PFEIFER

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SEIL- UND HEBETECHNIK
GMBH

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Wire ropes – Technical information

Wire ropes – Technical information

Moving means to set things in motion, to unfold dynamics, to create things. For us in the PFEIFER group, to move is very specific: it means that with our products from Wire Rope Technology, Rope and Lifting and Building Systems elevators, heavy loads on cranes, sheet metal coils, workpieces and precast concrete elements move. Our cable structure buildings are known all over the world, and so is our extensive knowledge on the dynamics of wire rope in all applications.

Moving also means for us that we don't sit still, we study, we learn, we apply and we invest. There is a reason why the PFEIFER group is one of Europe´s leading companies in Structures, Wire Rope Technology, Rope and Lifting and Building Systems.

We get things going – special requests by customers, efficient and practical solutions, technical expertise, quality and dependable service – these are the benefits for you as a partner.

Gerhard Pfeifer,
President of the PFEIFER group

The PFEIFER group is one of Europe´s leading companies in Structures, Wire Rope Technology, Rope and Lifting and Building Systems. The head-quarters are located in Memmingen, Germany. Numerous service centres and subsidiaries worldwide are responsible for sales and distribution.

Through the right choose of ropes and end terminations in accordance with their operating conditions you achieve the most economic lifetime, reduce potential risks and avoid high downtime costs on the basic of premature rope failure.

Well-know manufacturers of cranes and building equipment, as well as fleet operators and users, trust in PFEIFER know-how. Rely on our years of experience!

Content

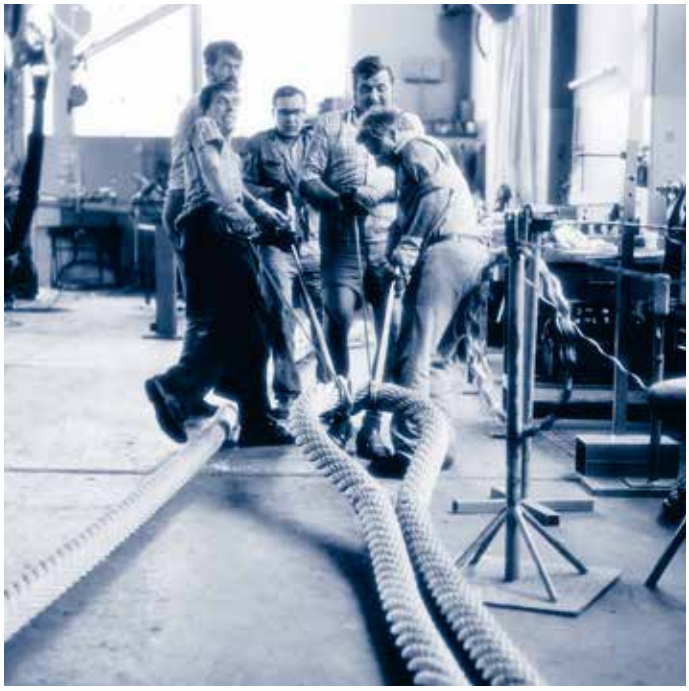
Reduce every risk and trust in our longtime experience of correct rope selection!

Please let us advise you!

➜ Further infomation can be found under Products & Services at the PFEIFER web portal:
www.wirerope.info

Wire ropes – a story of success

Historical review



When Wilhelm Albert, an official of the German Board of Mines, manufactured a steel wire rope in 1834, it was admittedly not the first wire rope in the world, but the tools he used and the level of wire production enabled him to produce ropes of acceptable length and quality.

The ensuring rapid development of wire rope production and its machinery and an ever increasing number of new rope constructions revealed, how urgently wire ropes were needed by the emerging industrial revolution.

Since then the very simple Albert rope construction has developed – according to the various demands – into a vast and for the uninformed somewhat daunting variety of rope constructions.

It was obvious from a very early stage that the structure of the strand in particular has a great influence on the characteristics of the rope. Over 100 years ago the Seale, Warrington, Filler wire and the cross lay (formerly called standard) wire configuration were already well known. Other common strand formations, e. g. Warrington-Seale and Warrington-Compound are merely combinations of these basic constructions.

Wire and strand diameter of our wire ropes have been optimized constantly by using computer technology. Thus bending properties and service life of the running ropes could be improved considerably. By an absolutely equal load distribution to all wires an early failure of any individual wire due to overloading will be eliminated.

Technical aspects about wire ropes

Components of wire ropes

Single wires

spinned to a strand (fig. 1)

1

2

Strands

surrounding the core (fig. 2)

Rope cores

The inner part of a single layer rope surrounded by the outer strands is normally filled by a rope core. Its main function is to support the outer strands and, by using a steel core, also to increase the load bearing metallic cross section.

Overview of material and construction:

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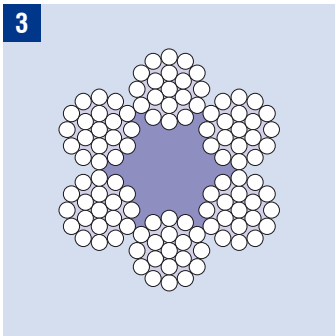

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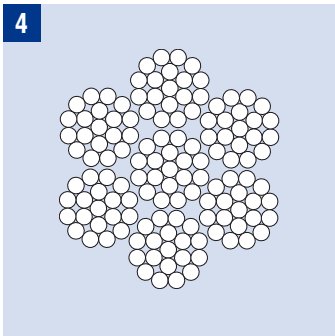

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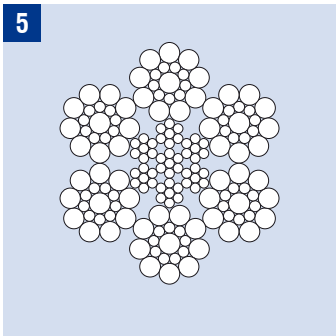

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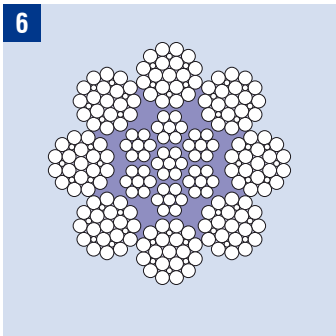


Fibre core (FC)

The core of the rope consists of natural (NFC) or synthetic fibre (SFC). Fibre cores (fig. 1 and 3) store lubricants, support the strands and dimish vibrations.

Steel core (WC)

There are two typical types of steel core

1. **Wire strand core (WSC)**
   The core of a round strand rope consists of a strand (fig. 4).
2. **Independent wire rope core (IWRC)**
   The core of the round strand rope consists of a stranded rope (fig. 2 and 5).

Independent wire rope core, plastic coated

The core consists of a plastic coated steel core (fig. 6 and 27).

Strand constructions

Differentation of moving ropes

- **Standard stranding method** (fig. 7)
  Standard stranding methods cause wire crossings between the wire layers within the strand resulting in high stress concentrations, where crossings occur. Premature damage may be the consequence.
- **Parallel stranding method** (fig. 8)
  All wires are arranged parallel in the strand structure thus a continous linear contact is provided. The result is a reduction of compressive stress of the wires. Therefore many of our special ropes for running service are made of parallel stranded strands.

Different lay type of outer wires in the strands

- **right hand lay** (abbreviated to z, fig. 9)
- **left hand lay** (abbreviated to s, fig. 10)

Different lay types of outer strands

- **right hand lay** (abbreviated to Z, fig. 11)
- **left hand lay** (abbreviated to S, fig. 12)

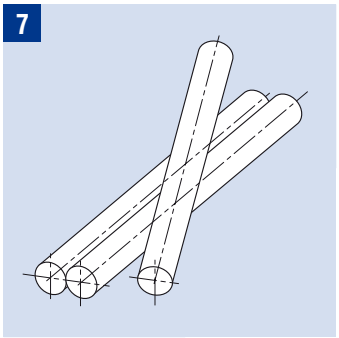
Different lay types

- **Regular or Cross lay**
  The direction of lay of the wires in the outer strands will be in opposite direction to the direction of lay of the outer strands in the rope itself. Types of lay direction:
  – **sZ**: right hand regular lay (fig. 13)
  – **zS**: left hand regular lay (fig. 14)

Regular laid ropes are more pressure and deformation resistant.

- **Lang lay**
  The direction of lay to the wires in the outer strands equals the direction of lay of the outer strands in the rope. Types of lay direction:
  – **zZ**: right hand lang lay (fig. 15)
  – **sS**: left hand lang lay (fig. 16)

Lang lay ropes provide improved abrasion resistant properties when used on multiple rope reeving.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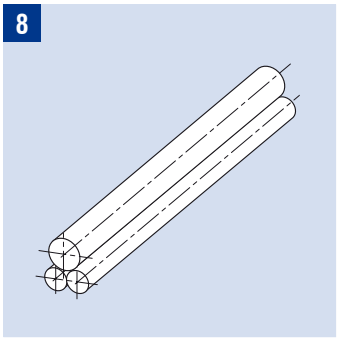
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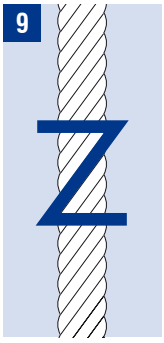
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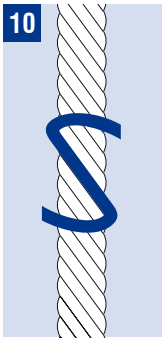
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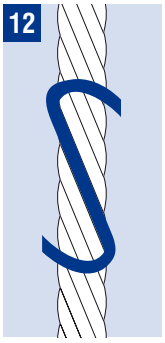
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Rope types

Single layer stranded ropes

Single layer round strand ropes (fig. 17) consists of several strands laid in one layer around a fibre or steel core. They are applied in cranes, excavators, winches, construction machinery, elevators or are used as sling ropes.

Rotation resistant ropes

Rotation resistant ropes designed to generate reduced levels of torque and rotation when loaded (fig. 18). Rotation resistant ropes generally comprise an assembly of at least two layers of strands laid helically around a core, the direction of lay of the outer strands being opposite of that of the underlying layer. To achieve an additional reduction of torque and rotation when loaded special rotation resistant ropes were designed and manufactured. Typical application for these special ropes are hoisting ropes for cranes working with only one fall and/or high lifting heights (fig. 19).

Parallel-closed stranded ropes

Parallel-closed stranded ropes (fig. 20) consist of at least two layers of strands laid helically in one closing operation around a core. The diminished gaps between the strands result in an enlarged metallic cross section and thus in higher breaking load values. They are used e.g. for cranes, excavators, construction machinery.

Low-stress ropes

If all internal stresses in the wires resulting from the manufacturing process have been completely or nearly eliminated the rope will be low-stressed. If seizing is removed strands remain in position. Wire breakages occuring during rope work do not protrude from the rope structure.

High performance compacted ropes

- **Compacted strand stranded rope** (fig. 25)
  Rope in which the strands, prior to closing of the rope, are subject to a compacting process such as drawing, rolling or swaging. Fig. 21 and 22 shows the standard, fig. 23 and 24 the compacted strand.
- **Compacted (swaged) stranded rope** (fig. 26)
  After stranding the rope usually gets additionally compacted by swaging or rolling.

The advantages of compacted ropes are: higher breaking load, better flexibility, smooth surface and a higher resistance to abrasion.

Ropes with plastic coated steel core

The interior structure of some of our special ropes is plastic coated (fig. 27). This structure is characterised by a number of improvements

- Reduced friction between rope core and outer strands
- High bending cycle strength
- High structural strength
- Excellent vibration-resistant properties
- Improved corrosion protection of the wire core

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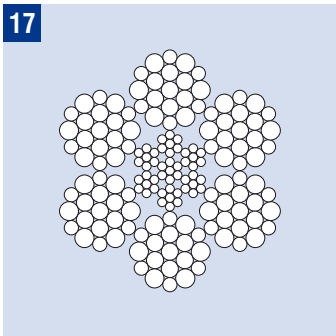

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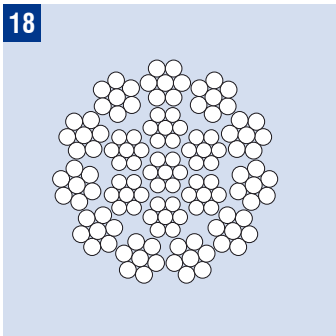

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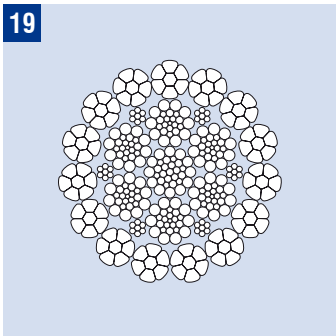

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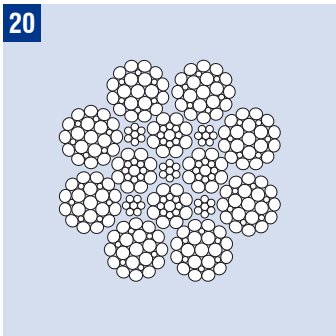

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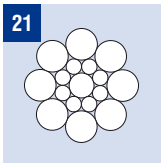

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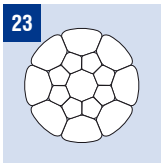

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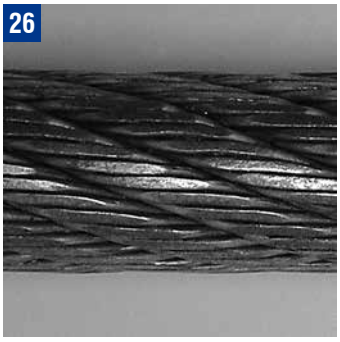

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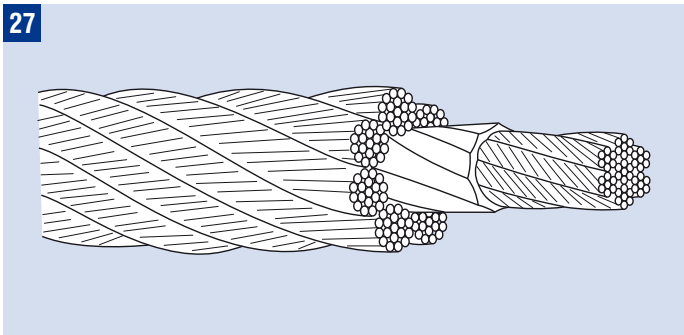

Surface treatment of wires

Wire surfaces

- **bright (U)**
  Uncoated ropes are marginally softer and more flexible than galvanized ropes and offer economical advantages for long lenghts.
- **galvanized (B)**
  Galvanized ropes are more insensitive against penetrating water and humidity than bright ropes. These ropes can be used in different applications and machinery.
- **Stainless steel**
  Ropes made of stainless steel are used if a high corrosion resistance is necessary or if a high value is placed on the optics. These ropes can be used for special requirements (e.g. hygiene regulations in the food industry) as well.

Rope lubrication

Lubrication tasks

- **Friction reduction**
  Lubrication of wires and strands reduces the destructive friction between the single rope elements.
- **Protection against corrosion**
  Special rope lubricants prevent an infiltration of humidity and pollution.
- **Enormous extension of the rope lifetime**
  The single rope elements are protected by primary lubrication and regular relubrication, therefore the downtime costs will be reduced.

Explanation of important terms

Nominal rope diameter

The nominal rope diameter is a size which defines a rope in combination with other characteristics. According to manufacturer or standard tolerances, the permitted range for the rope diameter can be derivated from the nominal rope diameter.

Actual diameter

To measure the actual diameter (fig. 28) it is important to do it the correct way. Only meassuring the surrounding diameter is correct. For this reason it is important to use caliper gauges with wide jaws.

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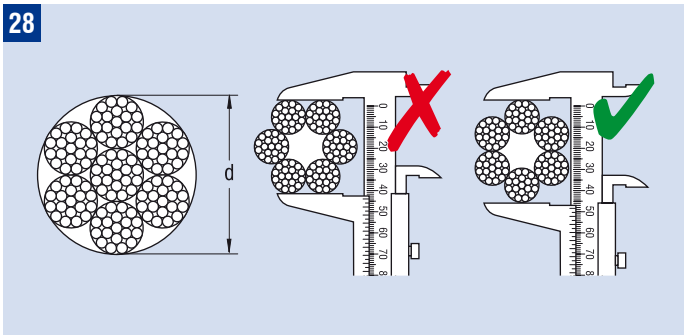

Fill factor

The fill factor is the relation of the metallic cross section of the rope to the area of its circumscribed circle.

Wire tensile strength grade

A level of requirement of tensile strength of a wire and its corresponding range. It is designated by the value according to the lower limit of tensile strength and is used when specifying wire and when determining the calculated minimum aggregate breaking force a rope, expressed in N/mm^2. Common tensile strength grades are 1770 N/mm^2, 1960 N/mm^2 and 2160 N/mm^2.

Rope strengths grade

The resulting tensile strenght of a rope is determined by the rope strenght grade. This grade characterized the requirement levels of the breaking force by a number (e.g. 1770, 1960, 2160)

Spinning loss factor

The spinning loss factor is a pragmatical value based on the breaking load loss of the wires during the spinning process.

Minimum breaking load (F_{min})

The minimum breaking load of the rope is the product between nominal aggregate breaking load and the spinning loss factor. Most of the end terminations decrease minimum breaking load of the rope. Detail in “Rope end terminations”.

Various main applications

Wire ropes are divided into four main groups:

Slings

… for load handling ropes.

Track ropes

… are used in forest applications.

Structural cables

… are ropes being anchored at two fixed points and do not run over sheaves or spool on a winch, e. g. guy and pendant ropes, suspension ropes.

Running ropes

… are ropes running above sheaves, drums or traction sheaves, e.g. hoist ropes, luffing ropes, elevator ropes, haulage ropes etc.

The most suitable rope for a given application is the one best able to withstand the conditions the rope will encounter in service. The correct choice for rope will not only decrease the danger and hazards for personnel and machine but will also help to prevent very expensive down time due to premature failure of ropes etc.

Avoid any risk, trust in our experience and assign this task to us. We are always ready to assist you in finding a solution or any special rope problem you may have, just contact us.

Please let us advise you!

Rotation resistant or non-rotation resistant rope?

Rotation resistant ropes

Rotation resistant ropes generate reduced levels of torque and rotation when loaded.

1. Rotation resistant ropes

These are rope constructions, e.g. 18x7, 17x7 (fig. 18), with two layers of strands laid helically around a core, the direction of lay of the outer strands being opposite to that of the underlying layer.

WARNING! Don't use these ropes attached to a swivel or have one or both ends rotate freely under load! If this is not observed serious injury, considerable damage or death will occur! Exception: Considering the recommendations of the rope manufacturer and the consent of an expert person (construction machinery manufacturer) a swivel is allowed to use.

2. High performance rotation resistant ropes (fig. 19)

We indicate the higher quality of these ropes through adding the term "high performance". The high performance resistant ropes have a steel core which is an independent rope, closed in the opposite direction to the outer strands. Today these ropes consist of 15 and more outer strands (fig. 29). Due to that, under load the core tries to twist the rope in the one direction, the outer strands try at the same time to twist the rope in the opposite direction. The result is, that high performance rotation resistant ropes almost compensate the torque over a particular load spectrum. Because of these excellent rope properties the high performance rotation restistant ropes are used with lifting heights and lifting unguided loads on a single fall. Up to now these ropes were also called "non-rotation ropes".

The high performance rotation ropes can be used with or without a swivel; if possible, the use of a swivel is preferred.

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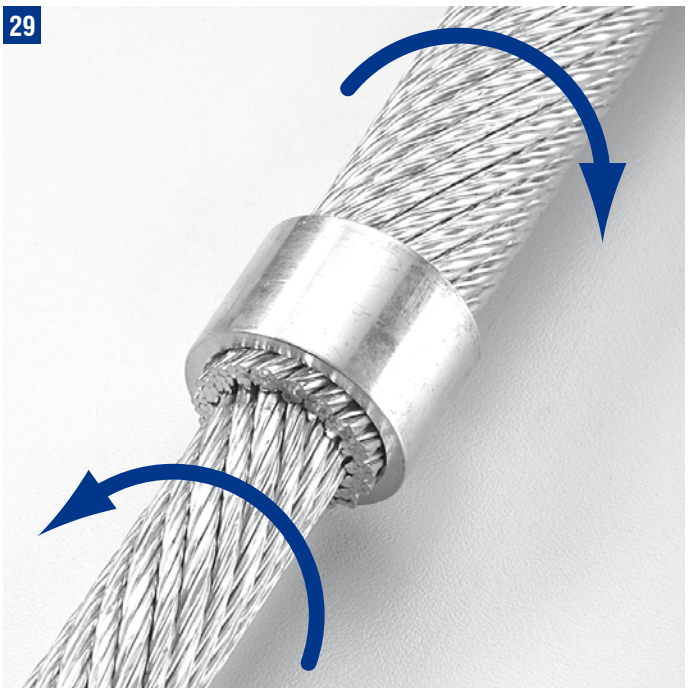


Non-rotation resistant ropes

According to the rope properties "torque and rotation" non-resistant ropes generate high levels of torque when loaded. That is why both rope ends must be fixed when loaded to avoid rotation. Typical wire rope constructions are ropes ropes with e.g. 6-, 8-, 9- or 10-outer strands. Non rotation resistant ropes can be used, when the load is guided, in lifting systems where pairs of the right and left hand ropes are working or when having a low lifting height with more than one fall. Under these conditions the advantage of non-rotation resistant ropes – compared with rotation-resitant ropes in the same application – is, that these ropes achieve a higher service life.

WARNING! Don't use these ropes attached to a swivel or have one or both ends rotate freely under load! If this is not observed serious injury, considerable damage or death will occur!

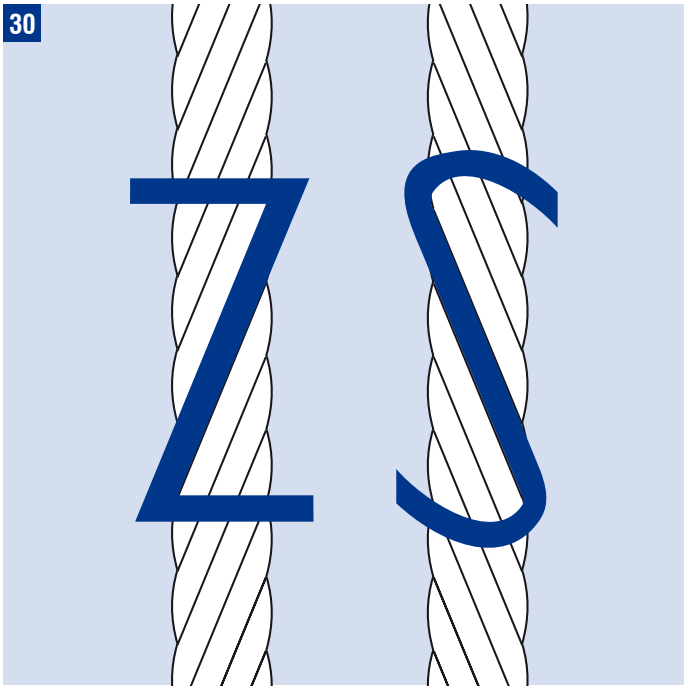
Right-hand or left-hand lay rope?

For the installation of ropes on winches there is the basic rule:

- Right-hand lay rope for a left drum
- Left-hand lay rope for a right drum

For the correct running of the rope it is necessary that drum and reeving will be of the same direction. If a rope runs from a right drum into a left reeving or from a left drum into a right reeving only a test can prove whether a left-hand or a right-hand lay rope must be installed.

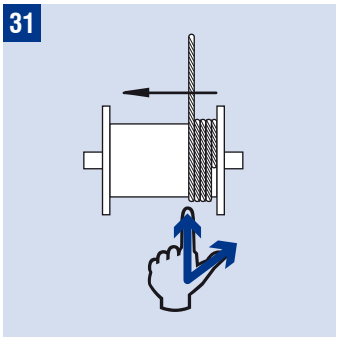
By using multiple layer spooling systems we recommend to follow the above mentioned basic rule.

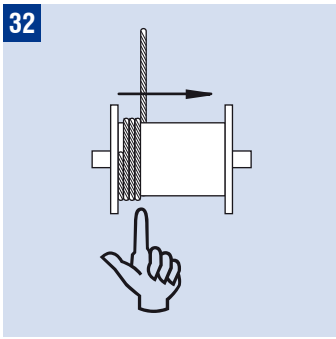


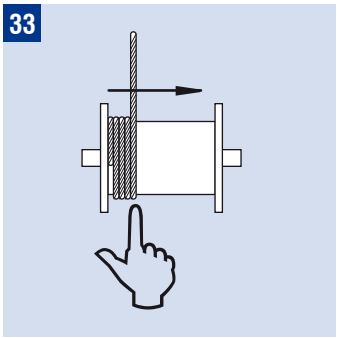
Rope lay direction

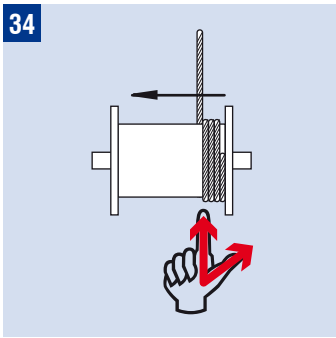
How to determine the correct rope lay direction?

- **First step:** Check how the rope runs from the drum into the reeving. There are two possibilities:
  - overwound drum (fig. 31 and 33)
  - underwound drum (fig. 32 and 34)
- **Second step:** Put your hand on the rope on the drum
  - Index finger shows in the direction of the rope running into the reeving
  - Thumb shows to the rope fix point on the drum
- **Third step:** Decision
  - If you need your left hand to fulfill the requirements of the second step, then you need a left-hand rope (fig. 31 and 32).
  - If you need your right hand to fulfill the requirements of the second step, then you need a right-hand rope (fig. 33 and 34).









Further information

Product safety

Our basic information in this brochure provides guidance on product safety. It is created for people already having knowledge of wire ropes, as well as for new users. Please pass the basic information on to others and take notice of our operation manual for stranded ropes.

Read it carefully, understand and practice these instructions, also read and understand the machinery manufacturer's manual. If these are not observed serious injury, death or considerable damage can occur! Protect yourself and others!

Further information can be found under "Correct handling of wire ropes" (page 20 and 21)

WARNING! Wire rope will fail if worn-out, shock loaded, over-loaded, misused, damaged, improperly maintained or abused.

Always inspect wire rope before use for:

- wear
- damages
- deformations
- corrosion

Never use wire rope which is

- damaged
- worn-out
- deformed
- improperly maintained
- not suitable

If in doubt about the wire rope, the wire rope application, the wire rope end termination or anything else, regarding the wire rope, please contact us or the machine maunfacturer.

Technical seminars for crane ropes

Target group

Contructors and persons responsible for cranes, crane drivers, crane installers, mechanical engineers, customer service specialists at our training centres, branches and on-site.

Seminar result

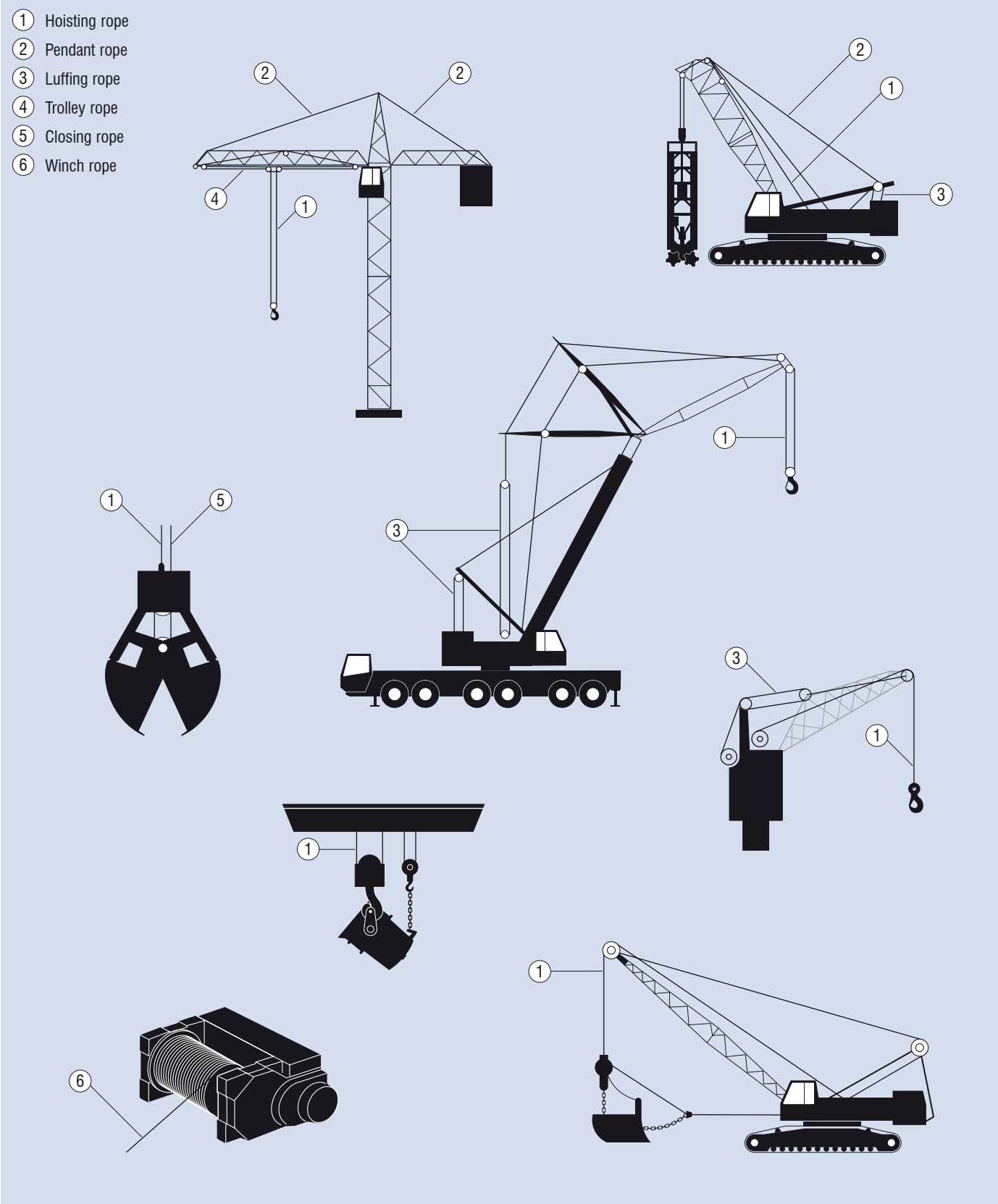
The seminar mediates important basics for the correct use and surveillance of crane ropes.

Seminarinhalte

- Standards
- Crane rope types, terms, rope constructions
- Performance criteria for crane ropes
- Correct rope selection
- Rope drive elements
- Handling and assembly
- Maintenance
- Surveillance and discard
- Rope damages and its causes

Interested in technical seminars? Please call us: +49(0)8331-937-301

Rope designations



Steel wire rope end finishing

PFEIFER is expert in all kinds of rope assembly – from the high precision manufacturing of the finest ropes for medical technology to the precise cutting to length of crane hoisting ropes and the casting of ropes with the largest of diameters.

Cutting to length

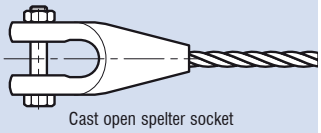
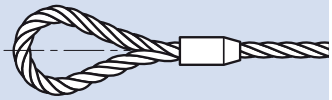
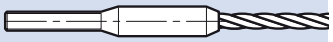
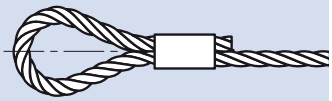
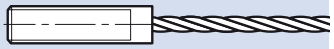
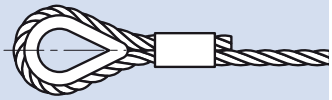
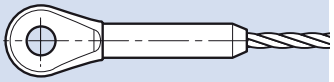
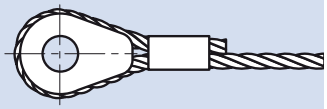
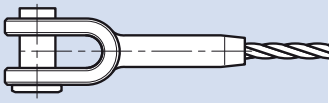
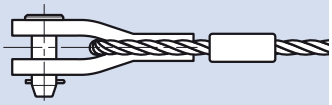
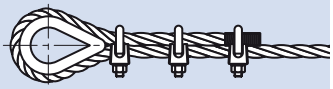
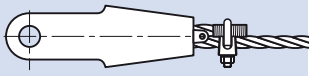
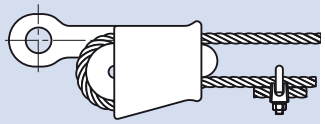
- **Pre-stressing**
  To achieve exact rope lengths under specified working conditions, it is necessary to pre-stress ropes with a deteremined load. A pre-stressing machine with a capacity rating of 3500 kN (in high precision class 1) and a length of 215 meters, enable us to do various elongation-, tensile- and breaking tests.

Ways of rope end finishing

- **Rope ends without end terminations**
  - **Rope end seizing**
    Seizing of rope ends avoids loosening of the rope structure. Firm seizing is absolutely necessary for rotation resistant ropes as they are not preformed.
  - **Fusing**
    We can taper and fuse rope ends up to a rope diameter of 40 mm. Larger diameters, the rope ends will be welded. Such end treatment simplifies the mounting of ropes on winches or in open wedge sockets.
  - **Welding**
    To protect ropes with large diameters against untwisting, the rope end is professionally welded by our experienced workers.
  - **Splicing**
    We are masters of traditional rope making and can splice eyes, Flemish eyes etc. for you.
- **Installation of end terminations on rope ends**
  - **Swaging**
    Aluminium ferrules or steel fittings are cold bonded to the wire rope under extremely high pressure. Two presses, with a pressing force of 4000 t each, enable us to swage steel wire ropes up to 97 mm diameter. Swaging reduces the minimum breaking load of ropes.
  - **Casting**
    Socketing with zinc alloy or synthetic resin means that the minimum breaking force is not reduced. Two socketing towers with five socketing boxes each, allow short processing time with a large number of ropes. In our plant ropes up to 140 mm diameter are casted with sockets. PFEIFER is very experienced in casting rope fittings either in our facilities or on site.
  - **Rolling**
    Rolled end terminations are pressed on the rope by a rolling motion. Due to the slim design the resulting connection can be used in different applications.

Standard or tailor-made – through our own development and production every rope recieves the optimal connection.

Breaking force reduction caused by rope end terminations

 Cast open spelter socket	100 %	100 %	 Cast cylindrical socket
 Flemish eye	90 %	90 %	 Swaged thread fitting**
 Swaged eye	90 %	90 %	 Swaged clamp with thread**
 Swaged thimble	90 %	90 %	 Closed swaged fitting**
 Swaged solid thimble	90 %	90 %	 Open swaged fitting**
 Swaged fork end thimble	90 %		
 Rope clamp acc. EN 13411-5***	80 %		
 Spliced eye	80 %	80 %	 Open wedge socket symmetric
 Spliced thimble	80 %*	80 %	 Open wedge socket asymmetric

* With spliced terminations in some cases, a reduction of the tensile strength of up to 40 % may occur. This depends on the rope construction and the rope diameter.

** These terminations are only for use with full steel wire ropes (with steel core).

*** The use of wire clamps with compacted wire ropes is not described by the standard and should therefore be avoided!

Most rope end terminations reduce the breaking force of the rope system significantly. As a **approximate value**, we give you the remaining value of the minimum breaking force as a percentage of the minimum breaking force of the rope according to the following table.

WARNING:
These data define the ideal case. That means that the in rope system used rope end terminations (especially casting sockets, fittings and open wedge sockets) must fit in design and material quality regarding the used rope type (construction, nominal strength, compacted / uncompacted). If in doubt, the system breaking force needs to be determined by type testing through tensile testing.

Further products and services

Rope accessories

Connecting links

For fast and simple connection and fastening options of steel wire ropes

Available in various versions

Swivels

To avoid the rope torque being transmitted to the load and thus causing great damage

Bolts

For fast and stable securing in the most diverse areas of application

Manual strand ropes

Detailed manual for the proper use of your strand ropes with useful tips to extend the rope lifetime

Further languages on request

Included in each Rope Service Starter Kit and the measurement equipment cases 75/150 or available as PDF in the PFEIFER download centre at:

→ **www.pfeifer.info/manual-strand-ropes**

Rope service and rope handling

Rope lubrication RL-S & RL-B

Product		Part.-No.
12 x Spray	600 ml	245066
Bucket	10 l	212406
Bucket	30 l	212405

Maintain your wire ropes with the proper re-lubricant and extend the lifetime.

Save costs for new ropes and rope changes by extended lifetime.

We can offer re-lubricating large rope lengths using a special re-lubrication device. Our service team comes to you worldwide and saves you cost intensive trips with your crane.

Rope measurement

- Groove gauges
- Caliper gauges
- Sets

Use our special measurement devices from the rope specialist to reduce costs by extending the lifetime.

Based on our long-term practical experience of rope drive inspection, we created a measurement devices program. These measurement devices are used by our rope experts for each inspection and thereby approved for general use.

Tools for working on ropes

- Crimping pliers
- Wire rope cutter

So that you can also easily carry out minor work on ropes, PFEIFER offers you a selection of different tools for working on ropes.

Rope assembly aids

- Winding blocks
- Rope tensioning clamps
- Cable grips

PFEIFER rope assembly aids assist you reliably in the attachment and replacement of your steel ropes.

Innovative packaging solutions

- Reels
- Stand for reels

PFEIFER-reels and PFEIFER-stands for reels – the perfect combination for your ropes:

- Optimized packaging sizes
- Simplified transport – to be taken by forklift
- Stands for reels are gently for reels and ropes
- Prevention of transport mistakes and resulting damages
- Heat treatment according to ISPM 15

Rope services

Rope assembly

PFEIFER is expert in all kinds of rope assembly – from the high-precision manufacturing of the finest ropes for medical technology to the precise cutting to length of crane hoisting ropes and the casting of ropes with the largest of diameters.

End connection design

Standard or tailor-made – through our own development and production every rope receives the optimal connection.

Rope stocking

Rope inspection

Technical rope seminar

Interested in a seminar at your premisis?

We would be pleased to provide you with an individual offer.

Rope application consultancy

Through the correct selection of ropes and end connections to suit the conditions of use you can achieve the most economical lifetime, reduce possible dangers and avoid high failure costs.

Repair service

Steel wire ropes are subject to wear in tough continuous use and can be damaged by external influences. PFEIFER offers you a rope repair in original rope quality at your premises.

PFEIFER guarantees fast availability in one of the industry's largest stock assortments and a capacity of well over 4000 tonnes in a fully automatic rope warehouse in Memmingen and in further warehouses all over the world. High-performance logistics partners guarantee fast delivery. Thanks to optimised packaging, every reel reaches its destination worldwide well protected.

After the delivery of the optimum rope we support our customers and are happy to assist with all questions regarding the rope application.

We analyse optimization potentials at rope winches and drives, check ropes for damages and abrasion to extend the lifetime and reduce rope change and down time costs.

We do this job on a daily basis – worldwide.

Using discarded products or disregarding basics of proper application by the use of wire ropes can cause enormous danger for humans and material.

Trained employees increase safety in your company, avoid accidents and reduce costs.

In our established technical seminars, our competent and experienced instructors train your staff in latest standards and in all theoretical and practical issues.

Rope services

Rope analysis

- PFEIFER analyses with extensive tests in the central Rope and Material Test Centre all properties of wire ropes and applied materials at the headquarter in Memmingen as well as at further machines at PFEIFER DRAKO in Mülheim/Ruhr. Also necessary tests can be done locally in our global subsidiaries.
- Aware that not only the usual catalog values such as weight per meter and minimum breaking force decide on the performance of wire ropes, all properties of the ropes are determined at PFEIFER in extensive tests.
- Equipped with this knowledge, we will choose the right wire rope for your application and so we optimize the lifetime of your equipment.

Test Facility for Determining Bending Fatigue

Spectral Analysis

Multi Layer Spooling Test Tower

Magnaflux Test

Rope Efficiency Test Facility

Tension Fatigue Test Facility

Further Offers:

Test Facility for Lateral Pressure Resistance

Coat Thickness Measuring

Ultrasonic

Torsion Test Facility

Microscopic Analysis

Elongation and Pull Test Facility

Hardness Test

Notch Impact Test

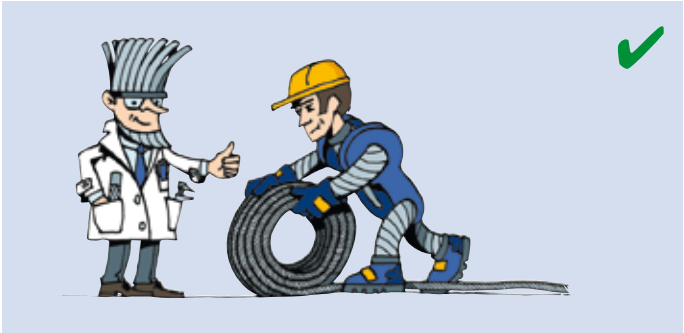
Dye Penetrate Test

Pull Test Facility
800 kN

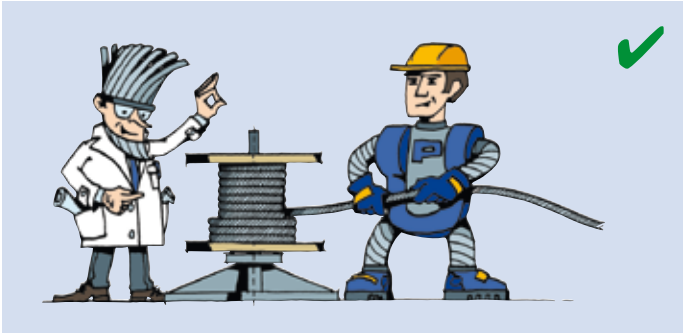
Pull Test Facility
6,000 kN

Correct handling of wire ropes

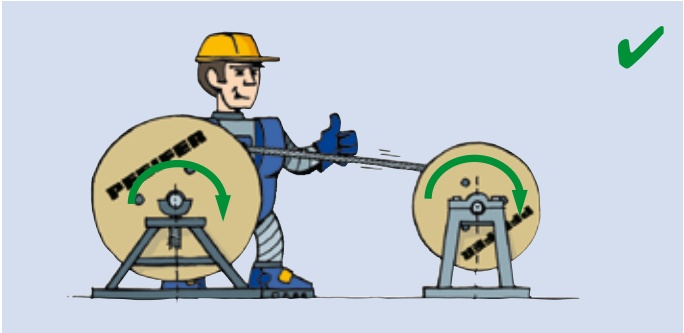
Spooling of wire ropes



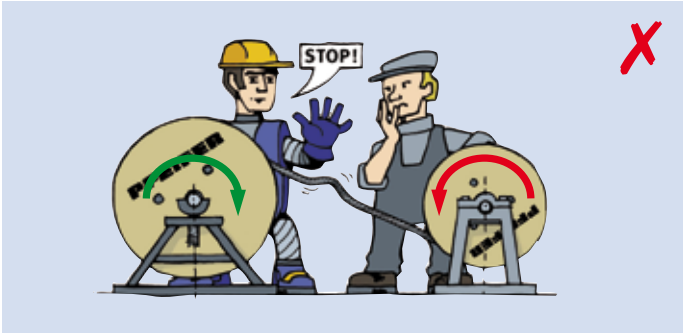
Correct
Lay wire rope rings on clean ground. Please consider the preferred bending direction when rewinding the rope.



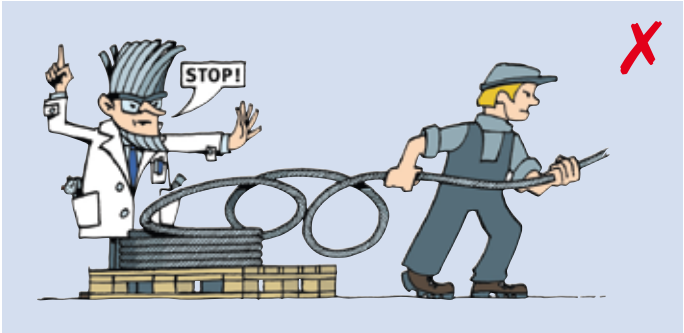
Correct
Place reel on a suitable frame or spike, draw-off straight. Make absolutely sure that the rope is not fouled.



Correct
When winding on a rope drum, pay attention to the direction of rotation and the right distance between reel and drum. A too small distance can cause torsional damage in the rope during later operation.



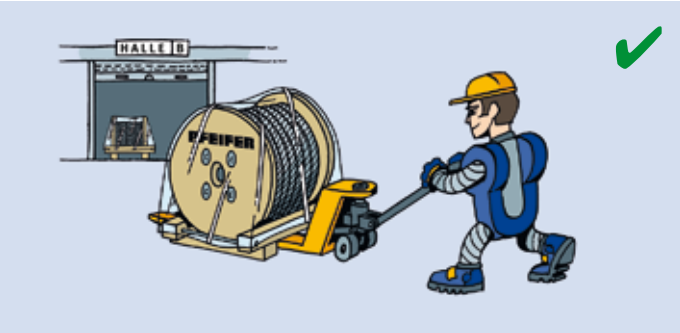
Wrong
Drawing-off the rope of a ring or over the flange of the reel as well as counterwise spooling cause “twist” for each winding in the rope. Loops may occur, which may result in bends under tension.



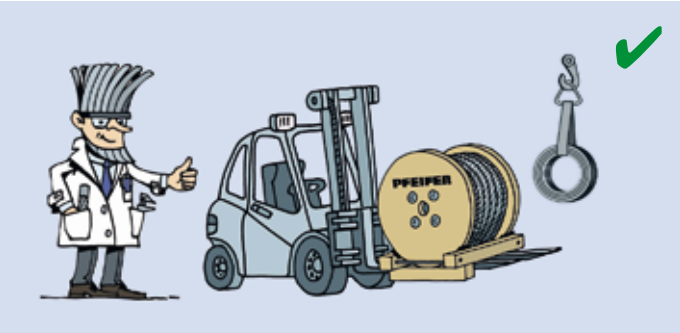
Detailed handling constructions you will find in our operating manual for stranded ropes in the PFEIFER download centre at:

→ **www.pfeifer.info/ manual-strand-ropes**

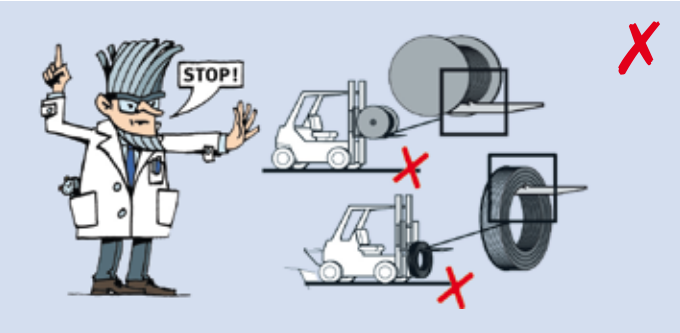
Storage and transport of wire ropes



Correct
Store wire ropes dry and cool. Avoid ground contact, so that humidity can not taper the rope. Take off air and water tight transport packing. Humidity causes oxidation.

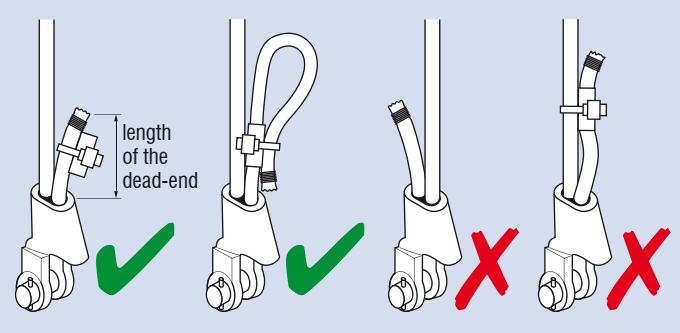


Correct
Protect the rope of crushes and kinks.



Wrong
Improper transportation of wire rope reels and rings will cause irreparable damage to wires, strands or the rope structure.

Instructions for use



Instruction
When a rope is to be re-terminated with a wedge socket assembly this can only be achieved by shortening the rope. No part of any previous flattening and/or damaged rope should be on the standing part of the rope or within the clamping area between either side of the socket body and the wedge.

With the use of wedge sockets the rope is introduced on the balanced side so that under load the center line of the rope is in-line with the bolt hole. The dead end is passed through the asymmetric side and is secured with a rope clip.

The length of the dead-end should be 10 x the nominal rope diameter, at least 150 mm. The rope clip must be applied only to the loose, unloaded rope end, never on both strands. The maximum operating temperature for wedge sockets is 200 °C / 400 F.

Detailed handling constructions you will find in our operating manual for wedge sockets in the PFEIFER download centre at:

→ **www.pfeifer.info/ manual-wedge-socket**

Installation of wire ropes

Wire ropes can easily be damaged and must therefore be handled with utmost care during transport and unloading.

Only the installation of an untwisted an undamaged rope will guarantee a trouble-free operation. Ropes must always be uncoiled from the reel or the ring in the direction of winding. Lateral uncoiling of the rope causes twisting and can lead to destruction by kink formation. It is recommended to use a frame-mounted reel for coiling the rope onto the drum. Coiling in the direction of bend gives an excellent fit on the drum and avoids that any additional tension is built-up in the rope. Never drag ropes over soil or dirt.

For installing the new rope it has to be fixed to the still mounted old one or an auxiliary rope. Connection between the two ropes can be achieved either by a cable grip or two welded pad eyes connected with a swivel.
Any transmission of torsion to the new rope from either the old one or the auxiliary rope must be definitively avoided. Nonrotating ropes must be protected from torsion by insertion of a swivel.

Multi-layer operation requires that even the lower layers must be tightly coiled with a pretension of 1 – 2 % of the minimum breaking load of the rope. It is attained by braking the reel.

The end termination of non-rotation resistant and rotation resistant ropes has to be fixed on both end terminations against rotation.

It is NOT allowed to use non-rotation resistant or rotation resistant ropes with a turnable fixed point (e. g. swivel).

If the lower layers on the drum are hardly or seldom used the pretension of the entire rope has to be renewed from time to time. To renew the pretension in the hoist ropes the complete rope has to be spooled off and wound up again with tension of approximately 2 % of the minimum breaking force or 10 % of the maximum line pull force in operation. Ropes work most efficient if is always used the entire rope length.

If the rope areas are used unequal the rope can be turned after a certain time. In multi-layer spooling the lifetime of the rope can be significantly extended by cutting away the length of half the drum diameter from the rope at the fastening point of the drum. Through this procedure the predamaged rope areas are relocated from the climbing zones on the drum into the parallel zones. The shortening procedure can be carried out, at most, two times.

Discarding time for wire ropes according to ISO 4309

Exemplary for single layer and parallel-closed ropes

Number of visible wire breaks, reached or exceeded, occurring in single-layer and parallel-closed ropes, signalling discard of rope

RCN	Total number of load-bearing wires in the outer layer of strands in the rope[a] n	Number of visible outer wire breaks[b]					
		Sections of rope, running over steel sheaves and/or spooled on a single layer drum (random distribution of wire breaks)				Sections of wire rope spooled onto a multilayer drum[c]	
		Classes M1 to M4 or calss unknown[d]				All Classes	
		Ordinary lay		Langs lay		Ordinary and langs lay	
		over a length of					
		$6d$[e]	$30d$[e]	$6d$[e]	$30d$[e]	$6d$[e]	$30d$[e]
01	$n \leq 50$	2	4	1	2	4	8
02	$51 \leq n \leq 75$	3	6	2	3	6	12
03	$76 \leq n \leq 100$	4	8	2	4	8	16
04	$101 \leq n \leq 120$	5	10	2	5	10	20
05	$121 \leq n \leq 140$	6	11	3	6	12	22
06	$141 \leq n \leq 160$	6	13	3	6	12	26
07	$161 \leq n \leq 180$	7	14	4	7	14	28
08	$181 \leq n \leq 200$	8	16	4	8	16	32
09	$201 \leq n \leq 220$	9	18	4	9	18	36
10	$221 \leq n \leq 240$	10	19	5	10	20	38
11	$241 \leq n \leq 260$	10	21	5	10	20	42
12	$261 \leq n \leq 280$	11	22	6	11	22	44
13	$281 \leq n \leq 300$	12	24	6	12	24	48
	$n > 300$	$0{,}04 \times n$	$0{,}08 \times n$	$0{,}02 \times n$	$0{,}04 \times n$	$0{,}08 \times n$	$0{,}16 \times n$

NOTE Ropes having outer strands of Seale construction where the number of wires in each strand is 19 or less (e. g. 6 × 19 Seale) are placed in this table two rows above that row in which the construction would normally be placed based on the number of load bearing wires in the outer layer of strands.

RCN = Rope category number

[a] For the purpose of this International Standard, filler wires are not regarded as load-bearing wires and are not included in the values of n.

[b] A broken wire has two ends (counted as one wire).

[c] The values apply to deterioration that occurs at the cross-over zones and interference between wraps due to fleet angle effects (and not to those sections of rope which only work in sheaves and do not spool on the drum).

[d] Twice the number of broken wires listed may be applied to ropes on mechanisms whose classification is known to be M5 to M8.

[e] d = nominal rope diameter

Detailed handling constructions you will find in our operating manual for stranded ropes in the PFEIFER download centre at:

➜ **www.pfeifer.info/ manual-strand-ropes**

Discard

⚠ **Warning: Considering security ropes should be taken off operation in time, if one of the following criterias apply:**

- Broken strand
- Local concentration of wire breaks
- Achievement of type and number of wire breaks according to the tablets
- Corkscrew deformation (fig. 1)
- Corkscrew (fig. 2)
- Hairpin like escape of wires (fig. 3)
- Decrease of diameter – regarding the nominal rope diameter
- Local increase of diameter
- Heavy corrosion: The surface of the wires is strongly affected or rosty dust comes out of the rope
- Loose rope structure (fig. 4)
- Constriction (fig. 5)
- Kinks or flattened areas(fig. 6 + 8)
- Bends or other deformations (fig 7)
- bluish discoloration, broken or fused wires due to heat effects or electric arc

If several of the above mentioned criterias apply, they need to be considered in their entirety. Therefore ropes need to discarded, if none of the criteria are completely but some partially fulfilled. For example: Light Corkscrew with some broken wires.

The above criteria are an excerpt from the ISO 4309 maintenance and care, inspection and storage. Consequently, these criteria do not replace the instructions and requirements for inspection and maintenance of wire ropes as written in the standard. For evaluation of the discard criteria please refer to our original operating manual for strand ropes!

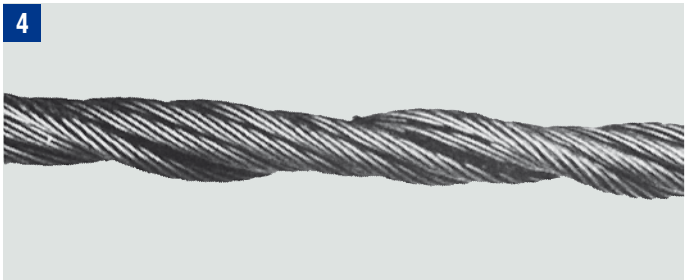
If in doubt on the estimation of the cable damage, the rope must be discarded or your rope specialist needs to be contacted: wirerope@pfeifer.de or via phone +49 (0) 83 31-937-301.

Looping on a wire rope

3

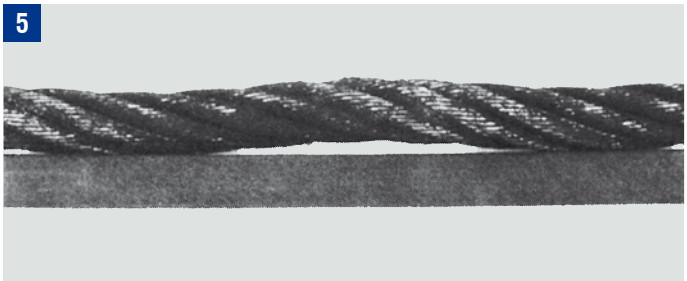
Through corrosion and wear heavy loose strand

4



Constriction due to a broken rope core

5



Flattened wire rope caused by over-ride

6

Corkscrew deformation

1

Basket deformation

2

Bend caused by a pinched rope sling

7

Kind caused by mechanical impact

8

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