is used to determine the diameter reduction:

$$\Delta d = \left[ \frac{d_{ref} - d_m}{d} \right] \times 100 \%$$

**Example:** A single layer steel core rope with a nominal diameter of 22.00 mm has a reference diameter of 22.80 mm as in calculation example and a measured diameter of 21.90 mm.  
To proof:

$$\left[ \frac{22.80 - 21.90}{22} \right] \times 100 \% = 4.1 \%$$

The rope has reached a discard maturity of 20 % by means of diameter reduction.

## INSPECTION REPORT

The report of DIN ISO 4309 provides support, listing all relevant points of a structured rope inspection.

Crane reference: _____					Rope application: _____						
Rope details: _____					Direction an type of lay <sup>a</sup> : (Right): sZ ZZ Z / (Left): zS sS S						
Brand name (if known): _____					Permissible number of visible broken outers wires: ____ 6 d ____ 30 d						
Nominal diameter (mm): _____					Reference diameter (mm): _____						
Construction: _____					Permissible decrease in diameter from reference diameter (mm): _____						
Core <sup>a</sup> : ____IWRC ____FC ____WSC											
Wire finish <sup>a</sup> : ____Uncoated ____Zinc/Gal.											
Date installed: _____					Date discarded: _____						
Visible broken outer wires				Diameter			Korrosion	Damage and/or deformation		Position in rope	Overall assessment i.e. combined severity rating <sup>b</sup> at position indicated
Number in length of		Severity rating <sup>b</sup>		Measured diameter	Actual decrease from reference	Severity rating <sup>b</sup>	Severity rating <sup>b</sup>	Nature			
6 d	30 d	6 d	30 d	mm	mm						
Other observations/comments:											
Performance to date (cycles, hours, days, months, etc.):					Date of inspection:						
Name (print) of competent person:					Name (signature):						

<sup>a</sup> Tick as applicable. <sup>b</sup> Describe degree of deterioration as: slight, medium, high, very high or discard.



**alps**   
wire rope corporation™

[www.alpswirerope.com](http://www.alpswirerope.com)

**we are  
alps**

## Important information

With the following hints, we would like to draw your attention to some essential points for correct selection, operation and maintenance of wire ropes.

In addition to technical literature on wire ropes, national and international standards, the Alps™ team will be happy to assist you with all questions concerning wire ropes. Please contact us!

### No. 1:

Wire ropes must be **properly transported**, stored and maintained. Please note the relevant literature on these topics.

### No. 2:

Wire ropes must be **checked for wear and damage** before each use. This also applies to their end connections. Never use worn or damaged ropes or end connections!

### No. 3:

End connections assembled by Alps™ may not be changed by the customer. **A swivel may only be used in combination with rotation-resistant rope constructions** from Alps™ otherwise there is a danger of serious personal injury and property damage, possibly even death.

If you are looking for a rotation-resistant rope construction, please have a look at the Alps™ catalog or contact us for further information.

### No. 4:

Wire ropes and their end connections are not fatigue resistant endlessly and must therefore be controlled periodically for safe operation.

**Wire ropes and the end connections must be discarded before reaching an unsafe condition.** Please refer to the respective valid international or national standards and the technical literature for expert inspection as well as for the correct determination of the discard maturity of wire ropes and their end connections.

During installation of ropes which are provided with an end connection it must be ensured that these have been carried out in accordance with the operating instructions at the designated place and can be installed in the correct position. For end connections, which can be dismantled, e.g., wedge end clamps, it is absolutely necessary to remove the rope or end connection according to manufacturer specifications.

For questions, ambiguities or problems, please contact the customer service of the Alps™ technical department:  
[quality@alpswirerope.com](mailto:quality@alpswirerope.com)

### No. 5:

Wire ropes must **not be overloaded** or even subjected to shock loads.



Incorrect selection and use of wire ropes can be dangerous!

**No. 6:**

Under the influence of very high or very low temperatures, the rope behavior can change considerably. Please discuss this with our experts. See standard.

**No. 7:**

The **rope installation** must be carried out or coordinated by at least one competent person. A competent person has sufficient knowledge and experience with rope installations and knows risks and consequences when disregarding the correct procedure.

**No. 8:**

During the winding process external influences like damages or twist must be avoided, to ensure a safe installation.

A rope on a reel or on a ring is not free of tension and can cause personal injury in case of uncontrolled loosening. The rope must therefore be removed with the greatest care. The rope end on the reel or on the ring should be fixed during loosening and in the preferred bending direction guided.

As soon as the end of the rope is reached, the speed of the rewinding operation shall be adjusted so that the end of the rope is not swinging around uncontrolled.

**No. 9:**

It can be dangerous when being in the presence of running ropes and their application. Therefore, a **suitable distance** should be maintained at any time. If the safe distance is not kept, it may result in serious injuries.

**No. 10:**

In the case of ropes installed by means of rope end connections the maximum payload of these must be taken into account.

**No. 11:**

Ropes, that are not **re-lubricated** sufficiently or in time, tend to corrode internally and externally. The functional capability of the applications greatly reduces. On the other hand, too much or the wrong lubricant will cause the dirt to adhere, which causes the rope drive to wear out faster and obstructs the evaluation of possible discard criteria.

**No. 12:**

Hitting rope falls in the free rope length is always a sign of **unbalanced torque** in the rope. The friction, generated between the rope, leads to damages on the rope. One method of untwisting the rope length is described on page 26. Occurred damages must be rated with the help of this brochure or according to official standards.

**No. 13:**

The intervals between periodic inspections are depending on the condition, the intensity and the external influences of the application.

For questions, ambiguities or problems, please contact the customer service of the Alps™ technical department:  
quality@alpswirerope.com

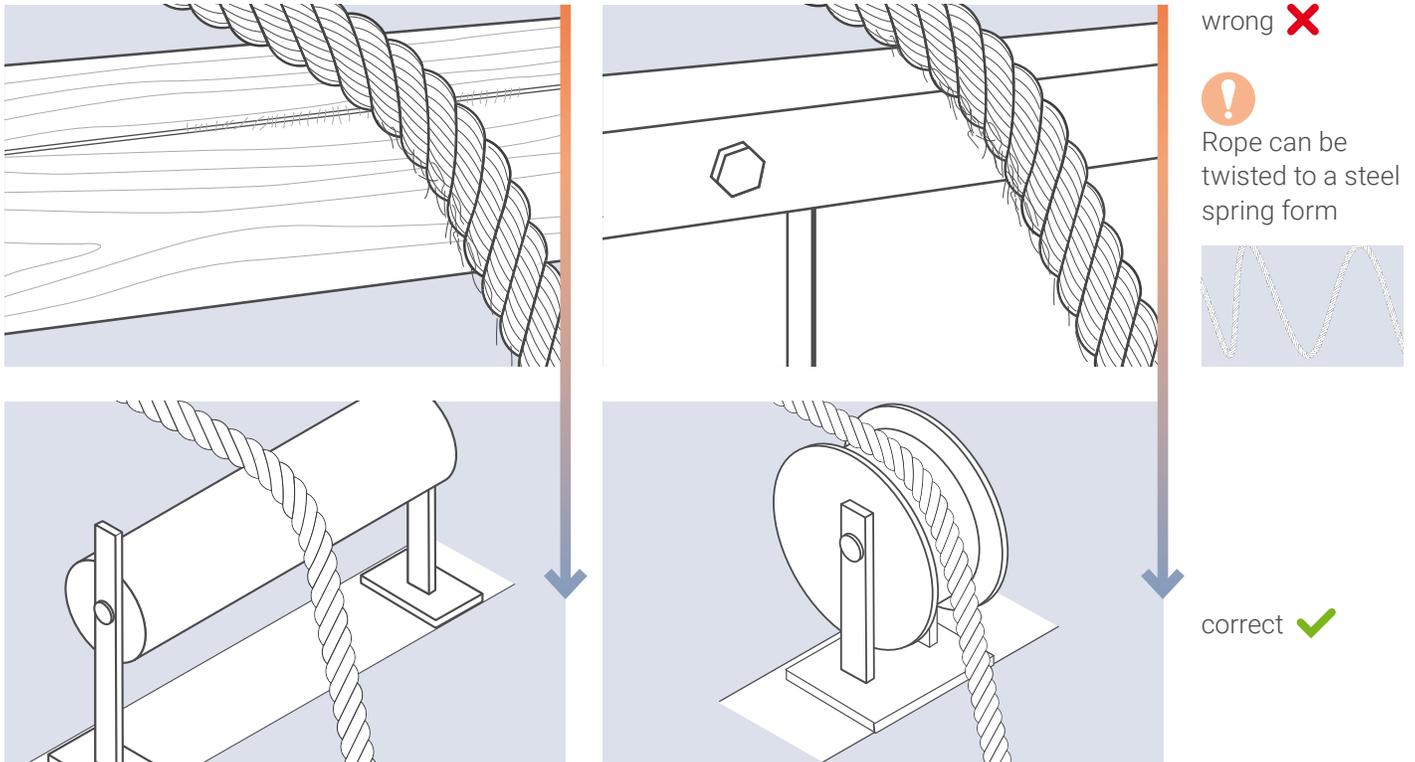


Protect yourself and others!  
Rope failure can cause serious damage to property, CAUSE injury or death!

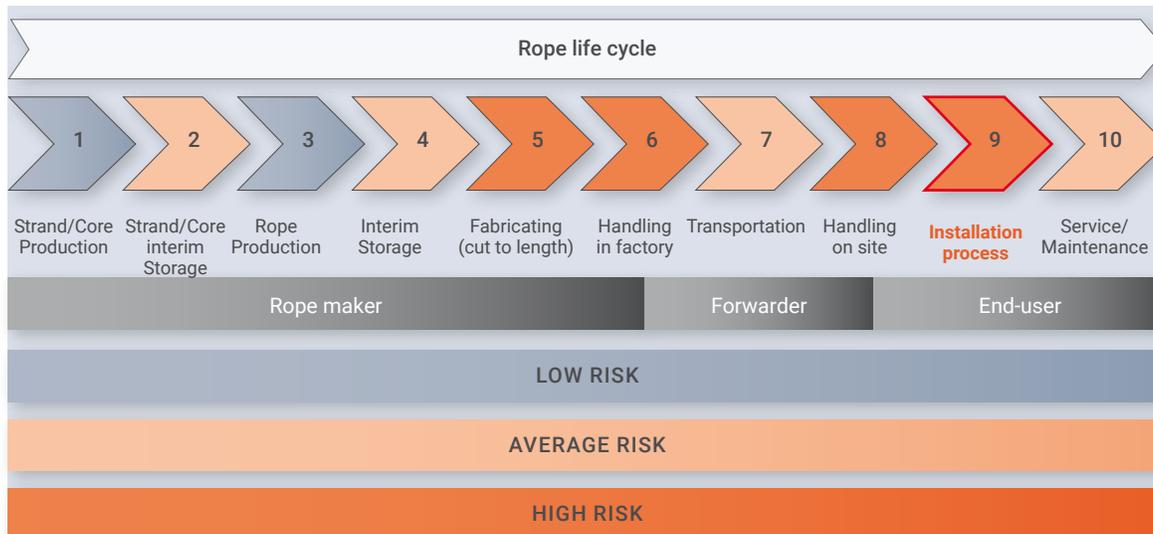
# ELEVATOR

## Installation instructions

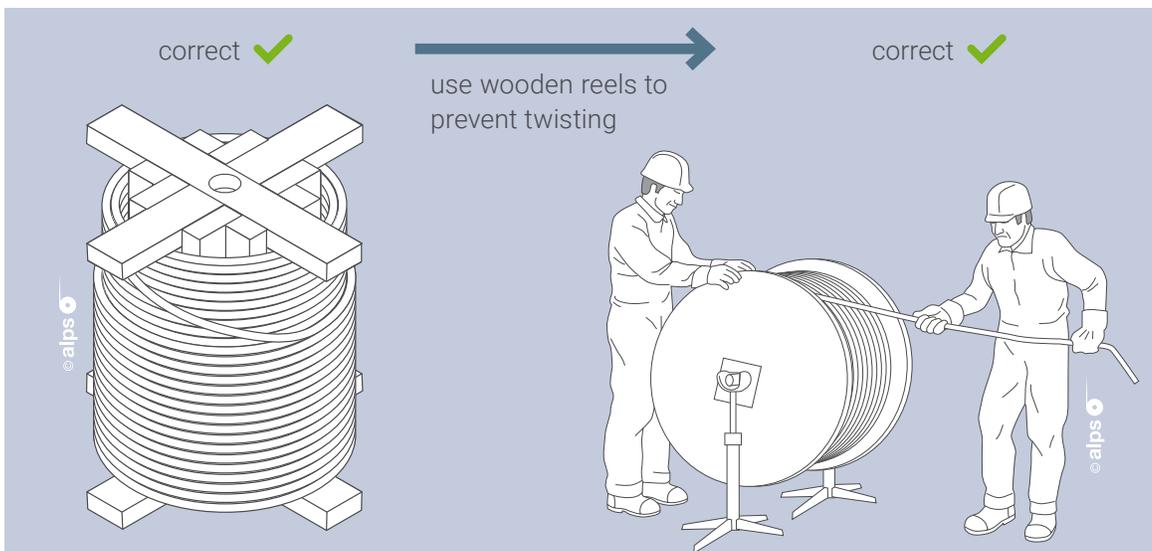
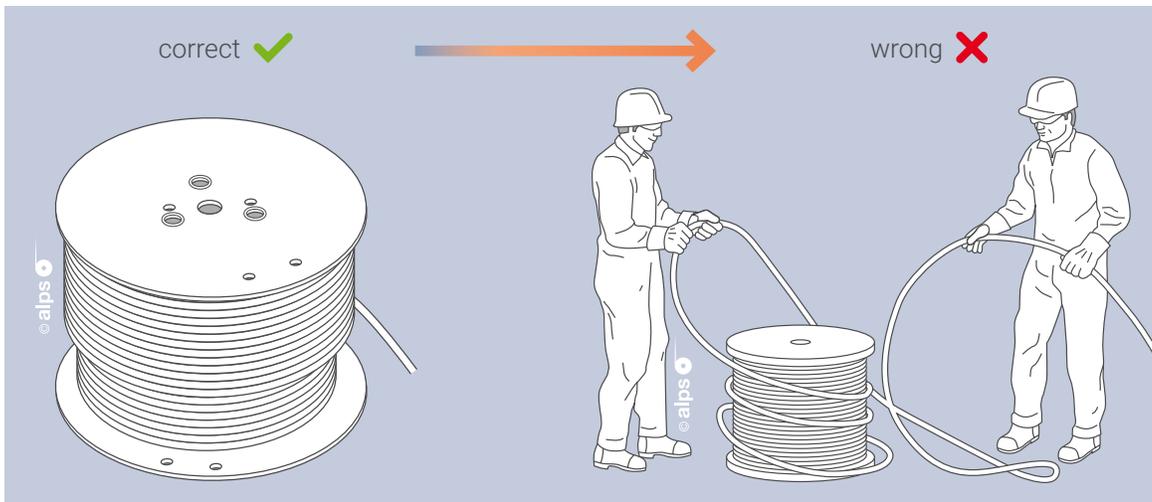
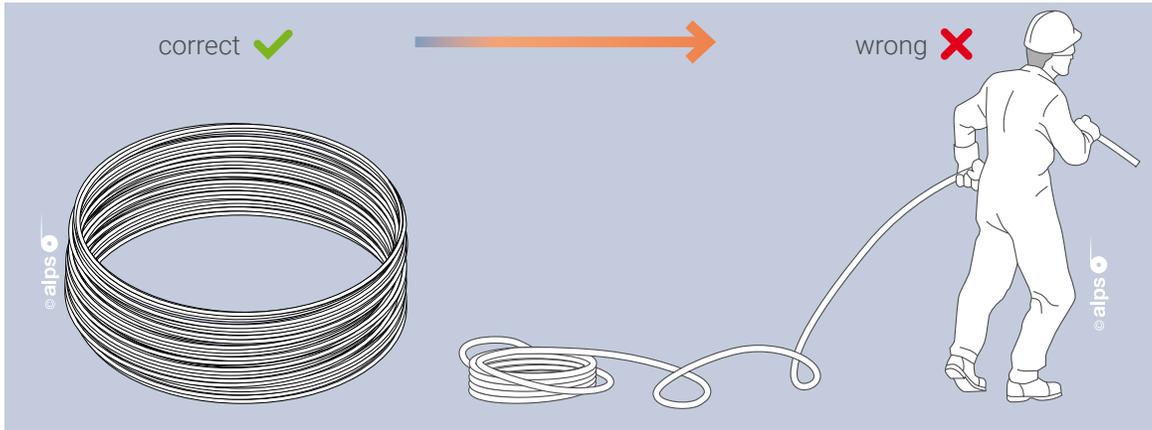
### INSTALLATION PROCESS



### Risk of rope damage

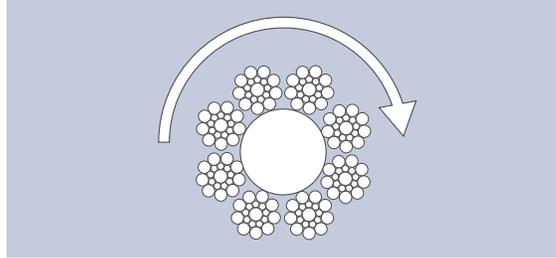


## WINDING AND DELIVERY



# ELEVATOR

Wire tensile of elevator ropes is **1320 to 1960 N/mm<sup>2</sup>**. Construction steel tensile is **340 to 510 N/mm<sup>2</sup>**. Ropes pulled over construction steel will always eat into the softer construction steel. Once the rope profile is engraved, the rope will rotate and destroy its original structure. De-structured ropes will have a very short service life.



## EQUAL ROPE TENSION

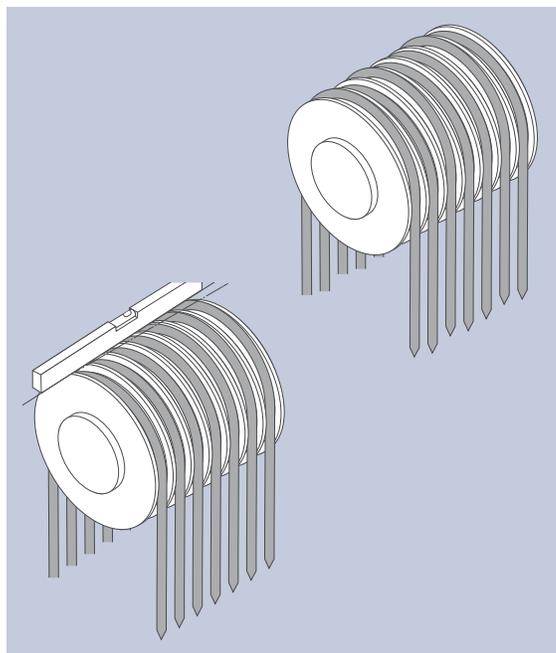
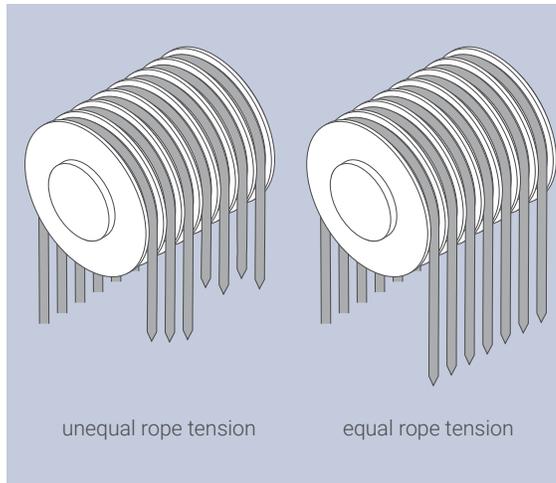
Hoist ropes in one elevator installation should carry the same load and be under the same tension: Equally tensioned ropes extend the service life of the ropes and sheaves and improve ride quality.

The elevator system works best when each rope carries a portion of the total load within a tolerance of  $\pm 5\%$ . Ropes with higher tension than others will cause a lot of pressure and friction to the grooves and ropes. Ropes with lower tension will slide over the sheave(s) and cause rope crown and sheave wear. Low tension is often shown by rope slapping, vibration and metal dust.

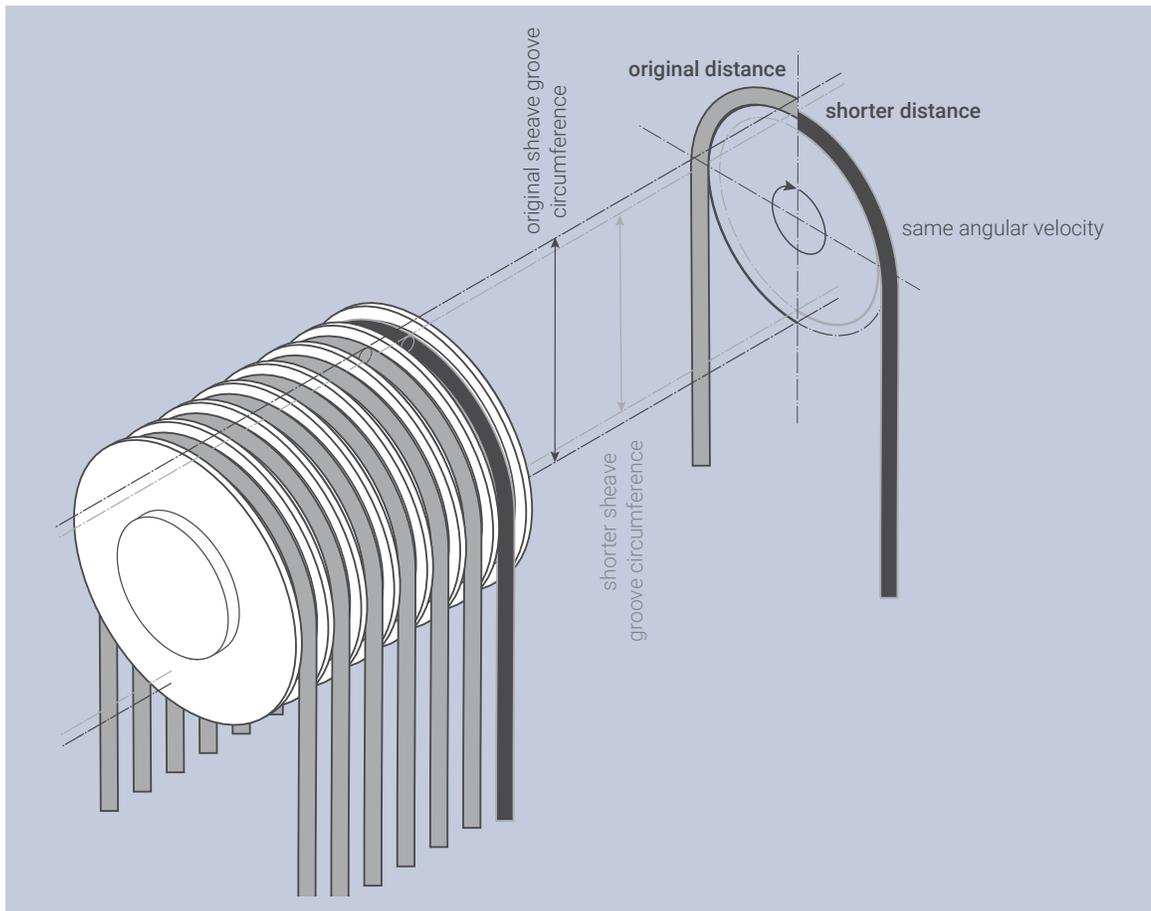
Equal rope tension is **not possible** with different sheave groove depth. Therefore, sheave grooves must be checked **before removing** the rope set to be replaced. Placing a straight bar over the rope set does show the different rope level which represents the different groove depths.

Using a flashlight behind the bar shows nicely the differences. If the unequal sheave wear is regularly distributed, the checking result might be deceiving. Therefore it is recommended to use a spirit level tool to recognize all irregularities.

If one rope is under higher tension than the others, it will carry more load.



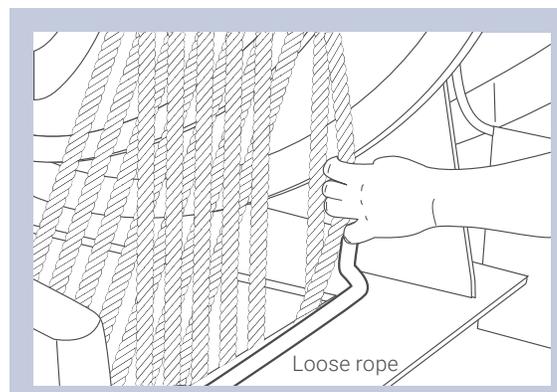
## Unequal tension



This results in higher groove and rope friction ending in a deeper groove and a smaller rope diameter. Sheave and rope will be damaged and must be replaced. **Always replace the whole rope set.** If only the damaged rope is replaced, the new rope will be larger in diameter and will carry more load. It will be under higher tension. The same damaging process will restart.

### Reasons for unequal rope tension

- Twisted hoist rope
  - During installation process
  - Missing torsion lock rope in end fitting
- Poor quality of springs or elastomer buffers near the end fittings
- Ropes from different master reels or producers
- “Hanging out” ropes before installation
- Unequal level of sheave grooves
- Failure of rope core
- Loose rope



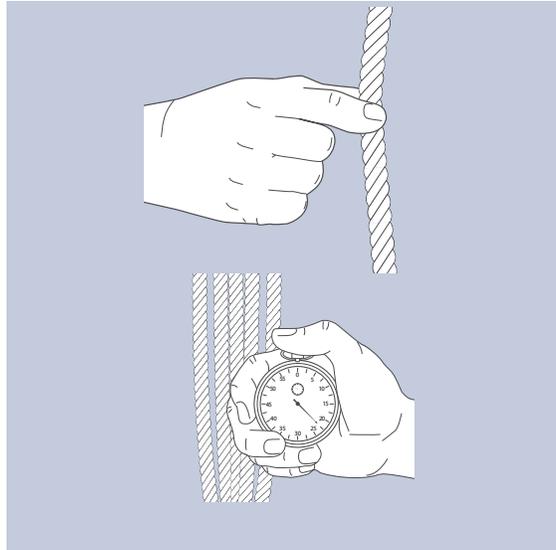
# ELEVATOR

## TENSION MEASURING

Since it is difficult to measure the weight supported by individual ropes, indirect methods were devised to measure rope tension.

### Tension control by feeling

There are some craftsmen who can determine rope tension by feeling. This is more an art form than a learned skill and is not an accurate method.

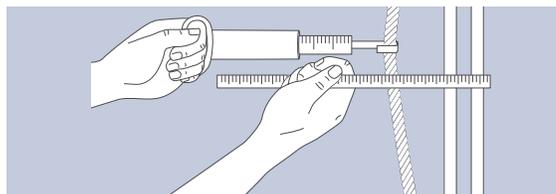


possible but inaccurate



### Tension control by tuning

The car is placed at the bottom of the hoist way and all dampening devices are removed. The rope is plucked like a harp string and the oscillations are timed with a stopwatch. The longer the time between cycles, the lower the tension in the rope. Although still listed in industry literature, this method is inaccurate at best! **Any load adjustment to ropes using either method described is a relic best left to the past.**

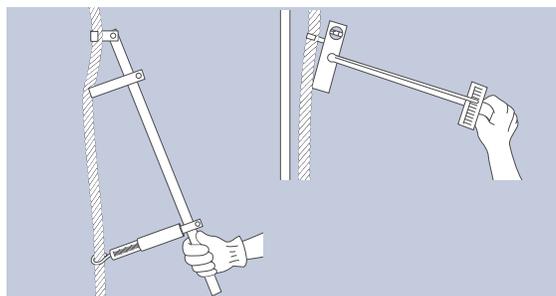


best method



### Tension control by tensiometer

An acceptable method is to use a tensiometer (similar to a torque wrench) to measure the rope's tension. Earlier, technicians evaluated rope tension using a simple scale. **This control method is the basic concept behind all rope deflection-based load measurement devices used today.**

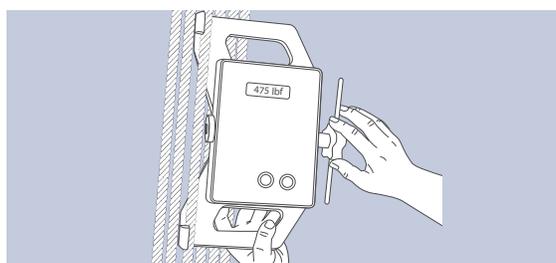


best method



### Tension control by torque wrench

OEM's have designed torque wrenches and pressure gauges available to their branches. Commercially marketed torque wrenches are also available from many suppliers. Torque wrenches are acceptable and will provide accurate readings of the tension on each rope. Needed adjustments can then be made.



best method



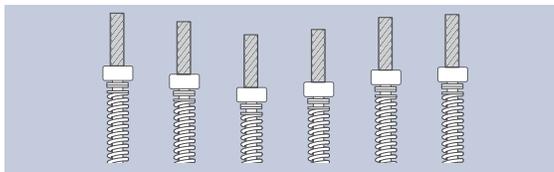
### Tension control by digital reading

This kind of tool allows to review load equalization more accurately and helps to understand the problems deflection-based measuring methods confront. It's truly a better method than the previous ones.

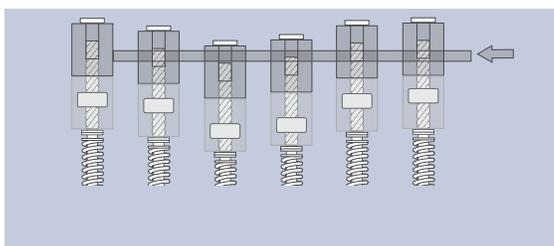
### Tension control in real time

However, the best way to determine the true amount of load on ropes is to measure the load of each rope in real time. This is possible with a special Rope Tensioning System available in the market.

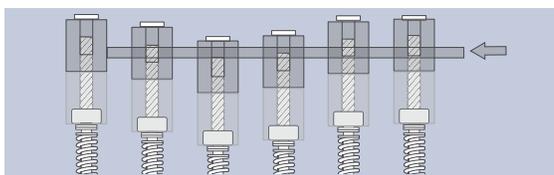
It is the industry's only patented hydraulics-based device that allows one person to equally tension all the ropes in a set at the same time in about 30 minutes.



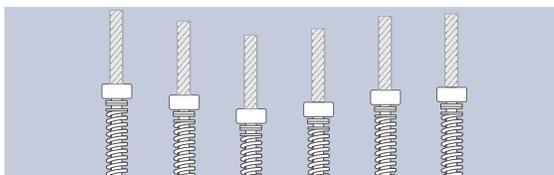
Washers, steel rings with openings, hydraulic parts and fixation screws are mounted on top of the spring. Interconnected hydraulic parts are put under pressure. Wedge sockets are pressed up from the spring to equalize rope tension (see different levels of the nuts (grey color)).



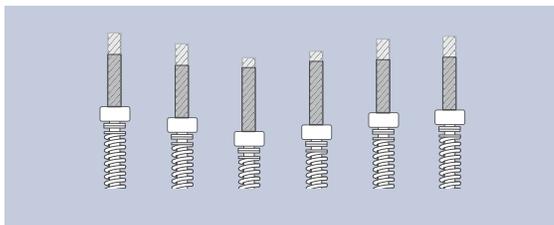
All nuts are tightened back to the top of the spring. Hydraulic pressure is turned off. Fixation screws, hydraulic parts, steel rings with openings and washers are removed.



All ropes are equally tightened now in real time and load.



Red marked are the wedge socket positions before the equalization of the tension. Only adjusting spring and buffer tensions is not sufficient, because manufacturing tolerances of springs and buffers are not precisely controlled or known. Springs and/or elastomer buffers must be of highest quality.



### Important

If a set of ropes is not properly tensioned early in its life, tensioning will become increasingly difficult and time-consuming. Multiple adjustments may be required to properly adjust a set of poorly tensioned ropes having undergone their initial constructional stretch period. To achieve equal rope tension is a demanding procedure. It needs a lot of experience and patience. Adjusting one rope influences tension in other ropes of the set. Nevertheless, equal rope tension is a must! Correct tools simplify the work.

# ELEVATOR

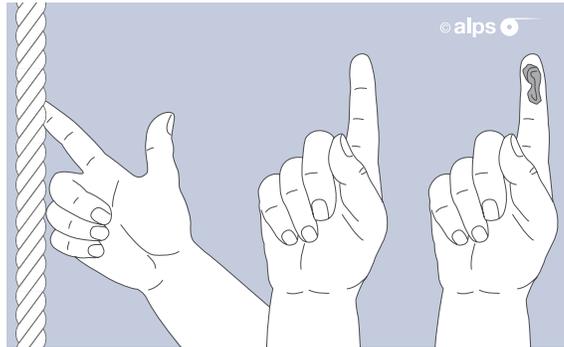
## Lubricant

### LUBRICATION AND RE-LUBRICATION

In ropes, there is friction between wires, strands and fiber cores. All these combinations need lubrication to assure an appropriate friction behavior and a good rope-lifetime. New ropes are lubricated during the production process.

A long period of time between production and installation, as well as incorrect storage conditions, can lead to dry strands and cores.

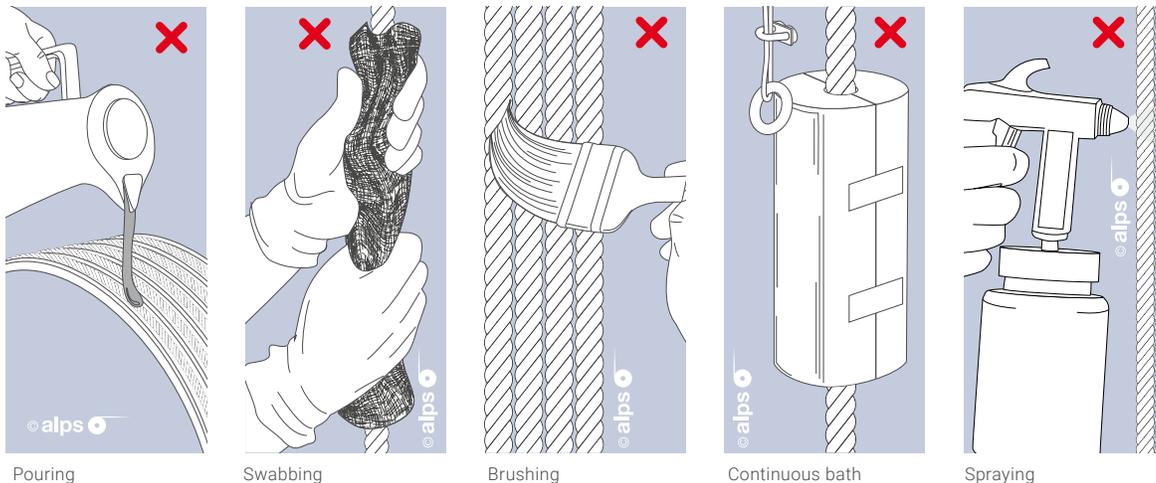
- Upon installation, new ropes must be checked for sufficient lubrication
- If necessary, new ropes must be relubricated to assure rope function from the start of the operation and a long rope-lifetime!
- Periodically ropes in service must be re-lubricated



Re-lubrication is necessary to prevent rope damages from rouging and corrosion.

**Elevator ropes shall be lubricated and re-lubricated at least once a year** or every 250'000 starts. A simple and practical option is to touch the rope and then check the finger for lubricant.

### Ropes should not be lubricated in these ways:



possible but inaccurate

The amount of lubricant applied this way is out of control. Over-lubrication will lead to dangerous slippage and pollution of the machine room.

### Ropes should be lubricated the correct way

Lubricant is pumped from a canister to a rope lubrication device. Equal and controlled distribution of lubricant to the ropes is ensured.

This type of lubrication does not need any action for a longer period of time. Brushes

are mounted to each lubricant can. The can is under pressure and slowly presses the lubricant through the brushes to the ropes. The amount of lubricant can be set with the timer on the back side of each can. Timing can be chosen between 1 and 12 months.

Automated rope lubrication is easy and safe.

Our product supports customers for problem-free rope lubrication and long service life span of the ropes.

### LUBRICANT QUANTITY

The amount needed for elevator ropes depends a lot on the installation and environment.

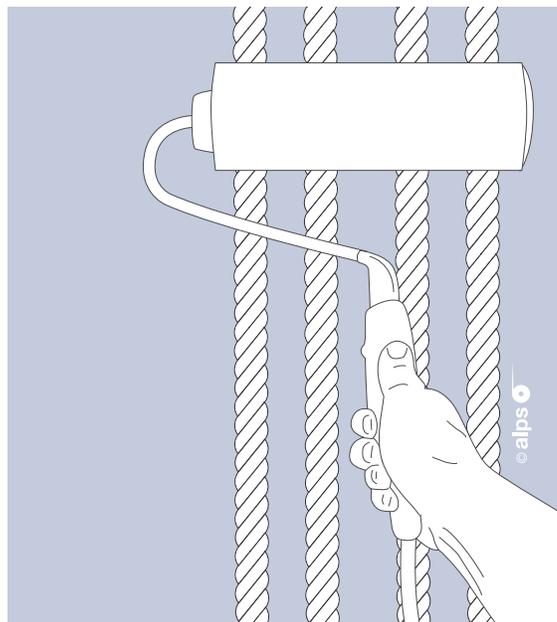
Influences, such as high elevator frequency, shaft temperature or draft from ventilation must be considered.

Lubricant should be compatible with the originally applied product by the manufacturer. Lubricant must be free of acids and alkalis. Lubricant should hold a high film strength and some anti-corrosion additives. The lubricant's viscosity should be capable of penetrating the interstices between wires under operating conditions. Intrusion of lubricant is supported due to capillarity within the rope parts. Lubricant should offer good adhesion with a friction coefficient of  $\mu$  0.09 [-] for the material pair steel/cast iron.

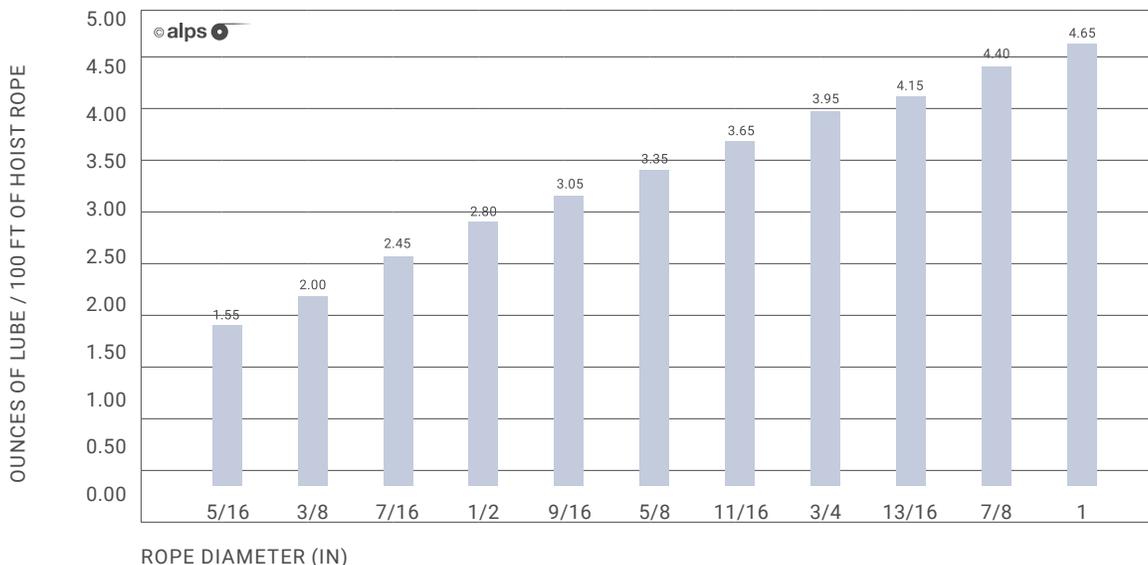
### Lubrication of elevator ropes is a demanding task

Lubricant for elevator ropes should sufficiently lubricate between the rope parts such as wires, strands and rope core. At the same time, it should provide good adhesion between rope and sheave.

### AlpsLube 60™ supports all the lubrication requirements.



best method



This chart is only a guideline to determine the amounts of **ounces** of lubricant **per** rope diameter and **100 ft** of rope length.

# ELEVATOR

## Discard Criteria

### DISCARD CRITERIA OF ELEVATOR ROPES

Elevator ropes are complicated machine parts and are subject to a large number of outer influences such as:

Stress / Friction / Bending / Torsion / Temperature / Corrosion / Pressure / Dust / Humidity / Vibration - etc.

Additional influences to consider are:  
Travel frequency / Maintenance / Lubrication / Equal tension / Installation condition - etc.

### Discard criteria can be divided into 2 groups:

- Measurable discard criteria (defined by quantities in standards)
- Non-measurable discard criteria (to be judged by the expert).

### Measurable discard criteria are:

- Outer wire breaks
- Diameter reduction

Measurable discard criteria are specified in national, international and company standards. Make sure you use valid standards, wherever ropes are installed.

### OUTER WIRE BREAKS

ACCORDING TO ISO-4344 ANNEX E	IMMEDIATE DISCARD			DISCARD OR RE-EXAMINATION WITHIN A CERTAIN INTERVAL FIXED BY AN EXPERT		
ROPE CLASS	6x19	8x19	10x19	6x19	8x19	10x19
AVERAGE NUMBER PER LAY LENGTH	> 24	> 30	> 34	> 12	> 15	> 17
PREDOMINANT NUMBER IN ONE OR TWO STRANDS PER LAY LENGTH	> 8	> 10	> 11	> 6	> 8	> 9
ADJACENT NUMBER IN ONE STRAND	> 4	> 4	> 6	4	4	6
VALLEY BREAKS PER LAY LENGTH	> 1	> 1	> 1	1	1	1

### Diameter reduction:

According to ISO-4344 Annex E:

**“Replacement should be considered if the diameter is reduced by 6 % of the nominal rope diameter.”**

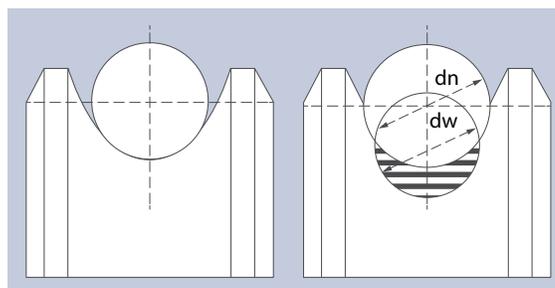
In addition, ISO-4344 says:

“If unusual features are evident that might indicate the possibility of advanced internal deterioration, replacement of the ropes should be considered. EXAMPLE: local reduction in diameter.”

### Non-measurable discard criteria are:

- Corrosion
- Mechanical damage
- Rope deformation
- Excessive wear etc.

To be judged by the expert.



e.g.:  
 Ø 16 mm rope →  
 min. Ø 15.04 mm  
 Ø 10 mm rope →  
 min. Ø 9.40 mm

**Rouging:**

Red powder from and on the rope during operation is friction corrosion or "rouging".

- Insufficient lubrication
- Friction between strands (rope-diameter reduction)

**Actions needed**

- Rouging after a short operation time:
  - Re-lubricate
- Rouging after a longer operation time:
  - Re-lubricate and reduce inspection interval (observe!)
- If the wire surface is smooth
  - There is no significant corrosion

**Corrosion:**

Red paste or red metal parts between the strands are corrosion.

- Insufficient lubrication
- Humidity and/or water penetration

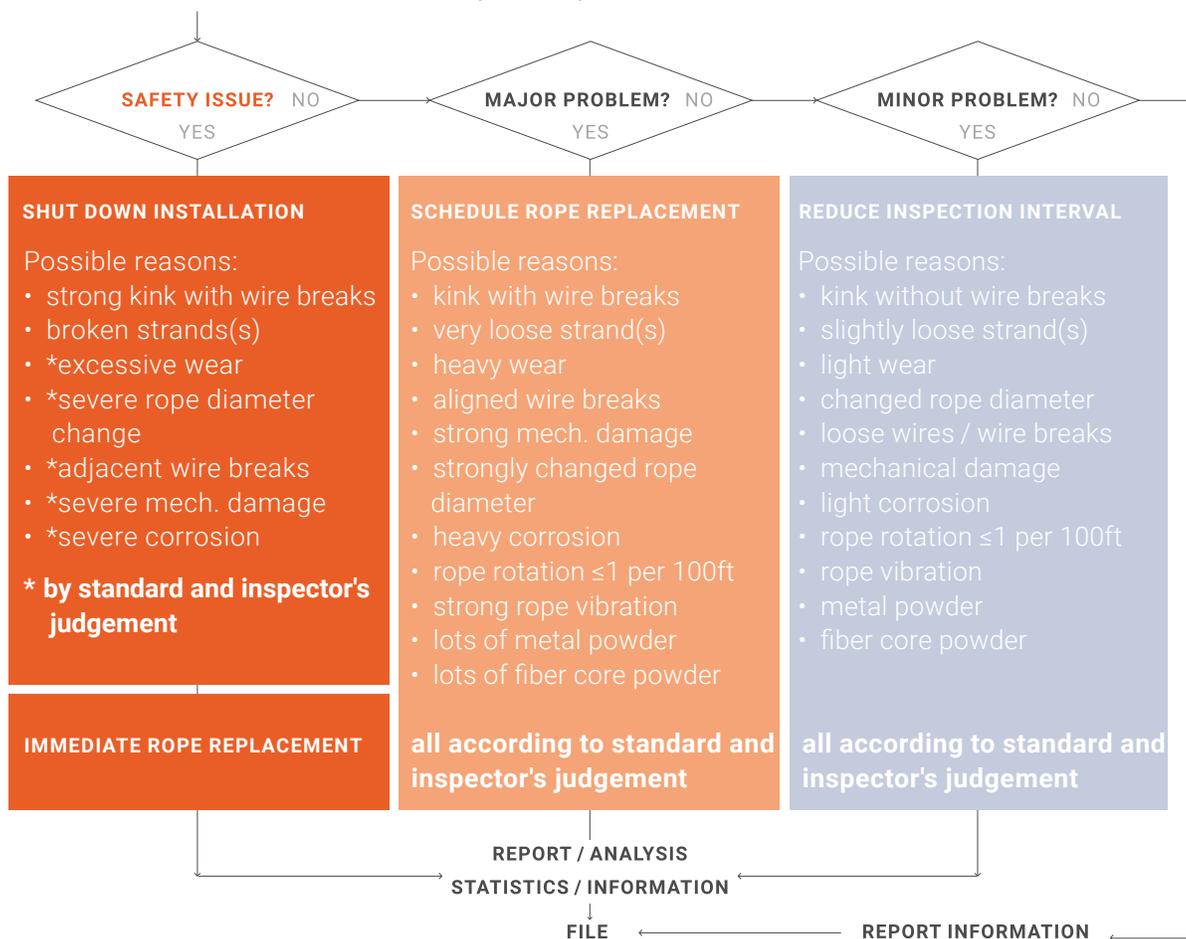
**Actions needed:**

Analyze the red paste, metal parts and wires.

- If wires have a rough surface and show pitting: → Replace the rope set
- If wires have a smooth surface and no pitting: → Clean rope from red paste/parts, re-lubricate and reduce inspection interval (observe!)
- If the wire surface is rough
  - There is significant corrosion



**Non-measurable discard criteria except for rope diameter and wire breaks**



If only the damaged rope is replaced, the new rope will be larger in diameter and will carry more load. It will be under higher tension. Always replace the whole rope set.

# ELEVATOR

## Elevator Rope Inspection Form

Ref. #:	Company:		Participants	Name	First name	Company	Function	Phone [1234567890]			
I N F O	Country:		Inspector:								
	Place:		A								
	Street / No.:		B								
	Building name:		C								
1	Elevator No.:	Install. year:	No. of floors:	Machine room temperatur:		°C					
2	Rope suspension: if matching-> <input checked="" type="checkbox"/>	<input type="radio"/> 1:1	<input type="radio"/> 2:1	Mach. Room humidity		%					
3	Hoisting height:	Sheave ø:	Elevator counter status:			cycles					
4	Car weight A:	Counterweight B:	Balance A-B:								
5	Travel speed:	Rope sheave wrapping: if matching-> <input checked="" type="checkbox"/>	<input type="radio"/> single	<input type="radio"/> double							
6	if matching-> <input checked="" type="checkbox"/>	<input type="radio"/> V-groove	<input type="radio"/> U-groove	<input type="radio"/> U-groove undercut	Aver tension		kN				
	Rope function (Hoist, OSG etc.)	Total no. Of ropes	Rope Lengths	Nominal-ø	Rope type: 8x19 etc.	Rope core: FC, IWRC etc.	Parallel laid (Y/N)	MBL kN	Tensile grade	Date of last shortening	Date of last replacement
7											
8	Rope no. (from left to right, standing in front of the installation)		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
9	Measured rope-Ø in inch	0°									
10		90°									
11	Average rope-ø of 0° & 90°	inch									
12	Ovality ≤ 3%*d	inch									
13	Measured rope tension	kN									
14	No. of rotations	0.0									
15	Visible wire breaks	per lay length									
17	Rope lay length:	inch									
18	Sheave groove radius	0									
19	Enough lubricant?	y / n									
20	Rope damages?	y / n									
21	Rope deformations?	y / n									
22	Abrasion?	y / n									
23	Corrosion?	y / n									
24	Sheave alignments OK?	y / n									
25	Vibrations?	y / n									
26	Describe end-fitting	(clamp, wedge, etc)									
Discribe general rope condition (use reference #):											
<div style="border: 1px solid black; height: 100px; width: 100%;"></div>											
Next steps, mark with	<input type="radio"/>	stop installation/replace rope:	<input checked="" type="radio"/>	immediate	>	Schedule:					
	<input type="radio"/>	discard rope until date:									
<input checked="" type="checkbox"/>	<input type="radio"/>	next inspection date:									
Date:	Inspector's signature:				Customer's signature:						

Elevator Rope Inspection Data

## elevator ropes by Alps™

Alps Wire Rope Corporation has provided the most innovative products in North America since its founding 1968.

Today Alps is the result of verope AG and Kiswire Ltd. joining forces to offer the highest quality wire ropes in the market.

[www.alpswirerope.com](http://www.alpswirerope.com)

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wire rope corporation™

verope 

  
Kiswire

**we are  
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## Installation instructions

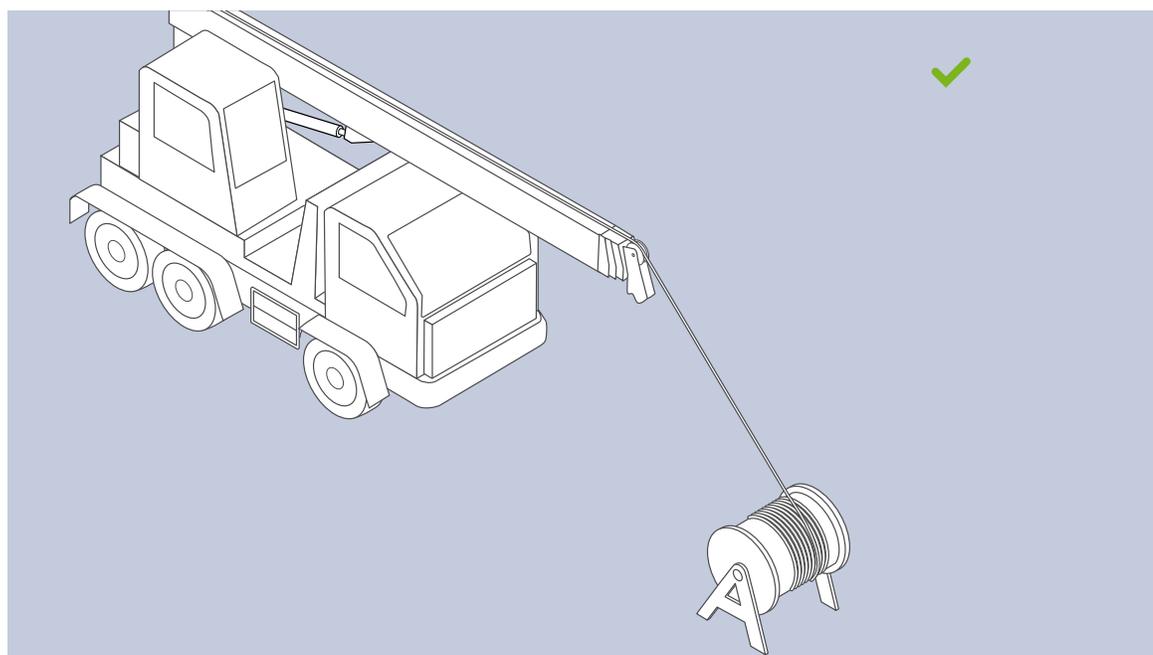
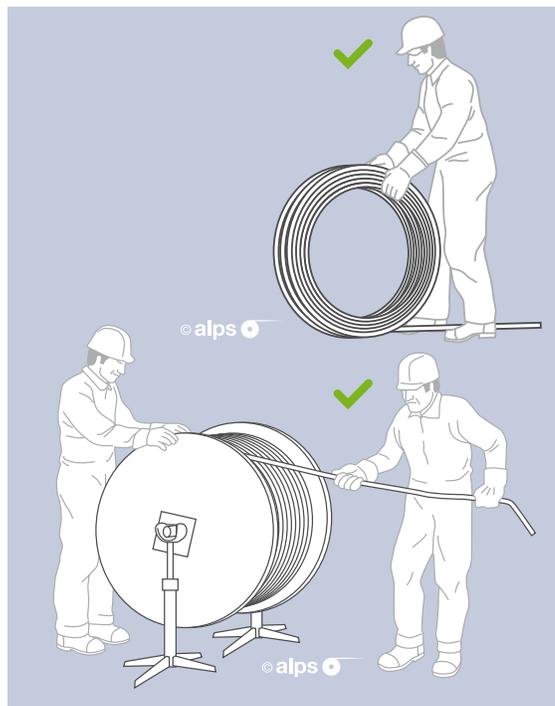
Many crane manufacturers work with special rope diameter tolerances. These values need to be constantly observed in order to achieve the best rope performance.

### PULLING ON

If you unwind the rope from the supply reel, this must be mounted so that it is free to rotate. Pulling the new rope off a stationary pulley or non-rotating reel will cause twist in the rope and the rope may be destroyed during installation. It must also be ensured that the rope surface remains clean and that no sand or dirt adheres to the rope lubricant. A dirty rope will damage the wires if the rope runs over sheaves.

The following illustrations show the correct and wrong way to unwinding a rope.

Special care must be taken to ensure that the rope does not come into contact with parts of the steel structure or other fixed parts. The deflection angle between the supply reel and the first pulley of the crane must not exceed  $2^\circ$ .

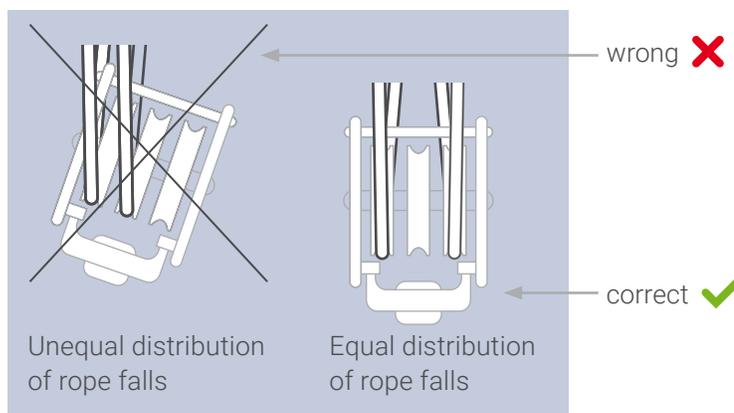
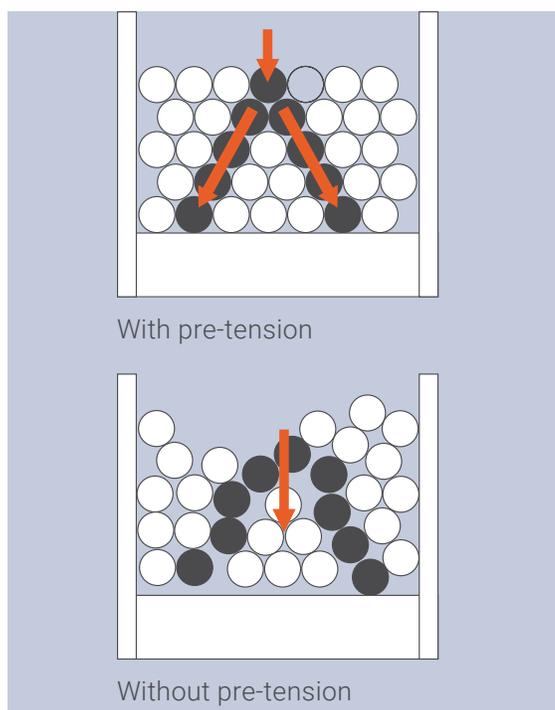




wrong **X**

## WINDING

The notes on pages 4 to 6 should be followed for pre-tensioned rope installation. In particular, sufficient pre-tensioning of the rope on the drum must be given. Renew the pretension at regular intervals so that all rope layers can work together firmly as a “package”. This can be done as follows: Extend the boom so far or so high that you can unwind the entire rope length up to the 3 safety coils on the drum. Now lift a sufficient load so that the rope is wound from the first drum layer with sufficient pre-tension of at least 2.5% of the MBL or 10% of the SWL. This procedure is also necessary if the crane has only worked with a part of the total rope length. The start and stop movements of the drum cause the rope layers to shift to the lower layers and become loose. If the pre-tension of the rope on the drum is too low, the individual layers become loose and the rope strands that run up under tensile stress can pull themselves into the loose drum layer. This causes the rope to be crushed and severely damaged.



## REEVING AND TWISTING

When reeving the rope, make sure that the rope falls are even distribution in the sheaves of the hook block. If the reeving is unevenly distributed, the hook block is out of level and rope can be twisted and damaged.

## TWISTING OF THE HOOK BLOCK

There are several reasons why a hook block can twist:

01. The reeving of an odd number of falls is significantly less stable than the reeving of even falls.  
A 3-falls reeving is less stable than 4 falls.
02. Torque or twist has been applied to the rope during the installation of the rope.  
The maximum permissible deflection angle of max. 2° was often exceeded here.
03. The center of gravity of the load is not under the hook
04. Wrong or uneven attachment when using a double hook
05. Inclined or poorly balanced hook block
06. Worn or too narrow groove profiles of the rope sheaves
07. Poor rope lubrication or re-lubrication
08. Diagonal pull during load pick-up (>2°)
09. Incorrect reeving of the rope with deflection angles >2°.
10. Misalignment of the crane
11. Handling operation (always the same activities with high repetition rates)

## UNTWISTING

### Method A:

Detach the rope end from the fixed point. Tilt the rope end in the opposite direction to the twisting of the hook block. When the hook block turns 1/2 turn, rotate the end of the rope 180°. If the hook block rotates 3 full turns, turn the rope end 3 times around itself against the direction of rotation. Re-attach the rope end and guide the rope (without load) through the entire reeving by lifting the hook block. The twists are thus distributed over the entire rope length and significantly reduced. If the hook block still twists, this process must be repeated.

### Method B:

If rotation-resistant ropes are used, a **swivel** can also be installed between the fixed point and the crane. **This swivel absorbs possible twist or eliminates twist that is already in the rope.** Once the twist is removed from the rope, the swivel can be blocked, completely removed or permanently installed. After the installation of a new rope, **the rope should run several times under low load and at reduced speed with the boom fully extended.** Repeat this procedure with increasing load and speed. This will allow the rope to adapt to the working conditions and all strands and wires will sit in a neutral position. Ideally, you should loosen the rope end again after the running-in time to release possible torque and twist that were built up during installation and running-in time.

For questions, ambiguities or problems, please contact the customer service of the Alps™ technical department: [quality@alpswirerope.com](mailto:quality@alpswirerope.com)



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# DECK CRANES

## Installation instructions

### THE INSTALLATION PROCESS

The most advantageous way to install a steel wire rope varies from crane to crane. In all cases a method should be chosen that (at a reasonable cost) **constitutes the lowest possible risk of twist or other damages to the rope**. When unwinding the rope from the supply reel, the supply reel must be mounted in a way **that allows its rotation**.

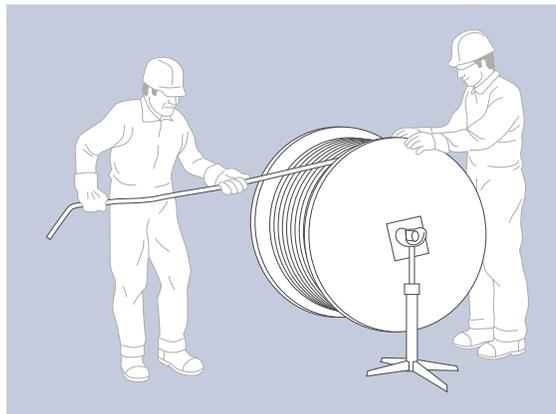
The removal of the new rope from a stationary pulley or non-rotating reel leads to rope twist and the rope can already be destroyed during installation.

- Lay down the old rope first and then install the new rope.

- or attach the new rope to the old rope and pull it in.

- or use a thinner rope as the pull-in rope, with **which the actual wire rope is later pulled into the system**. This method is often used on new equipment.

In any case, it should be carefully considered whether the wire rope should be pulled through the **entire reeving system** or whether it should first be wound from the reel onto the drum and then pulled into the system.

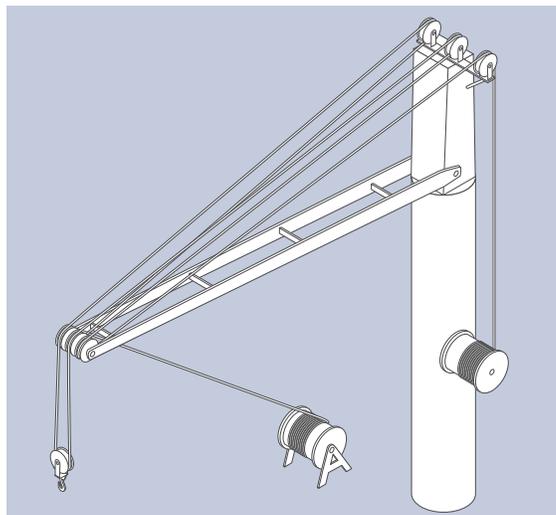


### TYPICAL EXAMPLE OF A DECK CRANE

Below is an example of a **typical deck crane** in which the rope is pulled from the rope reel over the sheaves into the reeving and wound onto the rope drum.

Care must be taken to ensure that the rope surface remains absolutely clean and that neither sand nor dirt adheres to the **rope lubricant**.

A **dirty** rope can **damage** its wires when running over the sheaves and significantly reduce the effectiveness of the lu bricant.



## INSTALLATION OF A NEW ROPE

If the new rope is pulled from the old rope or from a thinner rope, it must be ensured that the connection between the ropes is absolutely secure and that the thinner rope cannot rotate/twist. **Rotation-free ropes must be pulled in with the same rotation-free ropes or rotation-resistant 4-strand ropes.** When installing non-rotation-resistant ropes, it must at least be ensured that new and old ropes have the same lay direction. In all cases it is helpful to install a small rope swivel between the rope ends in order to remove any possible twist. If the new rope is pulled in with the help of the used rope, the two rope ends are often blocked. Such a connection can transfer the twist of the old rope, which is in the system, into the new rope. This type of installation can cause extreme damage to the new rope even before the first service inspection. There are even more reasons why this procedure is very problematic: When welded mounting eyes are used, they can be overloaded and break due to the twist.

## INCORPORATION

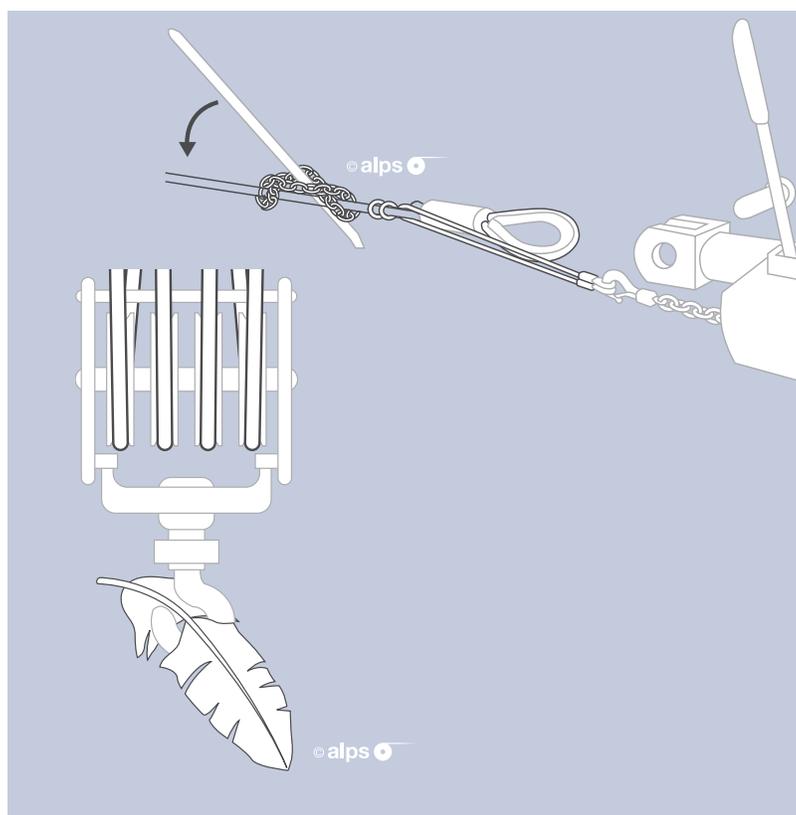
It is highly recommended that after the rope has been installed and before it fulfills its task, several runs of normal operation should be carried out under light load. The new rope has to be "incorporated" that the elements can settle and adapt to the actual operating conditions.

## UNTWISTING

If the bottom block is twisted due to overloads (rope not being worked in), uncontrolled working conditions (diagonal pull) or a poor installation condition (worn rope sheaves), the rope twist can be removed at the fixed point. The following procedure is only necessary if the rope strands touch each other. Rotation of the hook block by up to 90° can be regarded as normal. To do this, secure the rope at the end connection again with a chain hoist and loosen the fixed point. When loosening the end connection, pay close attention to the direction in which it is twisted and how often. If necessary, the end connection can be further rotated several times in the rotating direction using the steel rod. Now the rope has to be fixed again at the fixed point and several cycles have to be carried out over the entire lifting height. As a rule, the twisting of the hook block has been significantly reduced however the process may have to be repeated again.

## FASTENING

After the rope has been pulled through the reeving, the rope end connection must be brought to the fixed point. With the aid of a chain hoist, the rope end connection can be pulled to the fixed point and secured there with a pin. Before fixing, the rope end connection can be aligned exactly to the fixed point using a steel rod. The rod should be attached to the rope with a short chain. Under no circumstances should the rope be gripped with a wrench or pliers, otherwise the outer wires will be damaged.



Appropriate Handling of wire ropes

# ALPS ELEC



# AlpsELEC

## ESTIMATED ROPE LIFE CALCULATION SOFTWARE

The **determination of the life expectancy of an elevator rope** system is a reasonably complex process due to diverse factors that affect such a system. AlpsELEC is a **computer program** designed to help the elevator professionals

**select the best rope** for any application and **determine the lifetime** of the wire rope. Based on many years of technical experience in the elevator market, **Alps developed a powerful tool available to all Alps rope users.**





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