INSTALLATION AND MAINTENANCE

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INTRODUCTION

DIEPA Special wire ropes are designed to achieve longest lifetime and to provide best durability. And this in a huge variety of applications.

Even though, the service life of a rope is mainly affected by the condition of the surrounding rope drive components. Moreover the manner of correct rope installation plays a big role when talking about avoiding harmful effects.

This brochure gives the user of DIEPA Special Wire ropes some essential hints for what to care of. If there are any uncertainties or questions left, please contact our technical department.

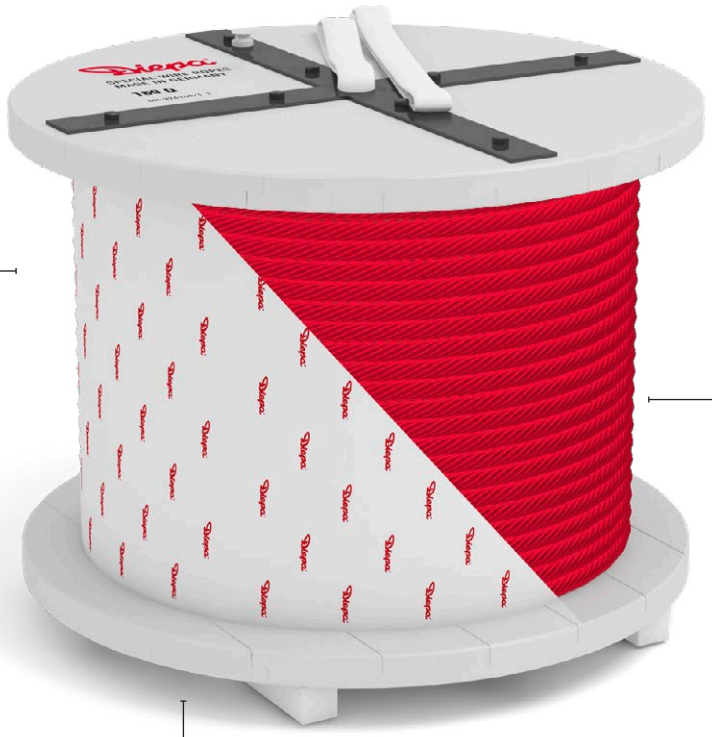
TABLE OF CONTENTS

DIEPA Drahtseilwerk Dietz GmbH & Co.KG Damaschkestraße 30 96465 Neustadt bei Coburg Germany Tel.: +49 (0) 9568 924 0 www.diepa.de

STORE THE ROPE IN A **SUITABLE LOCATION**

AVOID EXPOSURE TO DIRECT SUNLIGHT

AVOID EXPOSURE TO RAIN OR SNOW



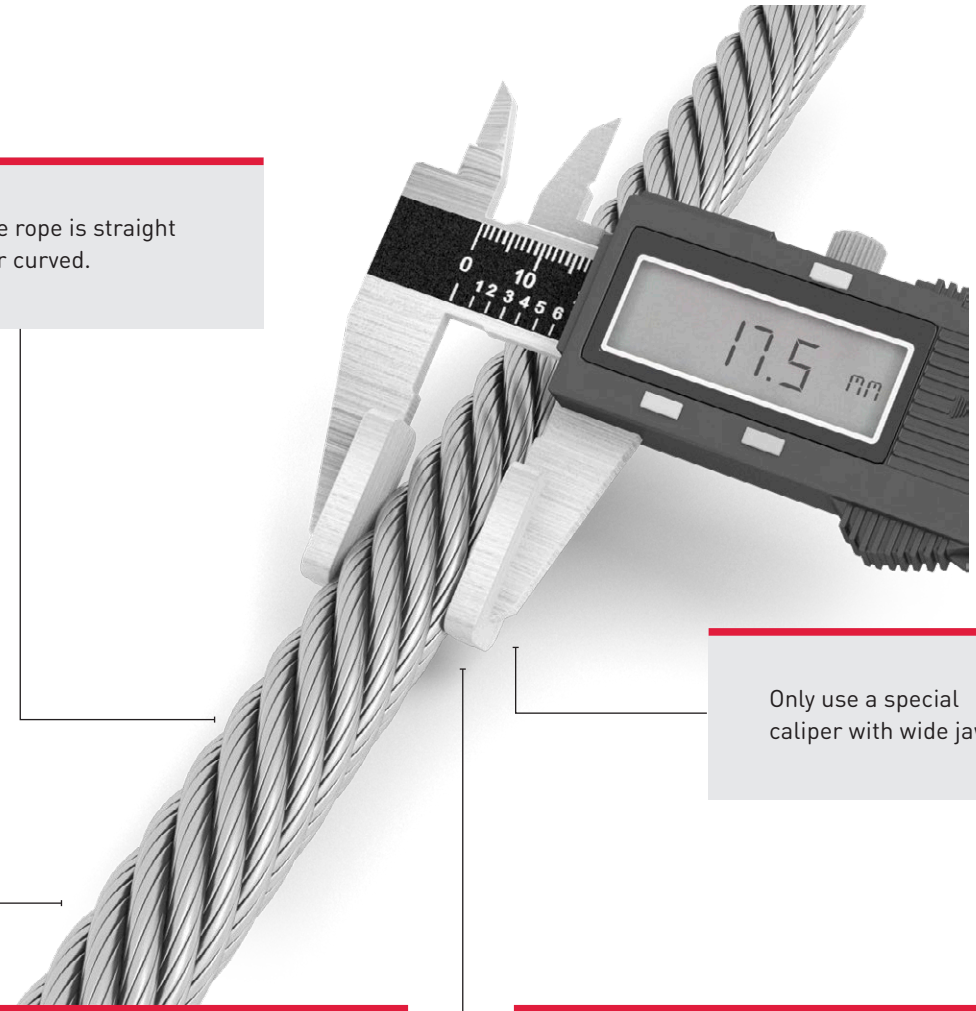
IDEAL TEMPERATURE
+5°C — +15°C
+41°F — +59°F

AVOID MOISTURE FROM THE GROUND

REGULARY CHECK FOR CONDENSATION AND REMOVE FOIL IF NECESSARY

BEFORE INSTALLATION
ENSURE THE CORRECT ROPE DIAMETER

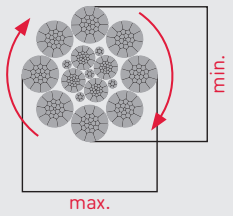
Ensure that the rope is straight and not bent or curved.



Only use a special caliper with wide jaws.

Measure at least at two points over a length of 1 meter in a distance of at least 2 meters from the rope end.

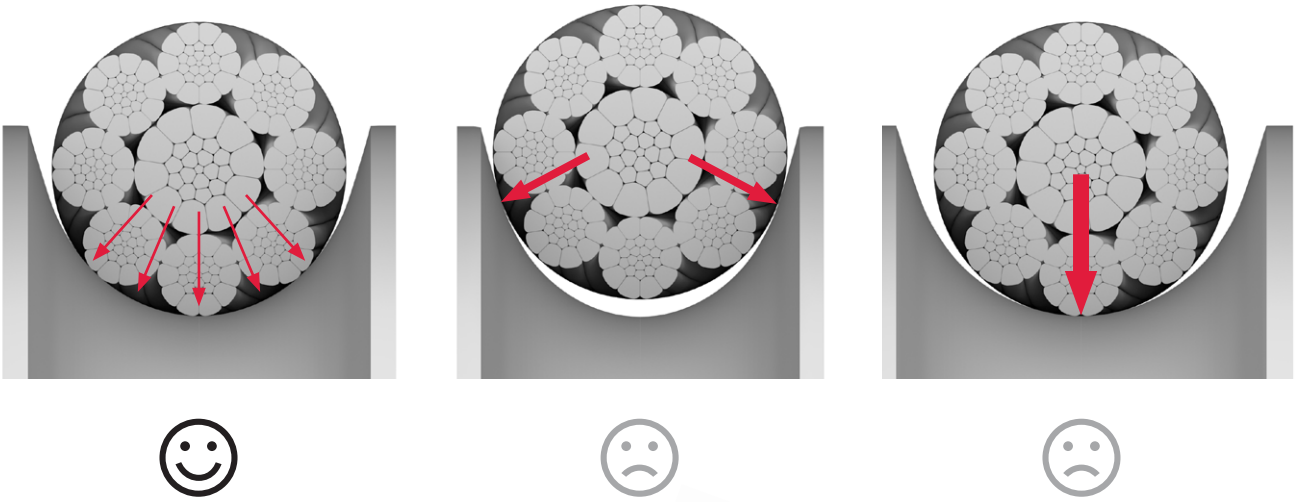
Turn the caliper around the rope axis to find out the maximum and minimum diameter at each location.



⚠ **Spooling and bending of an unloaded rope may increase the rope diameter slightly. This is a natural effect which is reversible when the rope is loaded. In case of doubt please contact us.**

CHECK ALL GROOVE DIAMETERS
BEFORE ROPE INSTALLATION

Groove diameters of sheaves, drums or other rope supporting elements are influenced by wear. During rope replacement it has to be assured that they are suitable to take in the new rope. Non-matching groove diameters lead to punctual pressure distribution causing local wear and rope deformation:



THE MINIMUM GROOVE DIAMETER SHALL BE:

- basically 6% greater than the nominal rope diameter
- ideally 1% greater than the actual rope diameter

EXAMPLE:

- rope diameter: 21mm
- sheave groove diameter: 21 mm × 1,06 = 22,26 mm

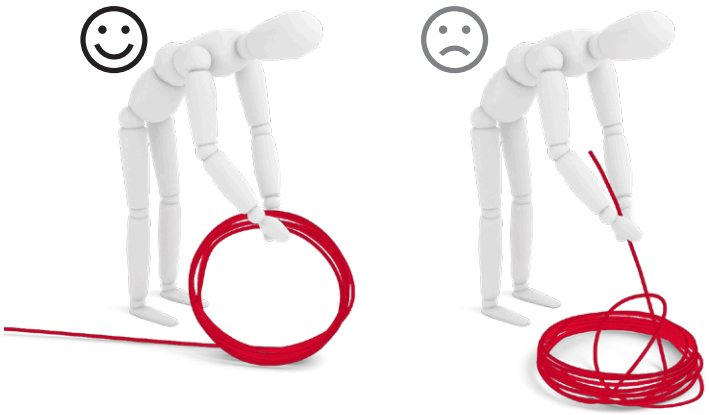
ℹ The sheave groove diameter can be conveniently measured with DIEPA groove gauges. Please contact us!

PREVENT MECHANICAL DAMAGE
BY HANDLING THE ROPE CAREFULLY

WHEN TRANSPORTING THE ROPE, ONLY LIFT THE REEL:

- at the flanges
- by using a bar put through the reel
- by using a crane

⚠ **Be aware the rope surface does not get in touch with any edges of lifter forks or other equipment!**

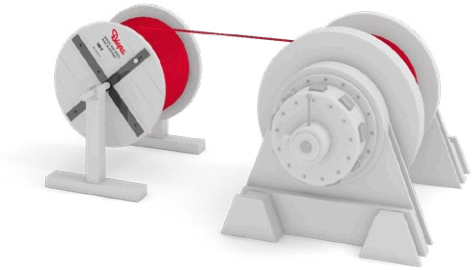


When uncoiling from a ring unroll it on a clean ground in the right sense of bending. Do not take it from the placed ring, this may cause loops leading to kinks when pulling!

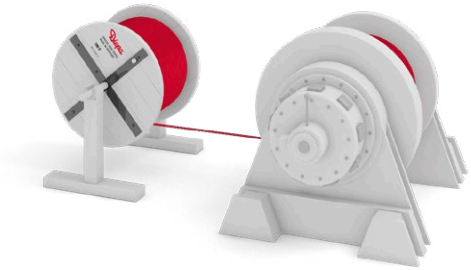
When uncoiling from a reel: unreel by turning the reel, not by taking off winding by winding. The rope shall never be pulled from a reel which is laying on its side!

WHEN SPOOLING
BEND THE ROPE ONLY IN THE SAME DIRECTION

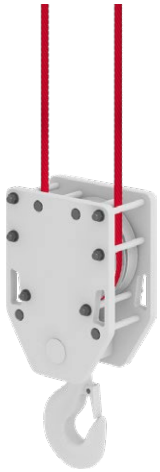
BENDING IN SAME DIRECTION PREVENTS FROM NEGATIVE EFFECTS



From the top to the top

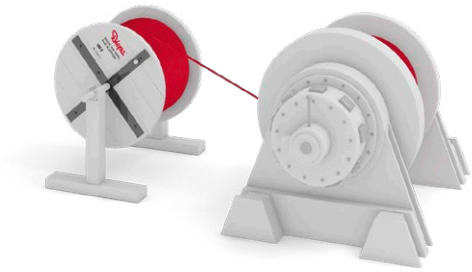


From the bottom to the bottom

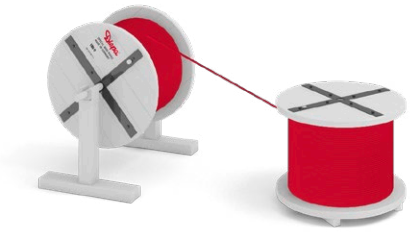


Result

BENDING IN OPOSITE DIRECTION MAY RESULT IN A ROTATING HOOK BLOCK



Frome one side to the opposite side



From upright to lying

Result

⚠ **Twist brought into the rope during spooling and before installation may lead to twisting rope falls during operation.**

CORRECTLY DETERMINE **PITCH DIRECTIONS**

DIRECTION OF LAY OF THE ROPE

LEFT-HANDED ROPE

When looking onto the rope and the outer **strands are pointing to the left side** it is a left-handed rope

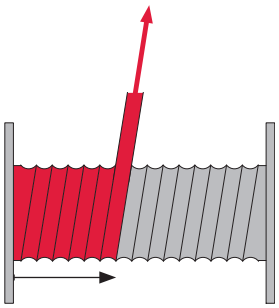
RIGHT-HANDED ROPE

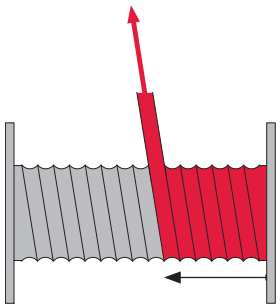
When looking onto the rope and the outer **strands are pointing to the right side** it is a right-handed rope

PITCH DIRECTION OF THE DRUM

LEFT-HANDED DRUM

Following the rope loops from the fixed end along in direction to the rope leaving the drum leads to a **left-handed screw.**





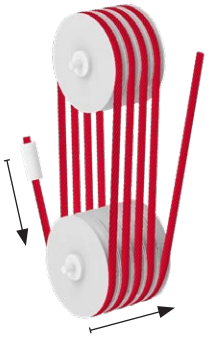
RIGHT-HANDED DRUM

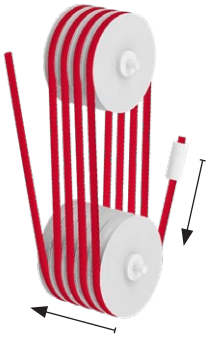
Following the rope loops from the fixed end along in direction to the rope leaving the drum leads to a **right-handed screw.**

PITCH DIRECTION OF THE REEVING

LEFT-HANDED REEVING

Following the rope line from the fixed end along in direction to the drum leads to a **left-handed screw.**



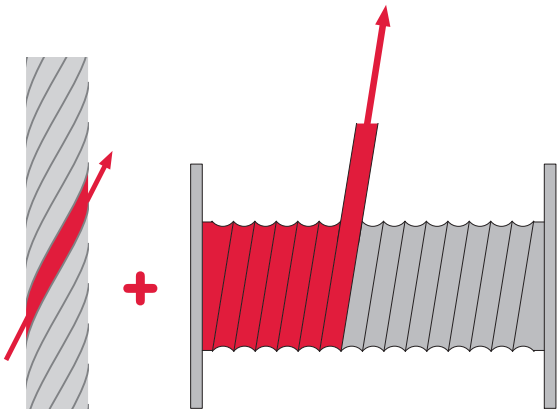


RIGHT-HANDED REEVING

Following the rope line from the fixed end along in direction to the drum leads to a **right-handed screw.**

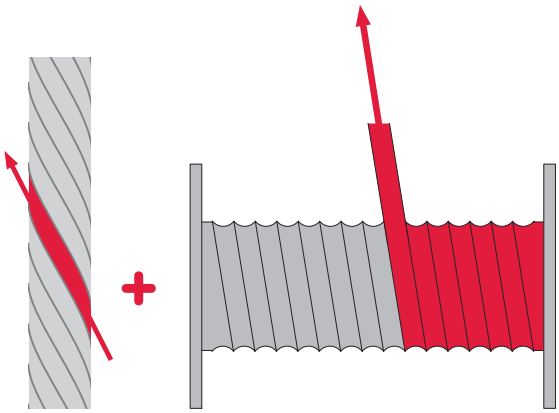
ROPE LAY AND DRUM PITCH MUST MATCH FOR TROUBLE-FREE OPERATION

FOR SYSTEMS **WITH SINGLE LAYER DRUM** THE FOLLOWING IS VALID



Right-handed rope **Left-handed drum**

A **left-handed** drum must be paired with a **right-handed rope**



Left-handed rope **Right-handed drum**

A **right-handed** drum must be paired with a **left-handed rope**

- For systems with two or more single layer drums ensure that all ropes are correctly assigned.
- For systems with one drum with two different pitch directions please follow the instructions of the crane manufacturer.

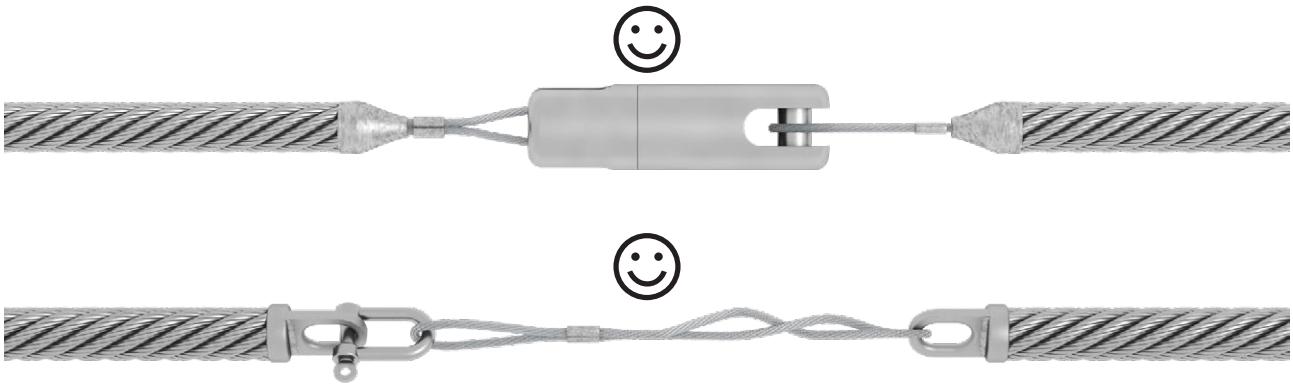
IN MULTILAYER OPERATIONS WITH A HIGH NUMBER OF FALLS WE CONSIDER THE PITCH DIRECTION OF THE REEVING AS GUIDING

	single layer operation		multilayer operation			
			low nr. of falls		high nr. of falls	
drum pitch	left	right	left	right	left or right	
reeving pitch	left or right	left or right	left or right		left	right
rope lay	right	left	right	left	right	left

- Considering correct rope lay selection, please also refer to the equipment's operating manual!

ALWAYS **CONNECT ROPES ROTATABLE**

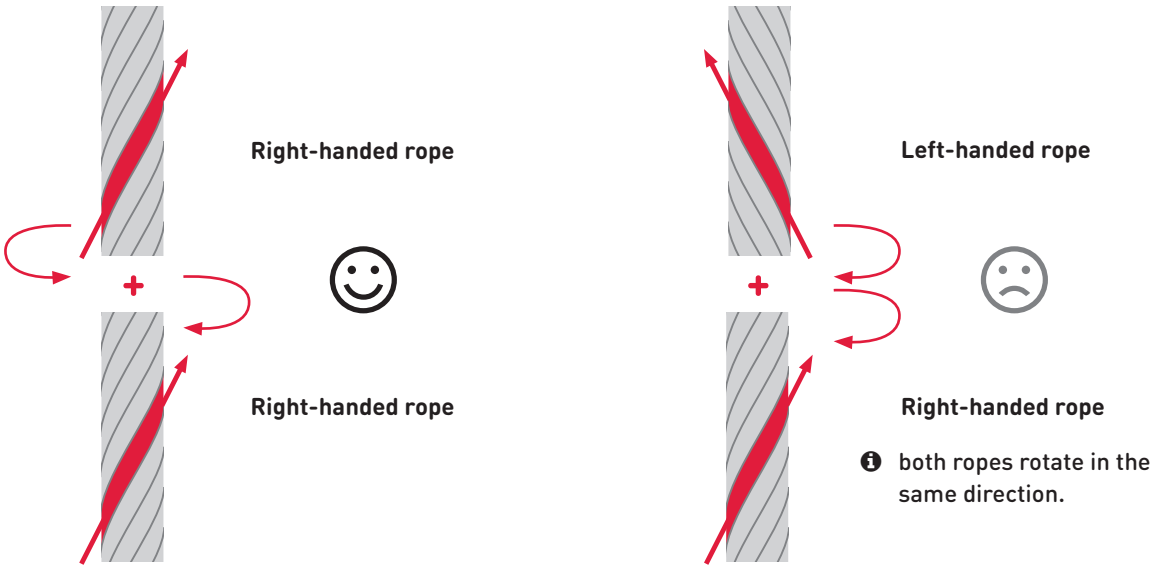
If the old rope is used to pull in the new rope during installation please ensure that twist from the old rope is not transferred to the new one. This can be done by e. g. using a swivel or an auxiliary rope absorbing twist:



ⓘ If a twist is present in the old rope, the auxiliary rope will twist.

⚠ Never connect ropes in a rigid way, e. g. by welding. This allows to transfer torsion. As a result, twist from the old rope will be transferred to the new rope!

PLEASE CONSIDER DIRECTION OF LAY **WHEN CONNECTING ROPES**

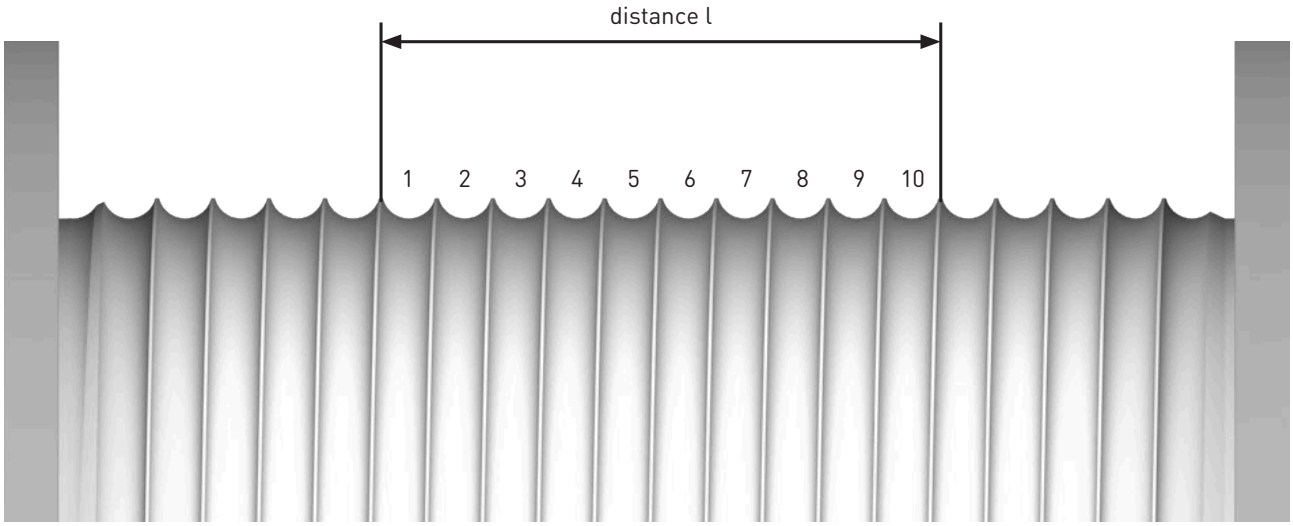


ⓘ both ropes rotate in the same direction.

⚠ Do never connect ropes with opposite direction of lay. As a result, both ropes will be turned open!

ACTUAL ROPE DIAMETER IS CRUCIAL IN MULTILAYER APPLICATIONS

TO OBTAIN A RELIABLE SPOOLING BEHAVIOUR THE ROPE MUST NOT BE GREATER THAN THE PITCH OF THE DRUM



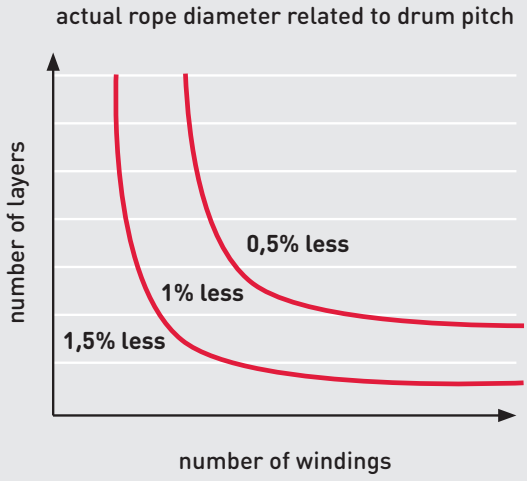
THE DRUM PITCH P IS CALCULATED BY:

$$p = \frac{\text{distance l}}{\text{number of enclosed windings}}$$

A COMMON RULE SAYS:

The actual rope diameter under tension has to be **1% less** than the drum pitch p. This ensures the rope has enough space on the drum. This is mainly valid for system with up to 20 windings and 5 layers.

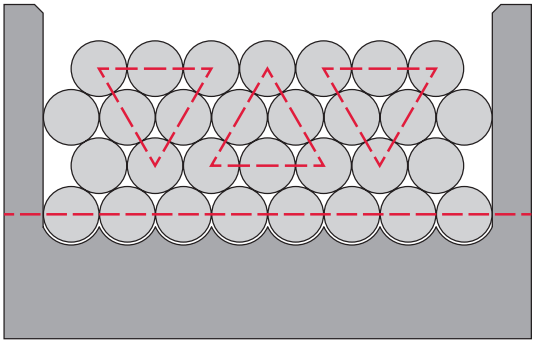
BASICALLY, **REQUIREMENTS ON ACTUAL ROPE DIAMETER** INCREASE WITH NUMBERS OF LAYERS AND WINDINGS



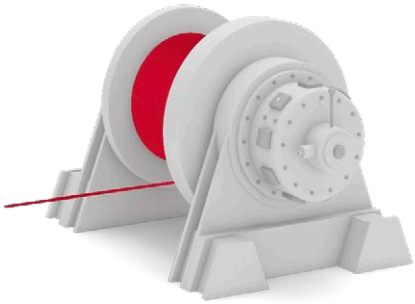
PRETENSIONING IS ESSENTIAL
WHEN INSTALLING ROPES IN MULTILAYER SYSTEMS

Good operating behaviour of multilayer systems is only achieved with a stable and rigid rope pyramide.

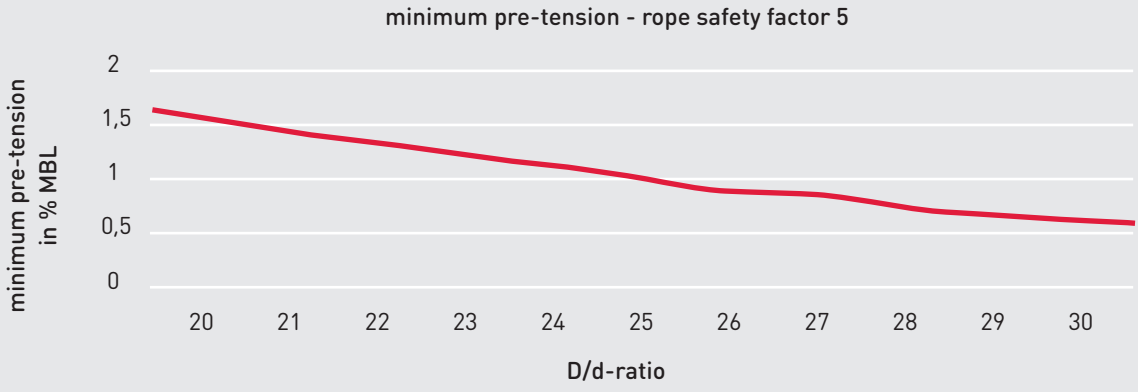
For receiving a stable and rigid rope pyramide in the multilayer-systems it is very important that especially the lower rope layers are settled tightly on the drum.



To achieve this, a simplified rule requires to spool the rope with a pre-tension of 1 – 2% of the rope's MBL or 10% of the equipments WLL.



MORE ADVANCED CONSIDERATION INCLUDES **DEPENDANCE OF THE D/d-RATIO**



If you are using a multiple reeving during installation, please ensure that the above mentioned pre-tension is the line pull of the rope running onto the drum!

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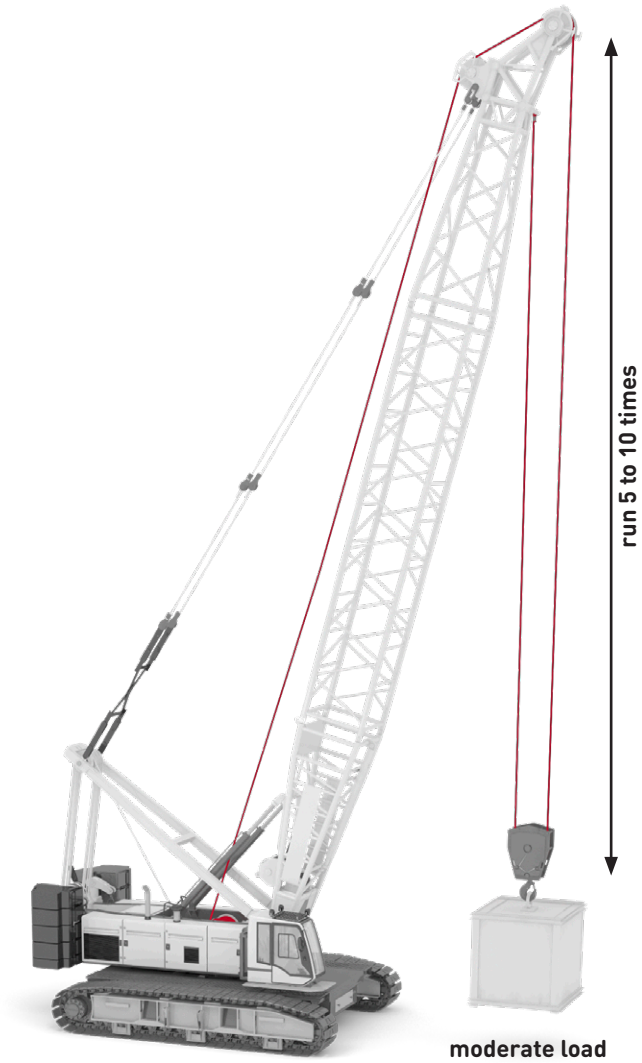
RUN IN A NEW ROPE AFTER INSTALLATION

Due to its flexible structure and a multitude of elements a rope can be considered as an "organic" element of a rope drive. Thus, it is recommended to prepare a new rope for a satisfying operation under duty.



AFTER INITIAL INSTALLATION OF A NEW ROPE, IT SHALL BE FIRSTLY ADAPTED TO THE INDIVIDUAL PROPERTIES OF THE ROPE DRIVE.

This helps to:

- enable final settling of the rope elements
- decrease and balancing of internal stresses and deformation
- equalization of bending effects and twist from rope installation

ESPECIALLY FOR ROTATION RESISTANT ROPES IT IS STRONGLY RECOMMENDED TO:

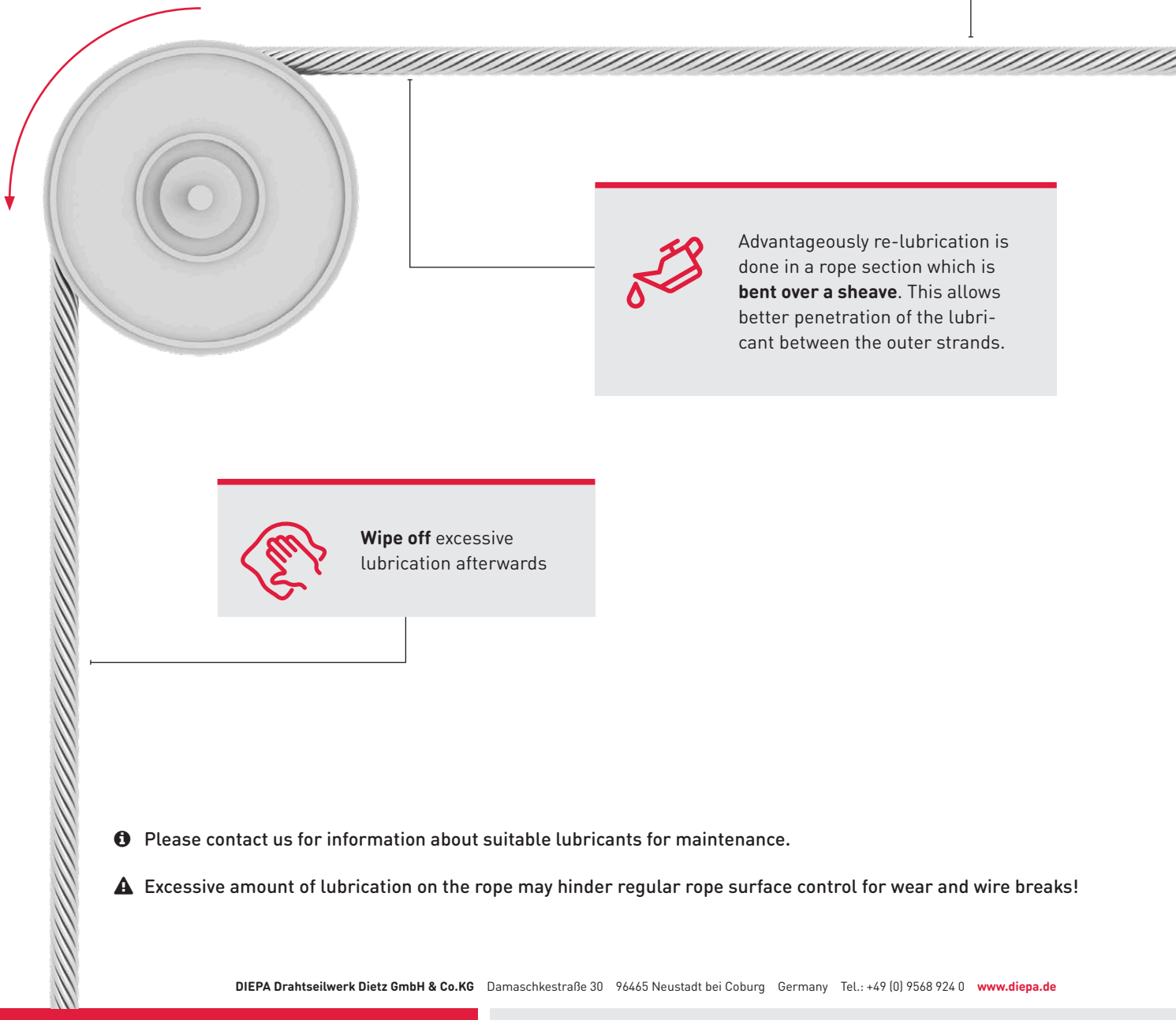
- forward residual twist from installation to the free rope end
- enable the rope to embed free of residual stresses
- in multilayer operations finally spool the rope with pre-tension, see page 12

⚠ **Ideally the whole rope length is run through the hole rope drive with moderate line pull several times.**

RE-LUBRICATION CAN BE APPLIED TO VERY DRY OR CORRODED ROPES

BASICALLY, DIEPA SPECIAL WIRE ROPES ARE LUBRICATED FOR LIFETIME.
NEVERTHELESS, IN SOME SPECIAL CASES RE-LUBRICATION MAY BE ADVISEABLE, E. G:

- when the rope surface appears **extraordinarily dry**
- when the rope surface shows **signs of corrosion**



Advantageously re-lubrication is done in a rope section which is **bent over a sheave**. This allows better penetration of the lubricant between the outer strands.

Wipe off excessive lubrication afterwards

Please contact us for information about suitable lubricants for maintenance.

Excessive amount of lubrication on the rope may hinder regular rope surface control for wear and wire breaks!

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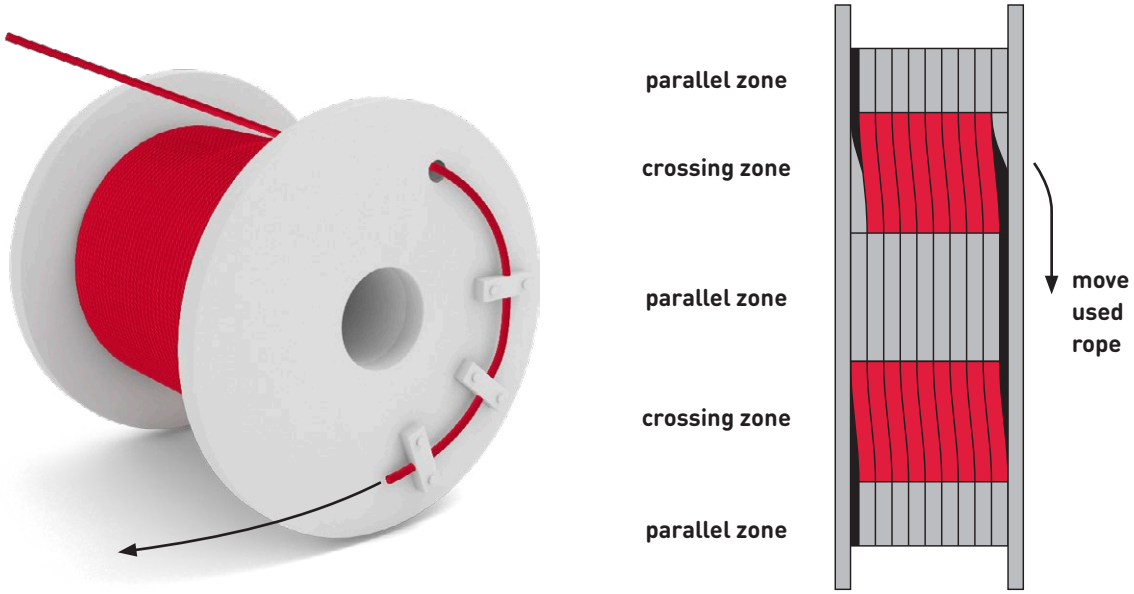
SHORTENING THE ROPE CAN EXTEND ITS LIFETIME IN MULTILAYER SYSTEMS

Multilayer spooling systems like e. g. LEBUS® drums have definite rope crossing zones equally spaced twice on the circumference.

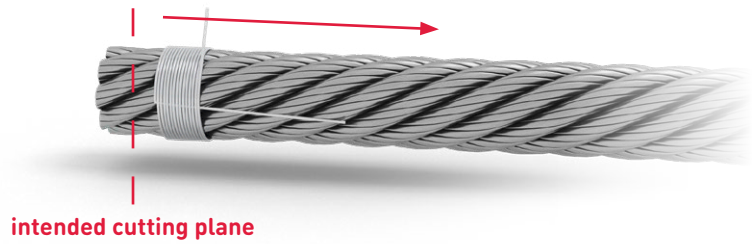
In these crossing zones the rope is extraordinarily stressed by local contact pressure and therefore wear is appearing firstly, shown by deformed, flattened or even broken wires.



- Moving worn zones from crossing zones to parallel zones may increase the rope's service life in a multilayer system. Normally the shortening of the rope can be performed twice as to ensure that **the wear is evenly distributed** along the rope.
- The proper time to shorten the rope is when the outer wires have been **flattened through wear**. No or only very few broken wires should be present.
- To shorten the rope, it must be dismounted from the drum and cut as required. Normally the length to be cut is **approximately ⅙ of the circumference** or approx. ½ of the diameter of the drum.

CAREFULLY SEIZE A ROPE BEFORE CUTTING

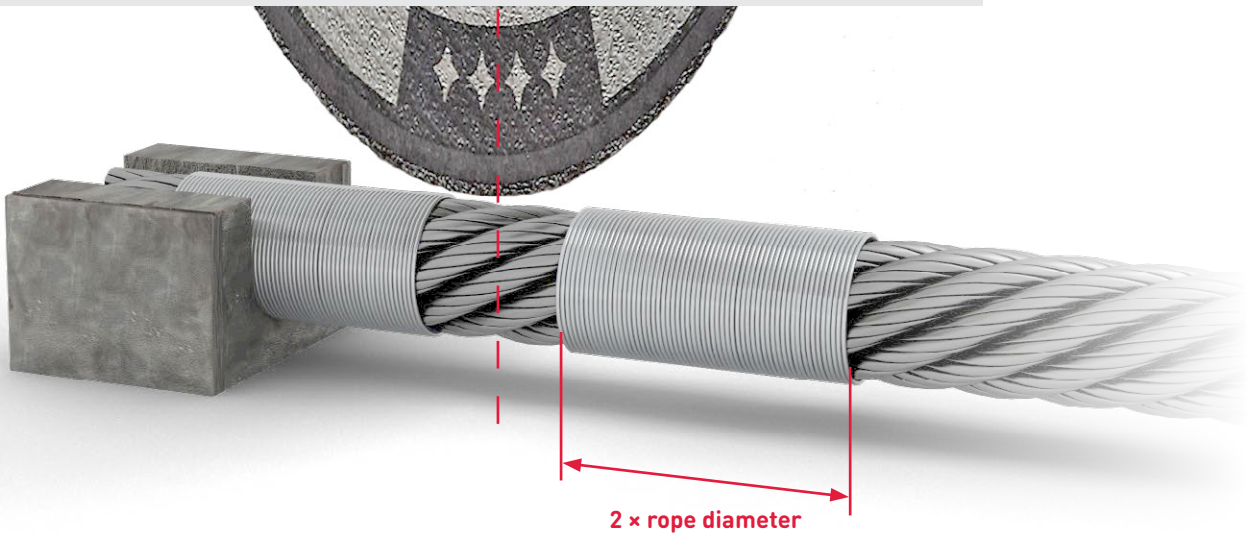
Before cutting a rope, it must be seized tightly besides the cutting plane.
This prevents the rope structure from opening.



ℹ Note, that the direction of winding should be away from cutting plane.

BEST PRACTICE

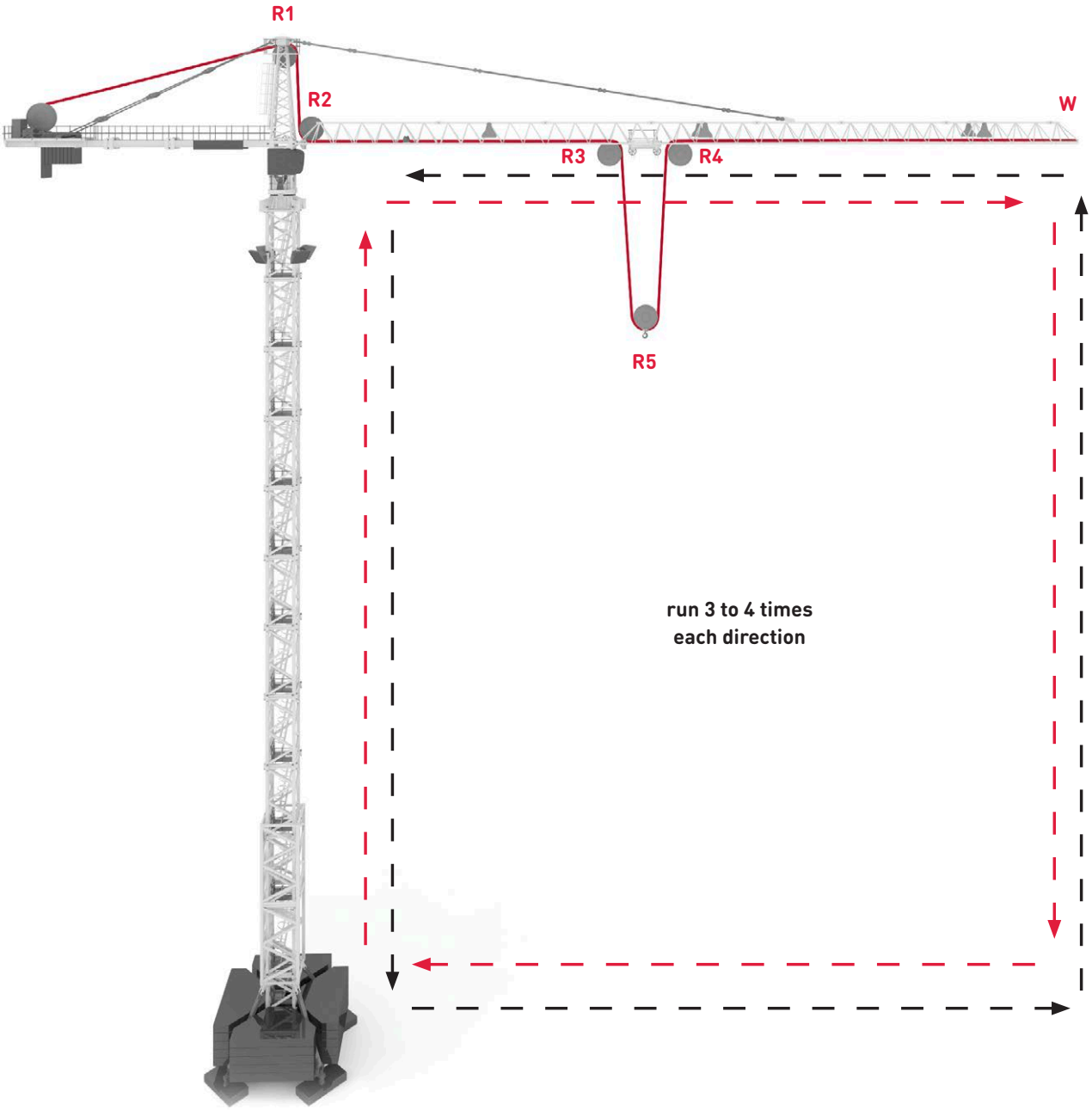
Attach two seizings at the rope on both sides of the intended cutting point. This helps to secure the rope's structure to a maximum and ensures a safe cutting procedure.



⚠ Accurate seizing is especially important at rotation resistant wire ropes (e. g. DIEPA B-, C- and K-series) to keep their special structure.

REMOVING ACCUMULATED TWIST
FROM TOWER CRANE ROPES

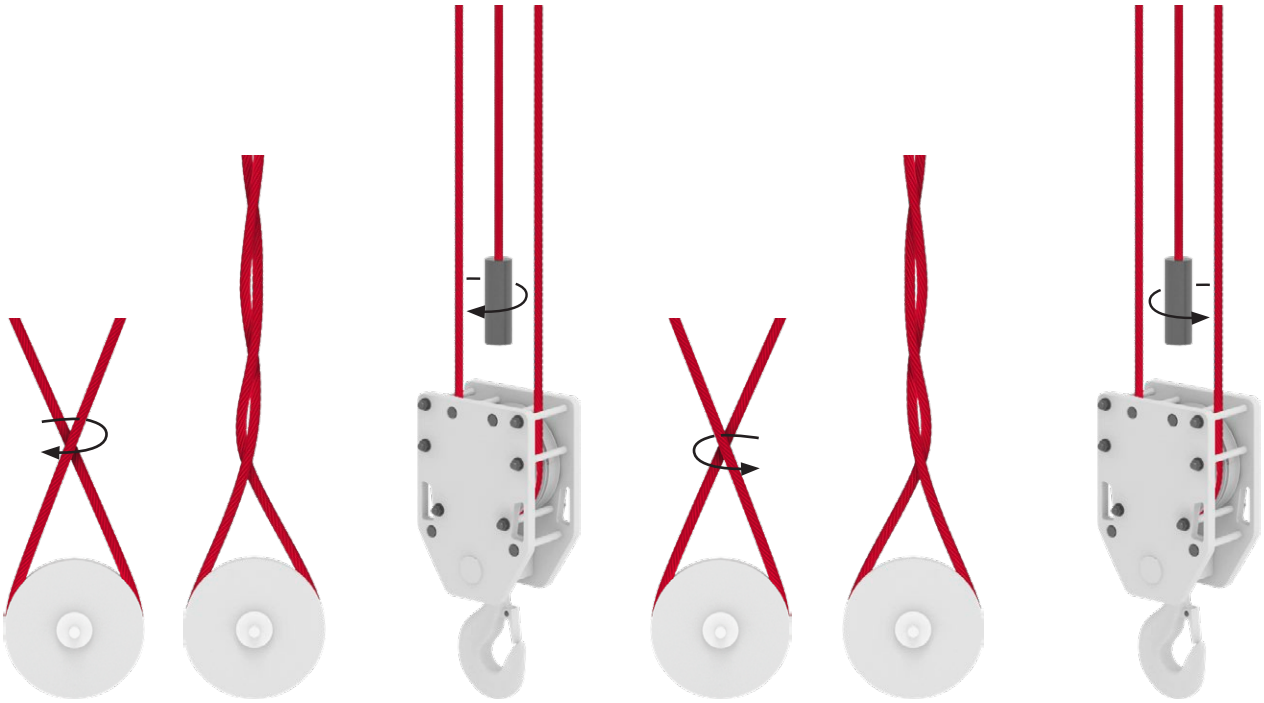
In some special cases tower crane ropes may accumulate twist which finally leads to twisting falls: When lifting operations are conducted **repeatedly at fixed trolley position** the rope only runs over the sheaves R1, R2, R3 and R5.
Since sheave R4 does not rotate, the twist induced into the rope is not conveyed over it. Hence the twist can not reach the swivel W to be eliminated.



⚠ By travelling with the trolley and the hook block according to the above shown pattern several times the twist can be moved to the swivel and thus be eliminated.

REMOVING ACCUMULATED TWIST
FROM MOBILE CRANE ROPES

For an effective elimination it is necessary that the rope end is fixed to the hook block.



If the hook block is turning clockwise*, the rope end must be turned also clockwise to achieve a counter torque.

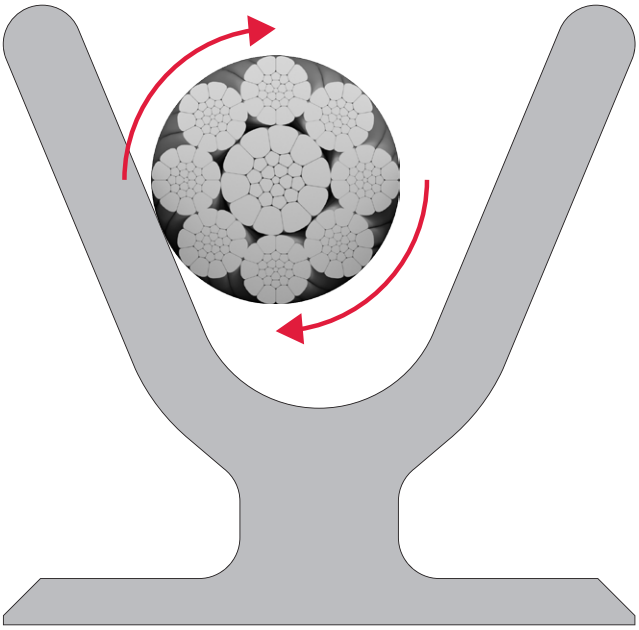
If the hook block is turning counterclockwise*, the rope end must be turned also counter-clockwise to achieve a counter torque.

*** when looking onto the top of the hook block**

It is recommended to turn **at least a half turn (180°) but not more than a full turn (360°)**. More may lead to structural damage of the rope. After imposing the twist, the hook block must be **travelled up and down several times** to convey the twist over the top sheaves and distribute it equally. Potentially, this procedure needs to be executed several times, until the hook block stays untwisted.

⚠ **Lifting height for this operation is recommended to be at least 15 meters.**

FLEET ANGLES TWIST THE ROPE



A rope running into a sheave or drum groove with a deflection angle of β > 0° is firstly contacting the groove side wall.

This provokes the rope rolling into the sheave groove bottom, **generating torque along the rope axis.**

THE EXTENT OF THIS EFFECT IS HEAVILY DEPENDING ON:

- fleet angle
- line pull
- friction coefficient

FLEET ANGLES MAY RESULT FROM:

- machine design
- working conditions

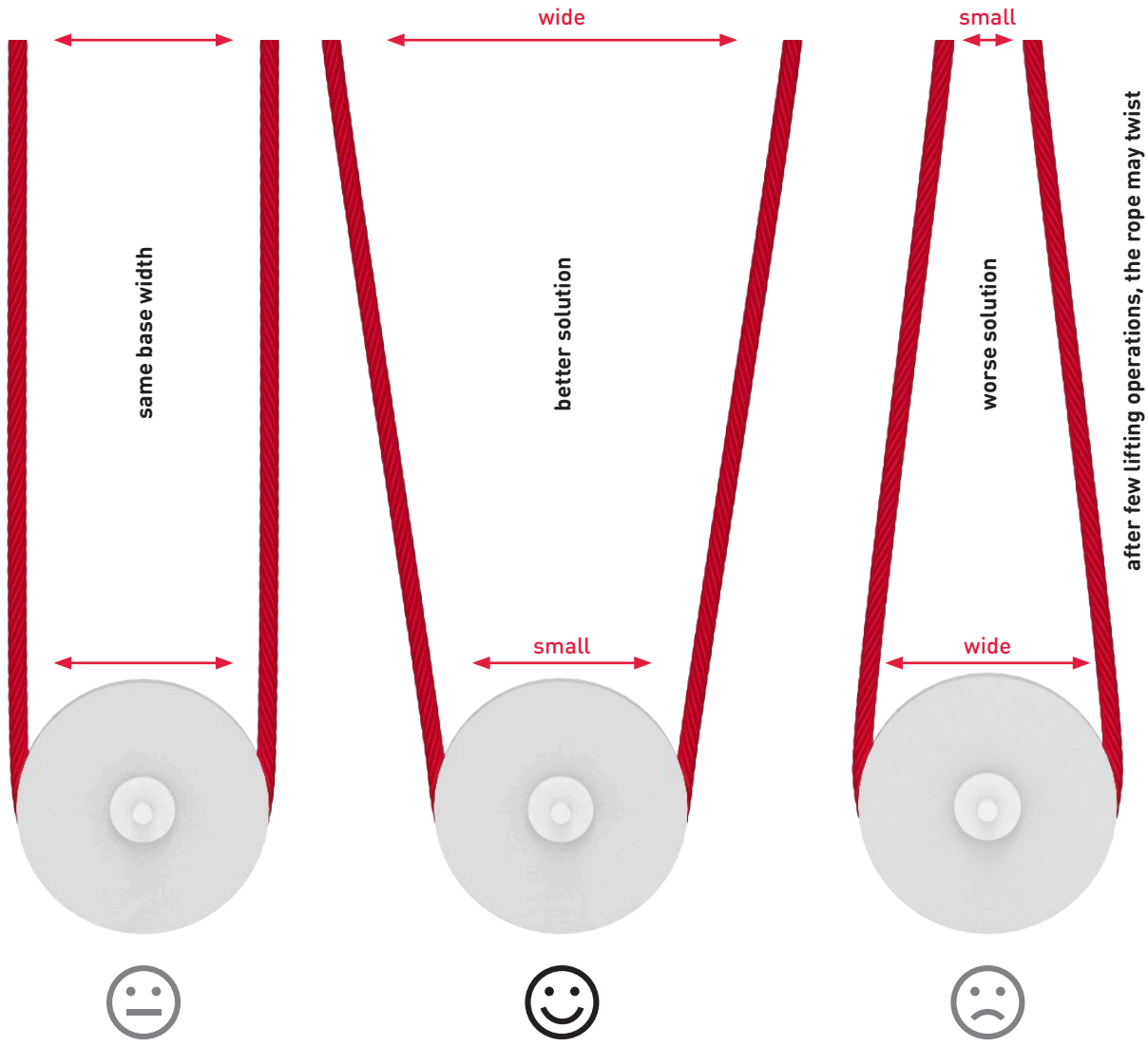
⚠ To minimize negative effects on the rope structure the admissible fleet angles are limited as follows (see also ISO 16625):

- non-rotation resistant ropes (e. g. DIEPA X-, H- and L-series) $\beta_{max} = 4°$
- rotation resistant ropes (e. g. DIEPA B-, C- and K-series) $\beta_{max} = 2°$

REEVING GEOMETRY INFLUENCES SYSTEM STABILITY

It is important to ensure that the base width between the rope strands at the top is at least the same distance or a greater distance apart.

BASE WIDTH TOP ≥ BASE WIDTH BOTTOM



⚠ For satisfying behaviour the rope falls shall be at least parallel or better v-shaped.

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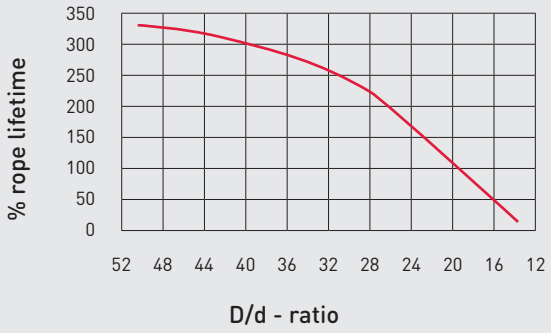
A VARIETY OF **OPERATING CONDITIONS** IMPACT ROPE LIFETIME

Rope lifetime is decreasing drastically with lower D/d-ratio

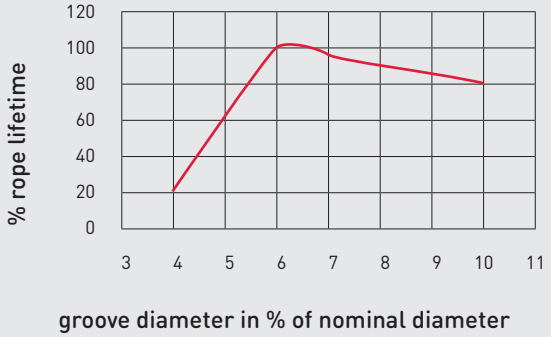
⚠ **For acceptable service life a recommended ratio of 20 shall not be undercut.**

INFLUENCE D/d - RATIO



Rope lifetime is decreasing drastically with alower r/d-ratio with groove diameters being too small.

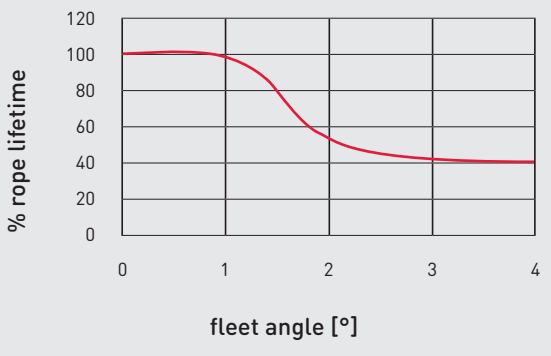
INFLUENCE SHEAVE GROOVE DIAMETER



Rope lifetime is decreasing drastically with increased fleet angles

⚠ **max. 2° for rotation resistant ropes**
max. 4° for non-rotation resistant ropes

INFLUENCE FLEET ANGLE



FOR SAFE OPERATION: REGULARLY CHECK THE ROPE FOR SIGNS OF WEAR!

Various aspects contributing to discard must be considered, such as:
- wire breaks
- rope diameter reduction
- corrosion
- abnormal signs of wear like waves, kinks, ...

For detailed illustration of this very important matter, please see our separate brochure:

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FOR A DEEPER INSIGHT
BELOW PUBLICATIONS MAY BE HELPFUL

[1] EN 12385 – 3, Steel wire ropes – Safety; Part 3: Information for use and maintenance

[2] ISO 16625, Cranes and hoists – Selection of wire ropes, drums and sheaves

[3] ISO 4309, Cranes – Wire ropes – Care and maintenance, inspection and discard

[4] VDI 2358, Drahtseile für Fördermittel

[4] Original Operating Manual for DIEPA Special Wire Rope acc. MD 2006/42/EC

[5] Feyrer, Klaus: Wire Ropes – Tension, Endurance, Reliability, Springer Verlag 2007

NOTES

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09/2022