Jakob®
Rope Systems

Operation and maintenance manual

Hybrid 5
Fiber Rope for low-level Ski Tows

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Content

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1. General

Applicability
This operation and maintenance manual is based around the requirements of the Cableways Directive (EU) 2016/424 dated 09.03.2016 and applies for Hybrid 5 ski lift ropes in ∅ 16 mm to ∅ 24 mm with five strands according to the description shown here. The application is intended exclusively for low-level ski tows and so-called Swisscord or Telecord systems. The basic requirements according to EN 12927 for fiber ropes for low-level ski tows apply.

Safety regulations
Users of this hybrid rope must have basic knowledge of the characteristics and working conditions of wire and fiber ropes, respect them accordingly and actively pay attention to safety. Protect yourself and your work colleagues:
– Check ropes, tensioning devices, attachment and lifting gear for correct installation, wear and damage before use. Worn or damaged aids must be exchanged or replaced.
– Ropes and tensioning devices must never be overloaded and must be taken out of service and replaced immediately after overloading.

The operating and maintenance manual is intended to help avoid hazards to people and ropes. Subsequent changes to rope-contacting components or changed loading of the rope must be carried out in accordance with the applicable standards and agreed with the rope manufacturer. Jakob AG excludes all liability for damage and injury caused by failure to observe these instructions and the corresponding legal standards and regulations.

The rope application temperatures are set as – 35 °C to + 45 °C.

During construction work, the ropes must be protected by suitable covers and visually inspected in the relevant sections at the end of the work.

Disposal
This hybrid rope consists mainly of the following materials:

Load-bearing fibers of the strand cores:	High molecular weight polyethylene (HMPE), Trade name “Dyneema”
Sheathing of the strands:	Polyester multi- and monofilaments
Fiber core:	Polypropylene fibers

Note: If materials are reusable according to their labeling and are fed into the recycling cycle, an important contribution can be made to environmental protection.

2. Rope data

This hybrid rope is a high-strength fiber rope made of HMPE/Dyneema, which is covered with a polyester monofilament-multifilament sheath and finally laid into a five-strand round stranded rope with a fiber core made of polypropylene.

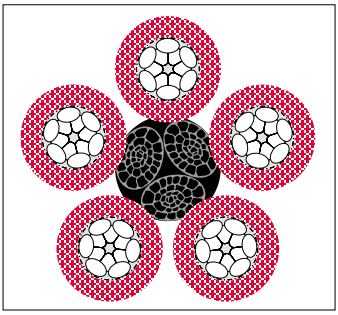


Figure 1: Schematic cross-section

Figure 2: Surface of the hybrid rope

Rope construction	16 mm 5 × PE-monofilament-multifilament-polyester/ HMPE – FC(PP) Z
Sheath	PES 16-weave monofilament | Multifilament
Core	Laid polypropylene fiber core
Minimum breaking load	51 kN (11 465.25 lb)
Weight per unit length	0.17 kg/m (0.37 lb/m)

Rope construction	24 mm 5 × PE-monofilament-multifilament-polyester/ HMPE – FC(PP) Z
Sheath	PES 16-weave monofilament | Multifilament
Core	Laid polypropylene fiber core
Minimum breaking load	172 kN (38 667.13 lb)
Weight per unit length	0.40 kg/m (0.88 lb/m)

The rope is intended exclusively for use on low-level ski tows and so-called Swisscord or Telecord systems. For example, with flat terrain profiles, the rope can be held directly by the passengers. In addition, commercially available rubber handholds may be applied to the nominal size 16 mm, which were provided by the original manufacturer of the tow lift system for fiber ropes with the same nominal diameter.

3. Transport, storage and installation

Rope transport

The rope is delivered fully spliced to a loop and wound onto a reel. If possible, the reel is to be used again until it is unwound at the place of use and, if necessary, for storage in the summer season. During transport, care must be taken not to damage the rope and especially the fiber sheathing by brushing against building or lift structures, terrain features or vegetation.

Storage

The rope must always be stored in a dry, protected place at the end of the winter season. It should not be exposed to direct sunlight during storage. The rope should be stored in a dry condition, sufficiently ventilated and protected from moisture. Proper condition of rope and packaging must be ensured during storage.

When storing the ring after the season, make sure that the rope ring is not permanently kinked at any point due to transport and securing it on the reel.

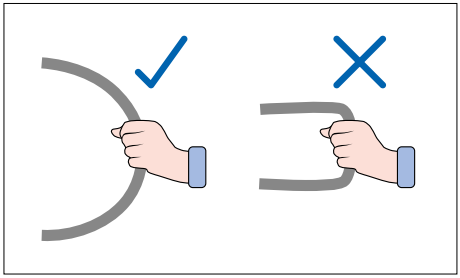


Figure 3: When pulling in, make sure that the rope is bent gently.

Installation

When laying out, take appropriate precautions to avoid twisting, looping or kinking or damage when pulling the rope during installation, cf. figure 1. The ring must not be kinked when pulled. Dirt ingress must be avoided. Dust, stones or sand can damage the fiber material at an accelerated rate during operation.

Make sure that the sheave linings and handles are made to match the ACTUAL diameter of the rope. When changing ropes, the corresponding elements must be professionally reworked or replaced if necessary. There must be no sharp nicks, gouges or other gaps or surface damage in the rope guide elements that could damage the fiber rope during operation.

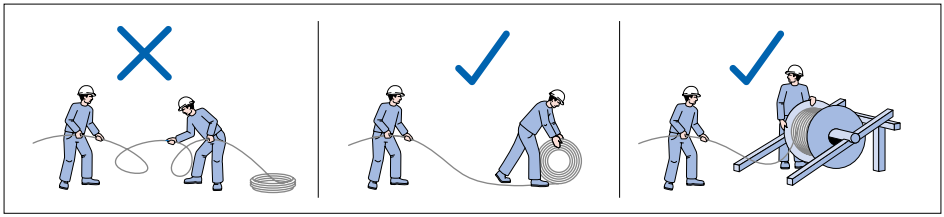


Figure 4: Examples of incorrect (left) and correct unwinding of the rope (middle, right)

4. Safety factor, discarding criteria and monitoring

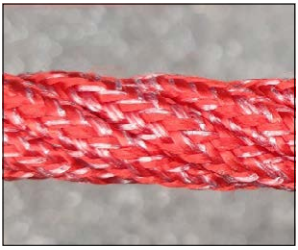
Safety factor
The permissible tensile safety factor for the hybrid rope is SF = 4.0 according to EN 12927.

Discarding criteria
Local damage to the rope must not result in a risk of injury to the user or rope failure during operation. During the checks, special attention should be paid to the use by children and their body size. If any of the following conditions are found on the rope, determine the cause and contact the rope manufacturer. The rope must be taken out of service until clarification is obtained.

– Damage to the sheath in the order of magnitude of the cross-section of a strand (16 mm rope: Circular area with approx. 6 mm diameter / 24 mm rope: Circular area with approx. 10 mm diameter)
– Whole fiber loops protruding
– Rope core protruding
– Local diameter reduction greater than 15%.
– Visible deformation of the splice knots
– Visible sinking of the strands at the tucked tail ends in the splice
– Visible waviness of the rope in the splice or on the free length
– unexpected, excessive elongation / sagging of the rope
– complete wear of the visible fibers (see following images) in conjunction with: advanced diameter reduction and increasing elongation

The fiber rope must be removed and replaced no later than 10 years after the first putting into operation.

The illustrations shown below are intended as an aid to visual inspection and assessment of the condition of the rope.



Start of operation:
Mono- and multifilaments intact

Longer-term operation:
first mono- and multifilaments wear out

Schedule rope change:
all visible fibers with wear

Figure 5: Examples for the development of the rope surface in operation

Start of operation:
Knot structure as well as Mono- and multifilaments intact

Longer-term operation:
Diameter in the knot area is reduced, first mono- and multi-filaments wear out

Schedule rope change:
Diameter in the knot area is strongly reduced, knot structure becomes indistinct, all visible fibers with wear

Figure 6: Examples of deformation of the splice knots and wear of the monofilaments, this can be a sign of impending splice renovation or advanced wear of the rope.

The condition of the rope surface, especially the white monofilaments, in combination with the development of the rope diameter and the rope elongation is a measure for the assessment. Occasional protruding monofilament breaks in the protective sheath may be removed, e.g. with side cutters, to maintain the rope and repair the surface. If the intensity of the monofilament breaks increases to such an extent that the rope can no longer be gripped comfortably by the passenger, the rope must be replaced, cf. Figure 5. If the visible fibers are completely worn and the rope diameter is reduced further and the rope elongation increases again after the initial elongation, the rope must be replaced.

The condition of the splice knots may also indicate that the rope is approaching the planned discarding period due to fatigue, see Figure 6.

If the splice knots are deformed, we recommend having the splice professionally repaired by shortening or re-underlaying the knots.

After installation, the rope shows a normal initial or setting elongation in the range of up to 2.5 %. In laboratory tests, fiber ropes generally start to stretch again more towards the end of the bending life. If the rope has to be retightened more frequently after a longer period of operation with almost constant elongation, or if a continuous increase in rope elongation is detected after a long period of time, this is an indication of advanced rope wear. The rope must be discarded and replaced.

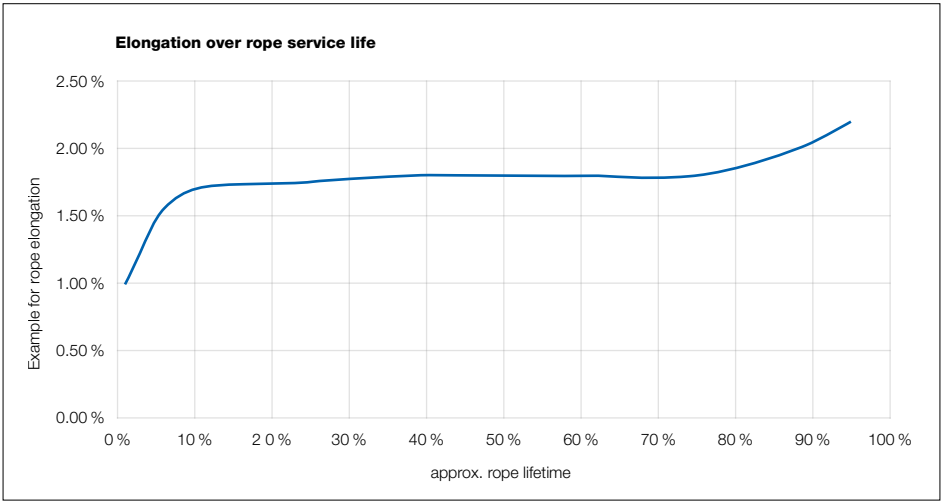


Figure 7: Schematic development of rope elongation over the service life

Visual inspection

The rope must be visually inspected for major damage during **daily start-up**. It is not uncommon for damage to occur during the night due to slope preparation or, unfortunately, vandalism. The check can be carried out at nominal speed or by walking or skiing by.

If the installation is iced up during a standstill, carefully remove the ice jacket by hand before switching on and detach the rope from the deflection pulleys. The drive pulley must not rotate under the stationary rope nor must the rope be pulled over a stationary deflection pulley. Also pay attention to the effect of running snow generators in the vicinity of the system!

A **careful visual inspection is to be carried out monthly** by walking slowly and, if necessary, by tactile inspection by hand. The splice knots and tucked tail ends must

be checked for deformation and damage at standstill, as well as the rope entry and exit areas at the rubber handholds.

If defects are found on the handholds, the cause must be clarified and the severity of the damage assessed before further operation. We recommend that you also contact the rope manufacturer.

After serious incidents or after unusual weather conditions, the inspection must be carried out particularly carefully.

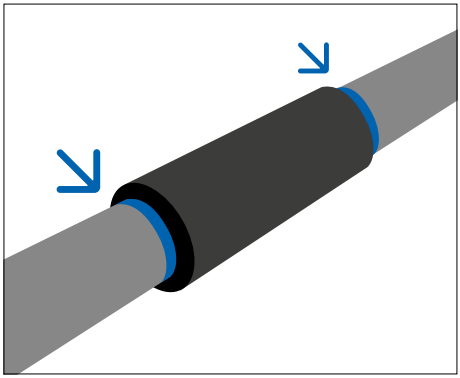


Figure 8: Inspection areas on the handholds

When removing at the end of the season and after installation, we recommend a careful visual inspection to ensure the availability of the system.

The deflection pulleys and any support rollers at the rope infeed of the stations must always rotate easily in the bearings. Rope pulleys that are difficult to move or stuck can lead to irreparable damage to the rope.

Diameter measurement

According to EN 12927, the rope diameter must be checked monthly. When measuring, it should be noted that the diameter of a five-strand rope is best determined using special rope calipers with wide jaws. If only calipers with classic measuring tips are available, the measuring device should be placed as flat as possible to the rope so that a sufficient number of strand tips are reached by both measuring tips.

Figure 9: Caliper gauge lying flat for correct determination of the rope diameter

Maintenance and repair

Individual protruding monofilament ends can be broken out or carefully cut off for further use. A locally damaged fiber jacket may be fixed with fabric tape for temporary further operation. We recommend replacing the affected strand in the medium term by splicing in a new strand.

The length ot the tucked tails must be at least 50 × d.

In case of a multiple occurrence of deformed splice knots, the splice can be rehabilitated by shortening the rope loop, as is also common practice with wire ropes of classic circulating ropeways. The damaged knot areas are thereby pulled into the thucked tail ends.

The long splice is made in the factory by a trained splicer in accordance with EN 12927. The total splice length and the length of the insertion strands must correspond to the following values:

Rope nominal diameter	Overall length of the long splice	Length of the tucked tails	Length of the center piece
16 mm	12 m	0.8 m	4.0 m
24 mm	18 m	1.2 m	6.0 m
Reference lengths	750 x d	50 × d	250 × d

Table 1: Splice dimensions

Preference is given to crossing splice knots. These are underlaid with an insert. The tucked tails must be carefully inserted and conscientiously massaged away from the knot to the knot before final cutting to length. Wrapping or doubling of the tucked tails is not necessary with five-strand fiber ropes.

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