



ROPES

Reliability and perfection.



Storage,
Handling,
Assembly, and Maintenance
of **WIRE ROPES.**



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DNV

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1

General notes

The following notes and warnings are intended to ensure safe handling. Non-compliance may cause damage and hazard.

Warnings refer to potential hazards that may prejudice rope quality, thus endangering personnel and damaging rope-associated equipment.

2

Unloading wire rope upon receipt

Check the rope packaging for any transport damage. Record any such damage on delivery note.

When unloading, take appropriate measures to avoid damage to rope. In particular, take care not to damage rope by forks of lift truck.

Lifting a reel with fork lift truck
correct



Lifting a reel with fork lift truck
incorrect



To avoid damage when lifting coils or reels, webbing slings are recommended.
Reels are preferably lifted by using a shaft inserted through the centre hole.

Inspecting wire rope as received 3

If not properly marked, coils or reels must be labelled immediately according to delivery note to avoid subsequent confusion.

Accompanying quality certificates must be checked against purchase order specifications and against marking on reel.
Make sure that certificates are kept in a safe place.

Lifting a reel with shaft inserted through centre hole



Wire ropes must be protected against humidity and weather conditions.

They should be stored in dry, well ventilated rooms at an ambient temperature. Storage in damp, poorly ventilated conditions may lead to corrosion.

If ropes must be stored in the open air, make sure to:

1. avoid rope being in direct contact with the ground;
2. cover rope completely with water-proof sheets, thus preserving original lubricant.

Allow access of air to avoid corrosion beneath cover.

Never store wire ropes at elevated temperatures nor expose them to dust, dirt or acids.

If wire ropes are left unused in shut-down plants, renewed cleaning and lubrication may be required when operation is resumed (see 8.2 *Wire rope dressing*).



Caution:

If stored at elevated temperatures, or in damp, corrosive or dusty environments, or if contaminated by soil or chemical contact, rope properties may suffer serious harm.

Stored rope must be inspected at periodical intervals and, if necessary, re-lubricated with grease compatible with the manufacturer's.

Guidance on the right dressing is given in chapter 8. resp. crane manufacturer's maintenance instructions.



Caution:

Incompatible dressing may render manufacturer's lubricant ineffective, thus critically lowering rope quality.

Wire ropes withdrawn from operation and stored for later re-use require careful cleaning and lubrication prior to spooling. Store ropes under same conditions as new ropes.

Uncoiling/Unwinding wire rope

5

Wire ropes must be uncoiled or unwound by trained personnel or under supervision.



Caution:

Incorrect handling of wire ropes may be extremely dangerous. Critical damage to ropes may seriously endanger both persons and equipment.

Wire ropes should only be handled wearing protective clothing such as safety gloves and footwear, eye protection and safety helmets.



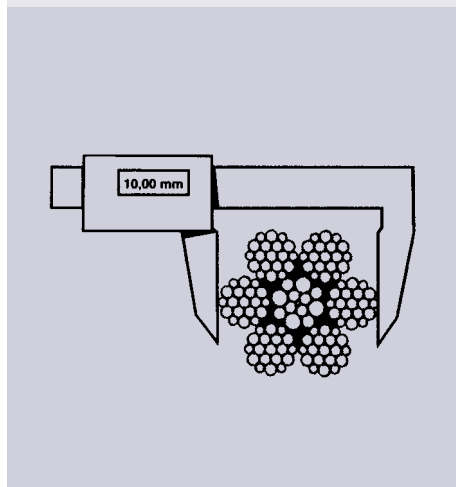
Caution:

Failure to wear suitable protective clothing may constitute a serious health hazard and cause injuries: Skin problems resulting from excessive exposure to certain lubricants; respiratory defects from inhaling gases when cutting ropes or embedding them in sockets; eye injuries caused by sparks, wire fragments, wire and rope ends; burns produced by sparks, molten lubricants or metals; and other injuries caused by backlash of wire and rope ends.

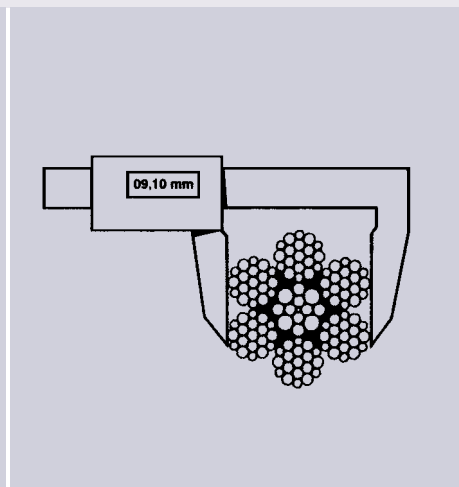
Prior to first use, check if the wire rope corresponds to the purchase order and the rope handling system manual or OEM's (Original equipment manufacturer's) instructions.

Correspondence is ascertained by measuring the rope diameter and comparing given rope construction on delivery note with purchase order.

Measuring
rope diameter
correct



Measuring
rope diameter
incorrect



To measure the rope diameter, two different sets of measurements are taken spaced at a minimum distance of one metre, and in two different planes perpendicular to each other. The measuring callipers (available from Teufelberger) have to be sufficiently wide. The rope diameter is the average of these four measurements.

(For measuring method see DIN or CEN rope standards).

The wire rope diameter should be within the tolerance specified in the purchase order. It has to be checked if there is a different tolerance in the rope handling system manual.



Caution:

Use of wire ropes not corresponding to the OEM's instructions may cause serious danger to personnel and rope conveying equipment.

Check the wire rope for defects caused by improper handling or storage.

Care must be taken when releasing the outboard end from the reel or the servings of the coil. The wire rope will tend to fly in an abrupt and violent movement.

Do not stand in line with outer end.

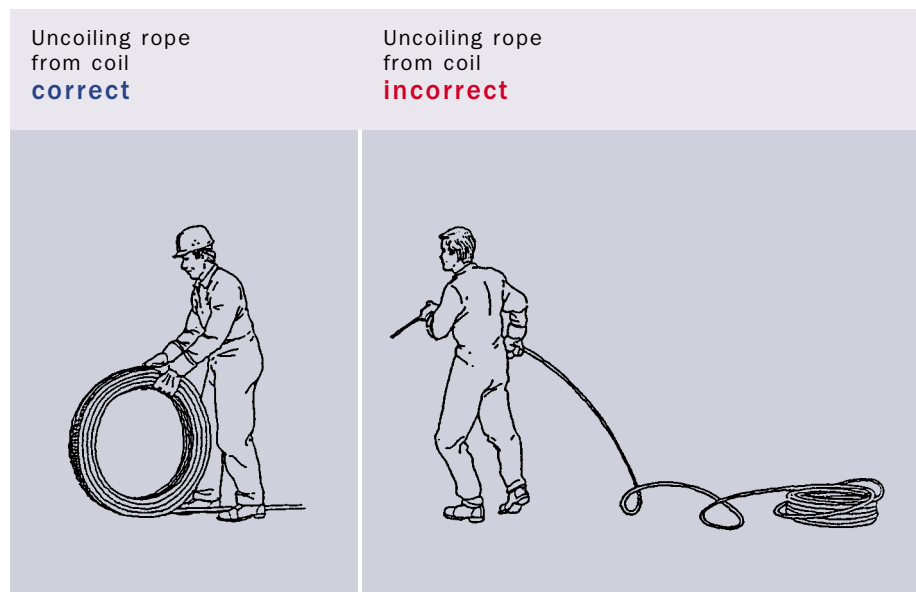


Caution:

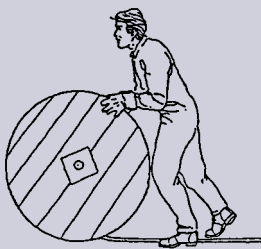
Uncontrolled release of the outboard end from the reel or uncontrolled opening of coil servings may cause injury.

Ensure that the wire rope is not damaged during installation. To maintain rope geometry, wire ropes must be uncoiled or unwound with maximum care. The rope should not receive any twist or turn. Pulling over sharp edges or through tight radii can seriously damage the rope and must be avoided. If the rope must be drawn over fixed parts during installation, these must be covered by adequate means such as sheaves or wooden material if necessary. The rope should never be pulled from coils sideways or over the flange of a reel to avoid turn causing serious or even irreparable damage to the rope. In the absence of any uncoiling equipment, the rope must be unrolled flat on the ground (see *illustration below*).

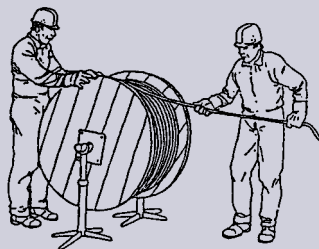
Uncoiling a rope from a drum also requires great care. The drum must be jacked up on a frame using a rod inserted through the drum's centre hole. The rope is then uncoiled from the drum under controlled tension to avoid formation of loops. This is achieved by applying a manual brake to the drum flange or using a special brake device.



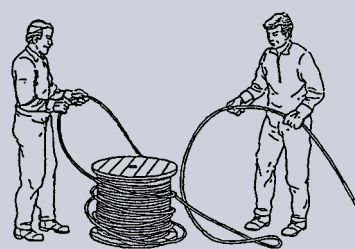
Uncoiling rope from drum
correct



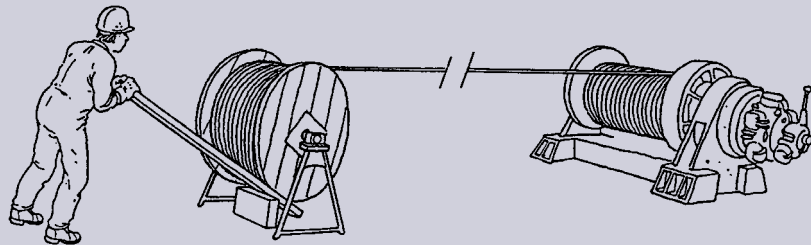
Uncoiling rope from drum
correct



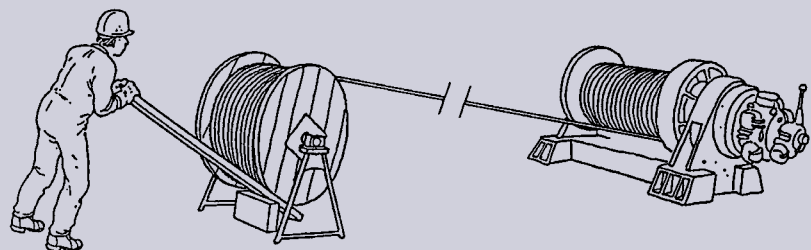
Uncoiling rope from drum
incorrect



Uncoiling rope from drum with a brake
correct



Uncoiling rope from drum with a brake
incorrect

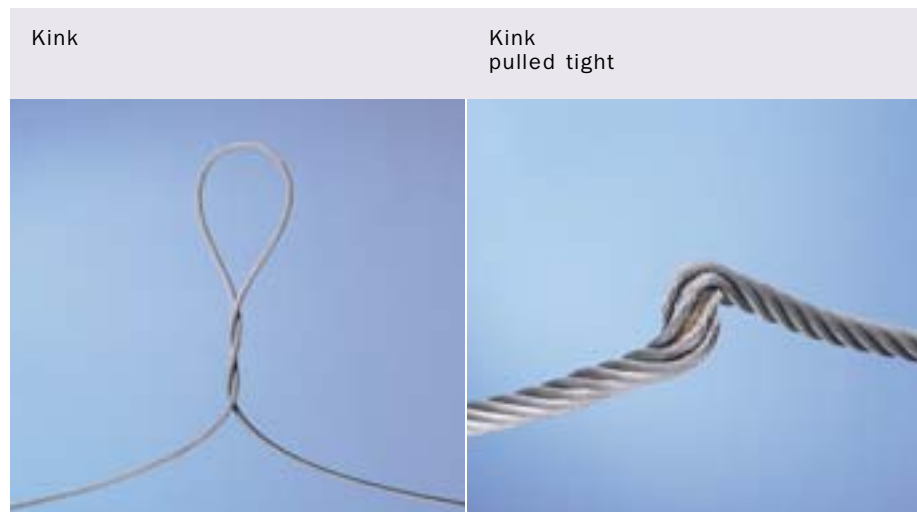


Loops formed during uncoiling may seriously damage the rope. Under load, loops contract and produce a kink which irreparably deforms the rope (*see illustration below*).



Caution:

A kink may significantly reduce the wire rope's breaking force and cause danger to personnel and rope conveying equipment.



6

Inspecting the rope conveying system

The rope conveying system must be inspected by experts or trained personnel only.



Caution:

Defects in the rope conveying system may cause serious injury to personnel.

Each defect in rope pulleys or drums will damage the rope, thus shortening the rope's service life at a much faster rate than through normal wear. Careful inspection of the system is therefore required prior to installation.

Before fitting the new rope, check the condition of the entire system.

6.1 Sheaves and drums

Check groove diameter and condition of rope sheaves, deflection sheaves and drums. Grooves in rope drums, rope and compensation pulleys must fit rope diameters. Groove diameter should never be smaller than actual rope diameter: ideally nominal diameter +6%. The groove diameter is checked with special groove gauges (see illustration page 14).

New wire ropes may be larger in diameter than old ropes, having thinned through use. When installing a new wire rope, it may not fit into the groove. Ropes running in narrow sheave grooves will present less endurance.

For the groove base to comply with DIN 15061, worn grooves may need to be machined out prior to rope installation.

We recommend exchanging the sheave.

Rope diameter must correspond to the drum pitch!

Groove gauges



Measuring sheave groove with groove gauge



Sheaves should rotate easily. Bearings must be in good condition. Sheaves must be in alignment with rope travelling direction and should have no wobble.

Sheaves should have no burrs. Drums must be checked for cracks. Rope guards and drum wedges have to be in perfect condition.

6.2 End termination

Rope anchorages and suspension devices must be in perfect condition. Check whether any rope fittings fit the anchorages. Make sure that anchorages and fitting correspond to the OEM's operating instructions.

6.3 Safety devices

Any rope monitoring equipment as well as derailment guards must be in perfect condition.

6.4 Examination

The wire rope's path through the equipment should be monitored to check for any worn areas produced by friction of rope and other parts; take remedial action if necessary.



Caution:

Failure to check the rope system may decrease rope service life and safety of operation.

7

Wire rope installation

Wire ropes may only be installed by technical experts or trained persons under competent supervision.

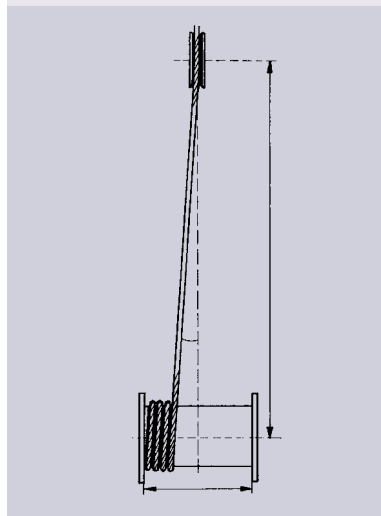
**Caution:**

Incorrect wire rope installation may be hazardous to those involved with installation and subsequent operation.

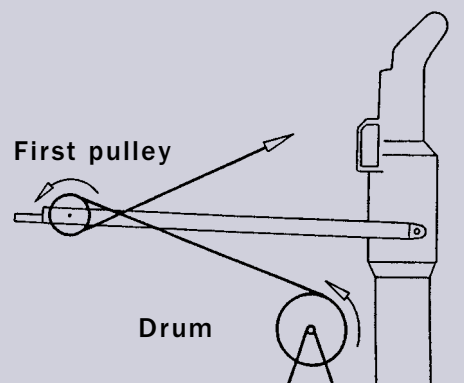
Make sure that the conveying equipment is safe for rope installation and that it cannot be started accidentally. Refer to the system OEM's operating instructions.

Make sure to carefully plan the sequence of rope installation. Follow the OEM's operating manual. Verify availability of tools and auxiliary equipment required for rope installation. Instruct installation personnel accordingly. Installation should be performed with due care and step by step under expert supervision.

1. Rope deflection angle



2. Retain preferred bending direction



During assembly, the reel should be mounted at maximum distance from the first sheave or the drum and without deflection, as deflection may cause rope to twist (see *Fig. 1*). Non-rotating ropes, for example, may even be damaged at 1.5° fleet angles.

When ropes are manufactured, ropes are wound on a reel, thus acquiring a preferred bending direction. When mounting a rope, the rope should retain the same bend to avoid damaging the rope or reducing its service life (see *Fig. 2*).

7.1 Installation

When fitting a new rope, turn should not be put into or taken out of the rope. If the rope is not installed by using the old rope, we recommend using a textile auxiliary rope or a thin, non-rotating rope. Stranded ropes must have the same direction of lay as the new rope.

If the old rope is used as pilot rope, make sure that no turn is transmitted to the new rope. Do not weld together old and new ropes. Though such junction provides a certain amount of tensile strength, the rope may break when passing over sheaves, thus creating a safety risk and possibly damaging the new rope or the equipment as a whole.

One way of joining old and new rope is by using a wire rope sock fitted over rope ends, which must be secured with tape or a clip (see *illustration page 18*).

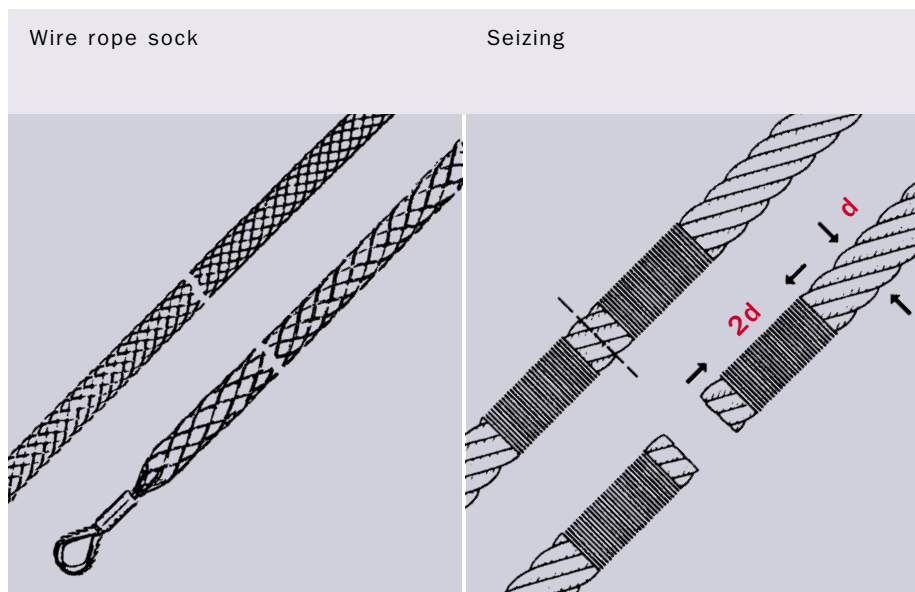
Wire rope socks must be sufficiently long to prevent the ropes from slipping out.

When using an auxiliary rope to install the new rope, the rope sock must have an eyelet. The auxiliary rope, which may be a fibre rope, must have sufficient tensile strength. If the new rope is introduced using the old rope, a rope sock open on both ends is used.

If the installation goes over large heights, the wire rope has to be prevented from rotating.

7.2 Cutting

If installation requires cutting a wire rope, make sure to apply proper servings before cutting ends, a minimum of one serving to each side (see illustration below). These servings must be equal to a minimum of two rope diameters in width. Special care has to be taken when applying servings to non-rotating and multi-strand ropes. Before cutting, the rope has to be secured and fixed on both sides of the cutting section so that both ends remain in the same position and do not unlay. Wire ropes are preferably cut by using an abrasive disc cutter or hydraulic rope cutter.





Caution:

When using an abrasive disc cutter, sparks and separated wire particles as well as toxic fumes may present a health hazard.

7.3 Reeving

Before installing a new rope, decide whether to pull the wire rope through the entire reeving, or to wind it on the rope drum as a first step and pull it through the reeving as a second - an exceptional procedure requiring sufficient drum capacity. If one inner end of the new rope ends in a fitting (e.g. a thimble), the only possibility is to pull the free end through the reeving.

When winding a rope on a smooth-faced drum, subsequent turns must be coiled tightly. Sufficient rope tension facilitates the operation. On smooth-faced drums, satisfactory coiling can only be achieved for a maximum of three layers and if the bottom layer is not used.

7.4 Multi-layer coiling

If multi-layer coiling is required on the equipment's winch drum, ensure that the new wire rope is under tension as it is coiled on the drum.

Higher rope tension enhances the strength of the entire wire construction, thus significantly reducing wear in the lower rope layers on the drum.

Loose winding may subsequently, when coiling under load, cause outer rope layers to cut into layers below, resulting in irreparable rope damage.

The outer layers may even be pulled in and trapped. The rope then has to be pulled out from layers below during subsequent uncoiling.

In most cases it will be sufficient to first wind up the rope, then pull it completely through the reeving (to the dead wraps) and subsequently wind it on the drum under minor back tension. Some rope systems require drum winding of the rope onto the drum under tension during initial installation. Rope tension should be as high as possible, but not more than approx. 1/50 of minimum breaking force. Such back tension can be achieved by applying a brake to the reel as the rope is drawn off. Please note that it is necessary to order conventional reels for the described installation procedure. Cross reels are unsuitable.



Brakes or tensioning apparatus shall not be applied to the rope directly to avoid twisting or deforming the rope, causing irreparable damage.



Caution:

Loose or uneven coiling on the drum can cause excessive wear, crushing and deformation of the rope.

7.5 Lay direction of a wire rope

How to determine the pitch of drums and blocks:

Position yourself in the axis of the drum or the block.

Start to follow the rope from a fixed point with your finger moving away from you.

If you turn your finger clockwise, this is a right pitch.

It's a left pitch if you turn your finger counter-clockwise.

Drawing rope from drum using a brake

Grooved drums will either have helical or parallel grooving. Parallel grooved drums are used for multi-layer coiling. Rope lay should be in accordance with either the drum pitch in the main working area, or the lead of the reeving. Drums with helical grooving are mainly used for single-layer, but can also be used for multi-layer coiling. Ropes should be chosen according to the table below:

Choice of rope			
Correct lay for multi-layer coiling			
Drum coiling	Drum lead	Reeving	Rope lay
single-layer	right-hand	secondary	left-hand
single-layer	left-hand	secondary	right-hand
multi-layer	secondary	right-hand	left-hand
multi-layer	secondary	left-hand	right-hand
multi-layer	secondary	neutral	right-hand or left-hand

Rope installation must be followed by checking and, if necessary, readjusting any limit switches.

Before start-up, check if the new rope is properly installed to fit the reeving and grooving of drums, sheaves and compensation sheaves.

Subsequently, test the system and allow the rope to bed in by applying a light load (max. 10% of full load).

In particular, test proper drum winding of the rope on the drum under load.

Wire ropes must be maintained at regular intervals (i.e. DIN 15020/ISO 4309 or other local regulations).

Ensure that rope conveying equipment cannot be started up by unauthorised persons during maintenance operations.

8.1 Cleaning wire ropes

Dirt must be removed from the rope before dressing.

When cleaning rope with a cloth, fibres may get stuck on broken wires or defective parts of the rope.

Dirt can be removed using a wire brush.

Use protective goggles when cleaning rope with brush.

Cable car ropes are cleaned with special cleaning devices.

8.2 Wire rope dressing

Depending on operation, wire rope must be dressed at regular intervals.

Use a lubricant that is compatible with the manufacturer's lubricant previously applied. If using a solvent-based lubricant, it should be used sparingly because the solvent may dissolve or wash out the original lubricant.

Repeated lubrication of wire ropes enhances their endurance and may reduce corrosion.



Caution:

Solvents can dissolve manufacturer's lubricant, causing large quantities of lubricant to accumulate on rope surface. This presents a hazard to rope conveying equipment requiring a minimum of friction between rope and sheave.

If rope cannot be dressed for operational reasons, expect it to be less durable and arrange for shorter inspection cycles.

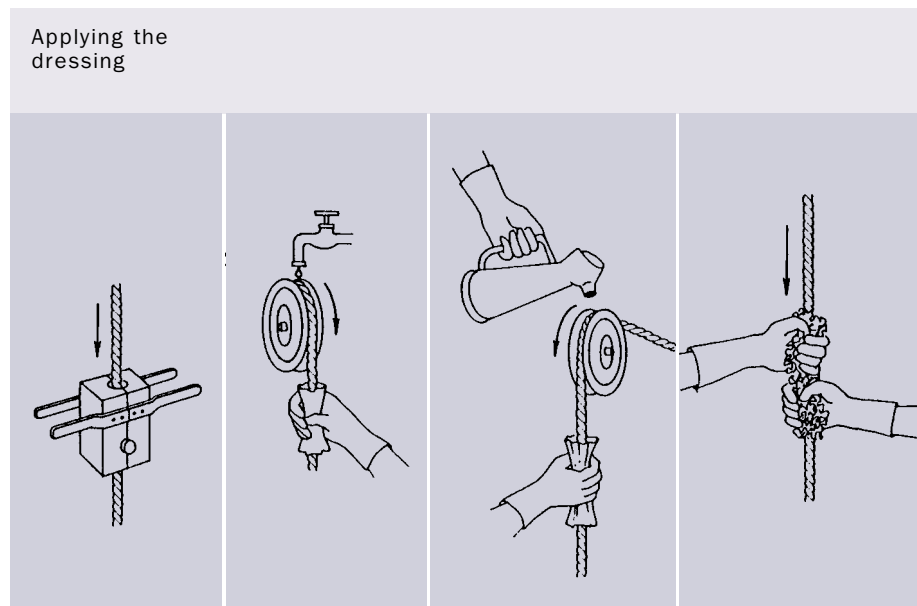


Caution:

Ropes not dressed at required intervals can have a significantly shorter life span than ropes undergoing regular lubrication.

Ropes are usually dressed by using a brush, cloth or the like. There are also solvent-based lubricants that can be sprayed on. Drip-feed lubricators or high-pressure lubricating machines are used in special cases.

High-pressure lubricators should only be handled by qualified personnel adhering to manufacturer's instructions.



Teufelberger **PERFEKT**[®] ropes are greased during manufacture to reduce friction within the rope and prevent corrosion. When ropes eventually turn dry by use and grease wears off, re-lubricate to enhance durability. **PERFEKT**[®]-OIL, including a dressing device, was developed for this purpose.

PERFEKT[®]-OIL has been tailored to the original lubricant used during manufacture and can be applied quickly and sparingly by using the attached application device. This special grease covers a wide temperature range between minus 40°C and plus 85°C. We recommend re-lubricating sparingly to preserve original lubricant.

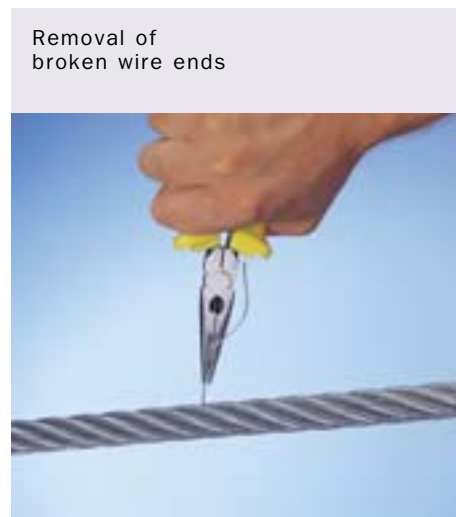
Lubricating
with PERFEKT[®]-OIL



8.3 Removal of broken wire ends

Protruding wire ends can damage adjacent wires and affect normal travel of wire rope. They should be removed.

It is not recommended to nip ends off with pliers but to grip them, bending them backwards and forwards until the wire breaks in the valley between two strands.



8.4 Repairing localised damage to the rope

Localised damage to rope may be caused by mechanical impact. Overheating due to friction usually causes localised hardening of wires (formation of martensite).

Immediate, careful abrasion of hardened sections prevents wire breakage and formation of broken areas.

Such repair is mainly performed on wire ropes with bigger diameters and should only be conducted by trained personnel.



Caution:

Improper attempts at repair are ineffective and may cause damage and be a hazard to safe operation.

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