



# Care, Use & Maintenance of Wire Ropes on Cranes

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Our partner  
in Australia




**CASAR<sup>®</sup>**

The company was founded in 1948

## **CASAR Ropes**

- ...are high performance ropes for the crane and underground mining industry
- ...are designed according to our own standards for highest performance and durability in the field
- ...are manufactured to match sophisticated OEM specs



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# The Crane System – yesterday and today

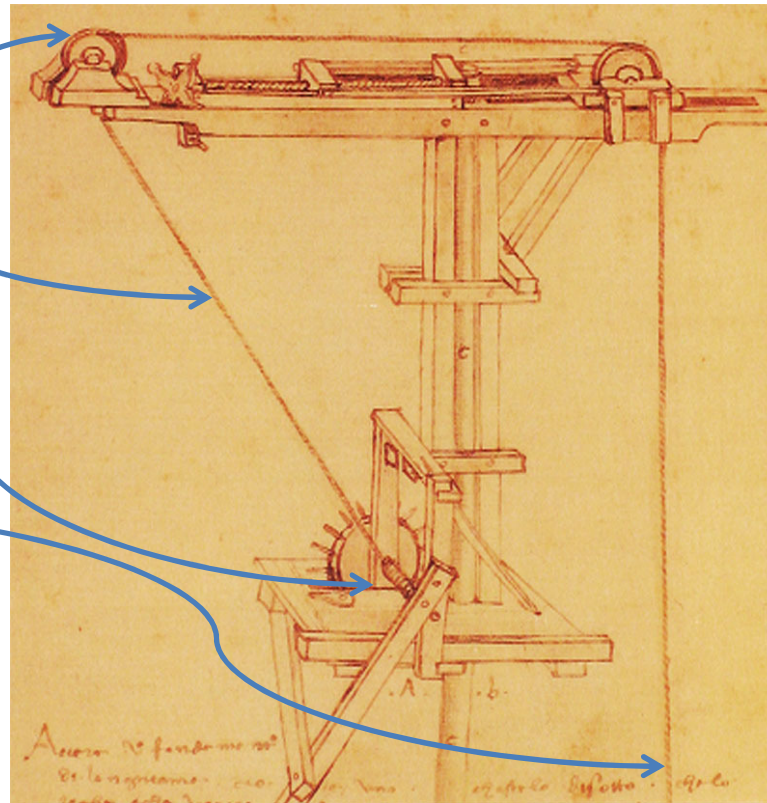


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## The Rope – Part of Crane's System

- Crane rope itself incl. termination
- Drum
- Sheaves
- Reeving and other components



Leonardo da Vinci



# Our experience with crane ropes



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The safe use and long service life of wire rope is qualified by a number of different criteria that have to be considered together

- **Correct rope selection**
- **The actual conditions and the maintenance of all system components**
  - Actual wire rope diameter (reduction due to wear...)
  - Rope lubrication condition (well lubricated or dry)
  - Actual sheave groove diameter and surface condition (any corrugations ?)
  - ...
- **The actual operating conditions**
  - Rope length used compared with the installed
  - Difference between actual line pull and pretension on multilayer drum
  - ...
- **The experience, care and attention of the crane operator**



# Rope categories used on cranes



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## Rope standpoint

1. Rotation resistant ropes (“Non-Rotating”)
2. Non-rotation resistant ropes (“Rotating”)

## Ropes from both categories can be manufactured

- All tensile grades
- Bright or galvanized
- Un-compacted or compacted
- Regular or lang’s lay
- Right or left hand
- With or without plastic coated steel core

Table G.1 — Comparison of rope grades – for guidance only

Rope grade designation	Equivalent rope grade
IPS	1770
EIPS	1960
EEIPS	2160

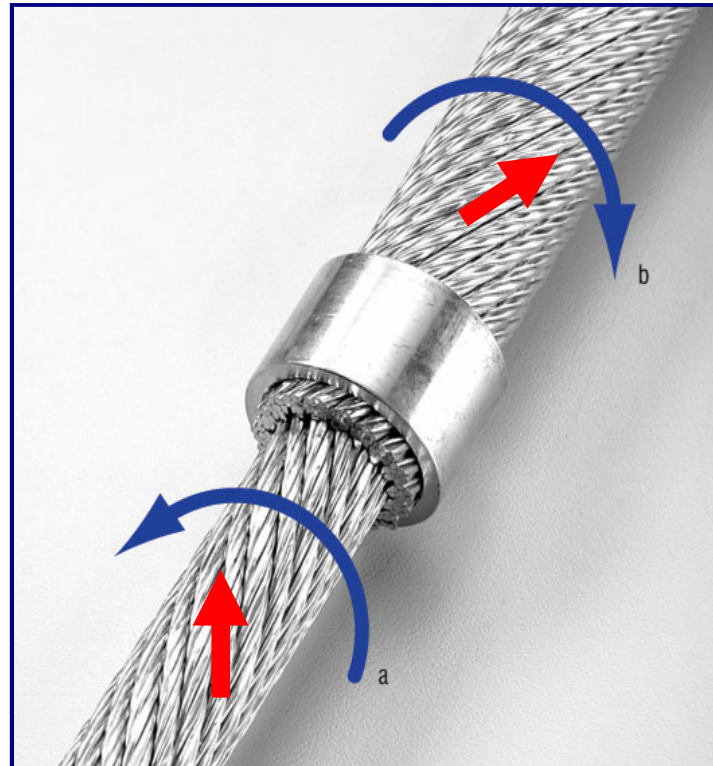


# Rotation Resistant Ropes

Also named as non-rotating ropes

## Definition

- The direction of lay of the outer strands being **opposite** to that of the underlying layer
- Designed to generate reduced levels of torque and rotation when loaded



# Rotation Resistant Ropes

Also named as non-rotating ropes

Rotation resistant ropes are required for hoist applications when

- ...lifting an unguided load
- ...with single fall configuration
- ...at great lifting heights



Note: can be used with a swivel



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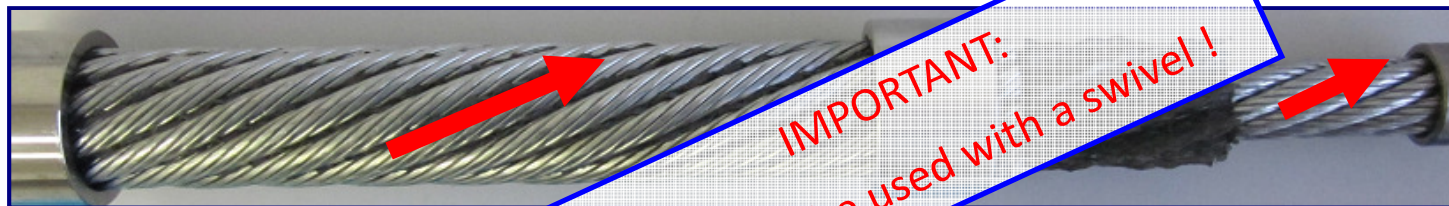


# Non-Rotation Resistant Ropes

Also named as rotating ropes

## Definition

- The direction of lay of the outer strands being same to that of the underlying layer
- Generate high levels of torque and rotation when loaded.
  - Due to that the Non-rotation resistant ropes must not be used with a swivel



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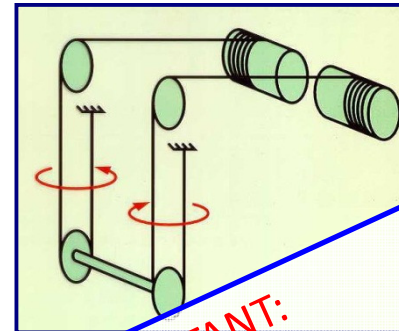


# Non-Rotation Resistant Ropes

Also named as rotating ropes

Non-rotation resistant ropes are suitable

- as hoist ropes when
  - Low lifting height (e.g. most overhead cranes)
  - When used in pairs (right/left)
- as boom hoist rope
- as pendant rope
- as trolley rope
- as retraction rope
- ...



**IMPORTANT:**  
must not be used with a swivel !



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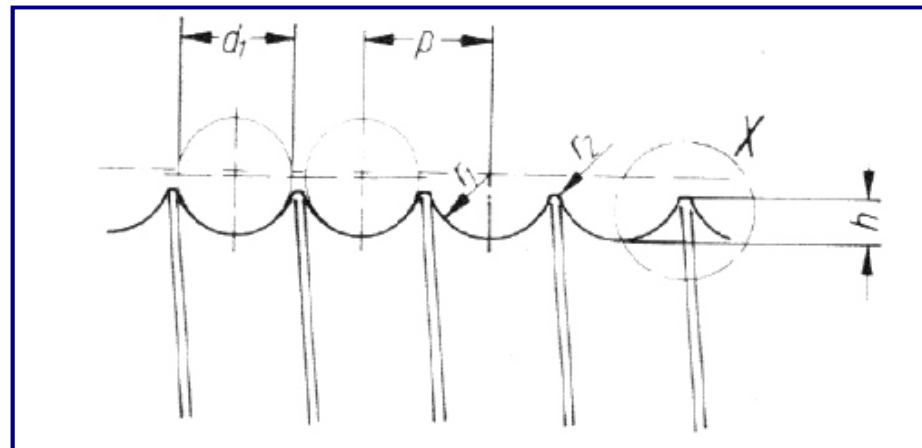
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# Drum types used on cranes

**Single layer drum**  
Helical grooved

**Multilayer drum**  
Special grooved

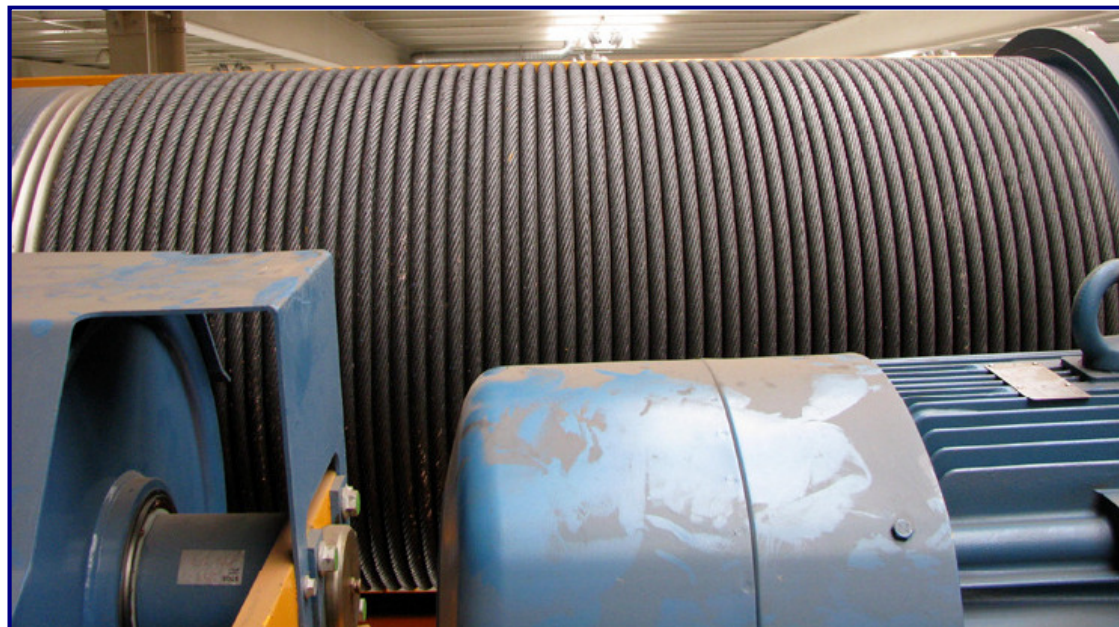


# Single Layer Drum

Common application - Overhead Cranes



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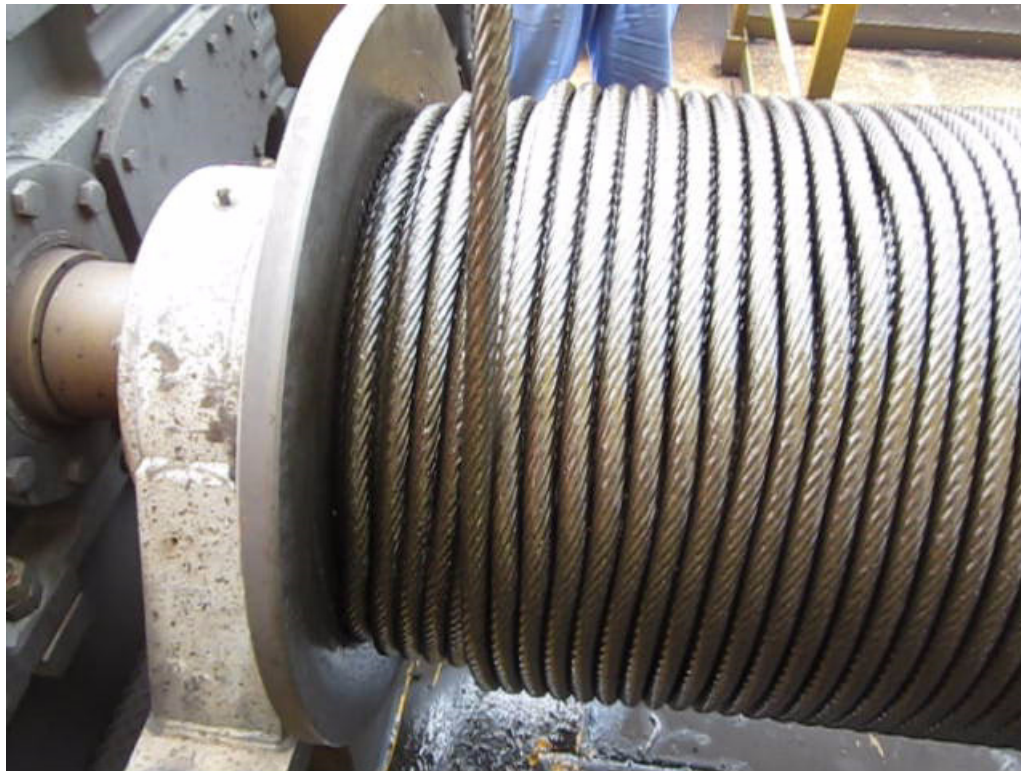
**Bad spooling behavior on a helical grooved drum with five layers leads to very poor rope service life and bad operation conditions**



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# Multilayer Drum System

- Multilayer spooling on modern cranes is needed because the physical constraints of the crane restrict the geometry of the drum
  - Common today:
    - Up to 10 layers
    - Up to 40 wraps per layer
    - Rope length for mobile and crawler cranes above 1000m per drum



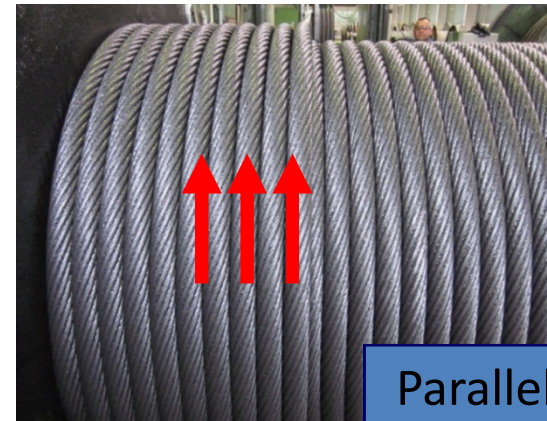
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# Multilayer Drum System

## LEBUS<sup>®</sup> Grooved Rope Drum

- rope wear is substantially reduced
- load is evenly distributed between the individual layers due to the pyramid building-up in the parallel track
- Two sections – parallel and crossover track – both are 180° offset



Parallel track



Crossover track



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# Ropes on Multilayer Drums – What must be considered

**Error-free multilayer spooling  
makes some demands!**

- First and foremost, a suitable wire rope is key achieving proper drum spooling.
  - The drum and wire rope are designed to work together.



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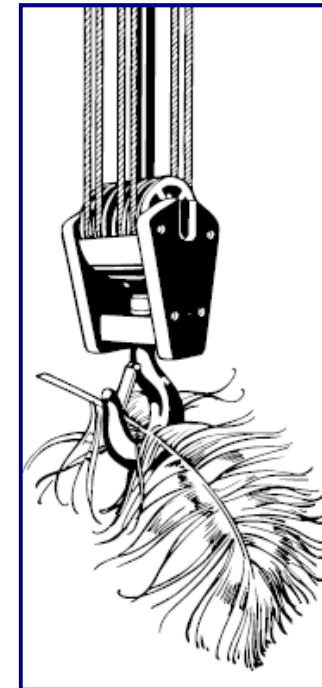
# Ropes on Multilayer Drums – What must be considered

## Demanding - pretension

After proper installation the rope has to be pretensioned by a certain load – “breaking in”!

## Target of pretensioning and “breaking in”

- the components can settle and adjust themselves to the best position by bending the rope over sheaves more often
- pretensioning the wire rope is a basic requirement for multilayer wire rope applications so the rope is spooled tightly around the drum



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# “Breaking in” and pretensioning the new installed wire rope



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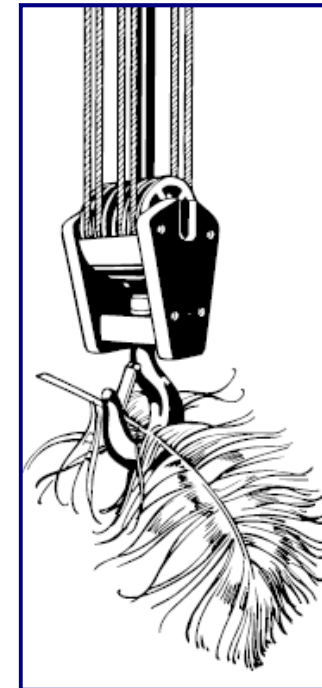


## Demanding - pretension

### Steps

- Bring the whole rope length into the reeving by selecting a suitable hook
- Look for proper lubrication, after a certain storage time  
Re-lubricate during installation if the ropes surface is dry
- Apply a load up to 10% SWL

**Only pretension a wire rope by adding weight to the hook!**



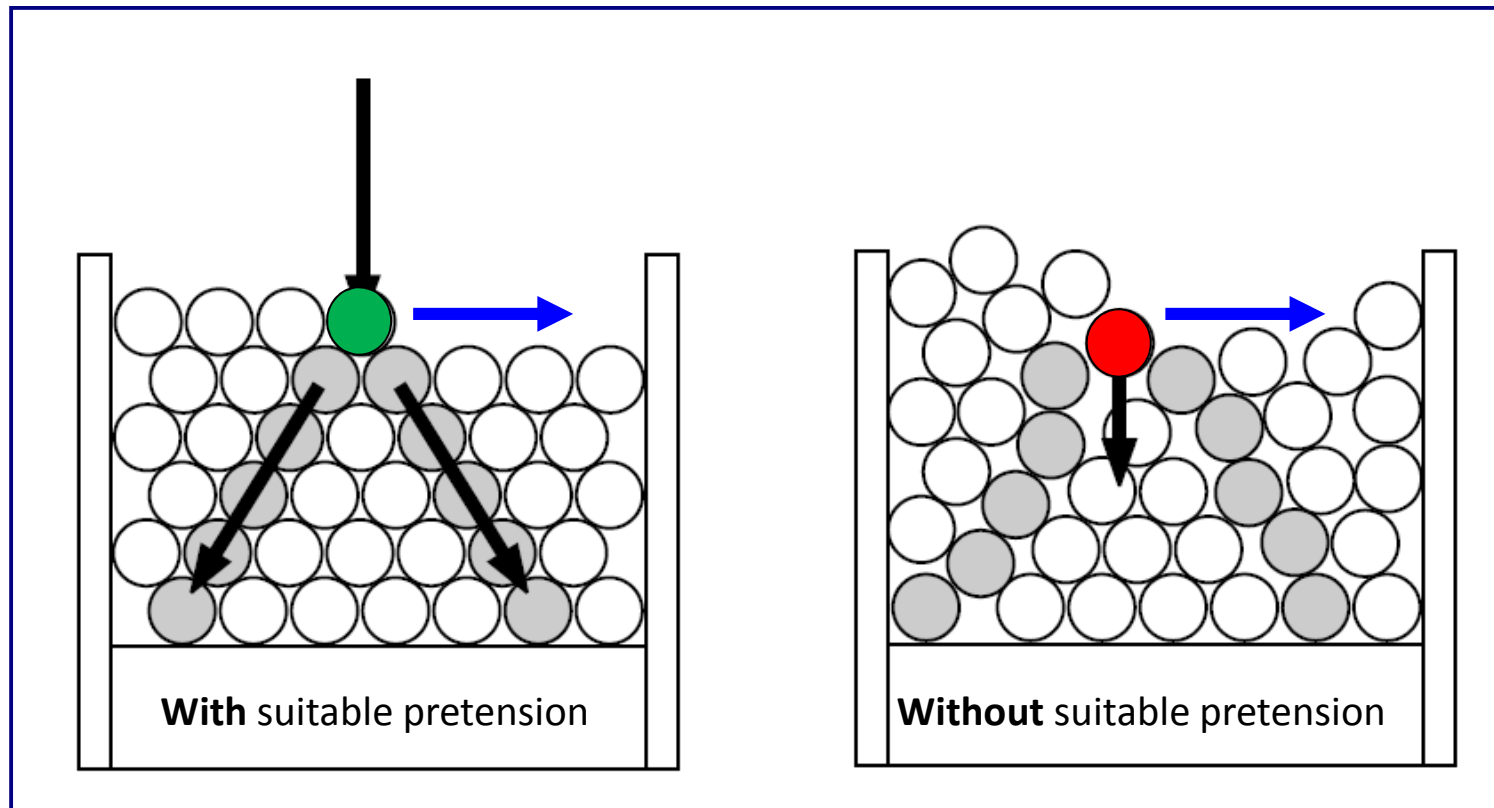


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# Load distribution between the individual layers depending on pretension

## Demanding - pretension



→ Winding direction



# Ropes on Multilayer Drums – What must be considered

**Demanding– climbing from layer to layer**



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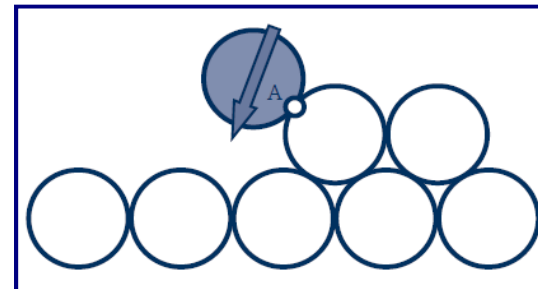


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# Ropes on Multilayer Drums – What must be considered

Demanding – wear resistance



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# Ropes on Multilayer Drums – What must be considered

Demanding – wear resistance



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# Ropes on Multilayer Drums – What must be considered



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**Error-free multilayer spooling makes some demands!**

- The drum-rope system works best when the entire wire rope length installed
  - is used
    - that is best case and very common in the tower crane industry by using rope lengths adapted to the actual crane configuration
  - is spooled onto the drum under load on a regular basis to renew initial pretension
    - Pretension as a precondition for multilayer systems when high loads are applied





# Ropes on Multilayer Drums – What must be considered



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**Error-free multilayer spooling makes some demands!**



- Depending on the specific lift or preferred crane configuration, sometimes only the top layers of the wire rope are used for long periods of time

**Q: What are the consequences?**





# Ropes on Multilayer Drums – What must be considered

**Q: What are the consequences?**

**A1:** Continually using only the upper layers results in differing rates of wear on the used and unused sections of wire rope



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# Ropes on Multilayer Drums – What must be considered

**Q: What are the consequences?**

**A2:** The unused, inactive rope parts lose initial pretension, the rope parts become loose!

- that allows gap creation between the wraps in those layers
- Gaps will lead to spooling problems and as a consequence cause rope damages



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# Ropes on Multilayer Drums – What must be considered

**Crane operator's duty: Monitoring the spooling behavior**

By monitoring the spooling behavior rope damages are avoidable!



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# Ropes on Multilayer Drums – What must be considered



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**Q: What are the consequences?**

**A3:** Severe mechanical damages are a consequence in that unused bottom layer the used rope is constantly running over

Example: The crane operates layers 4-6 a couple of months

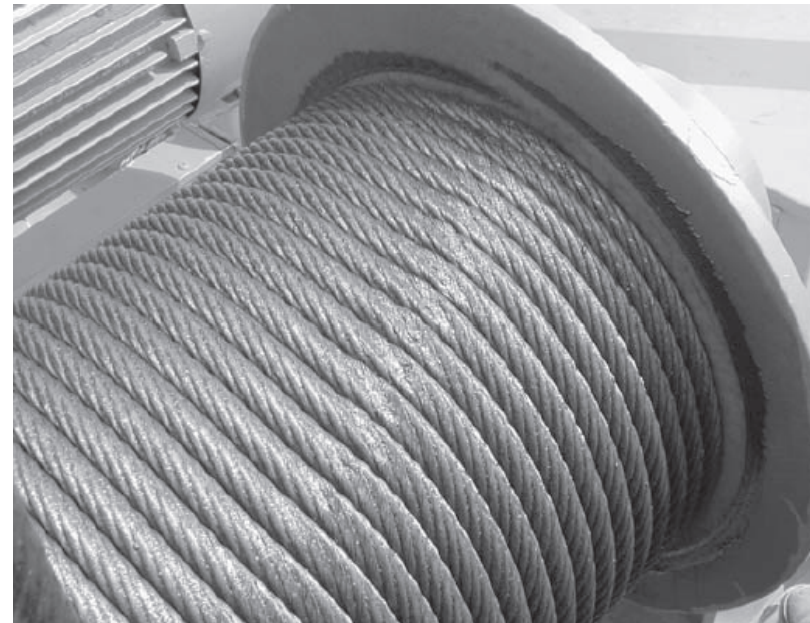
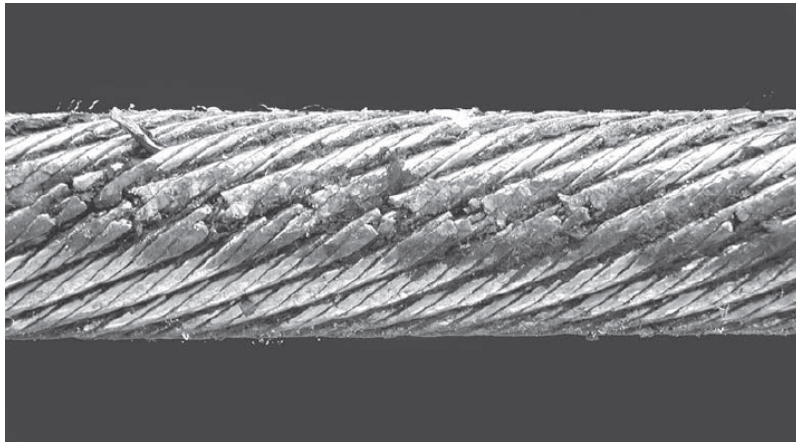
**Q:** Which layer will show severe mechanical damages?

**A:** Layer 3 will show severe mechanical damages that may cause rope discard although not used!



# Ropes on Multilayer Drums – What must be considered

Severe mechanical damages in that bottom layer, that isn't used for a very long time



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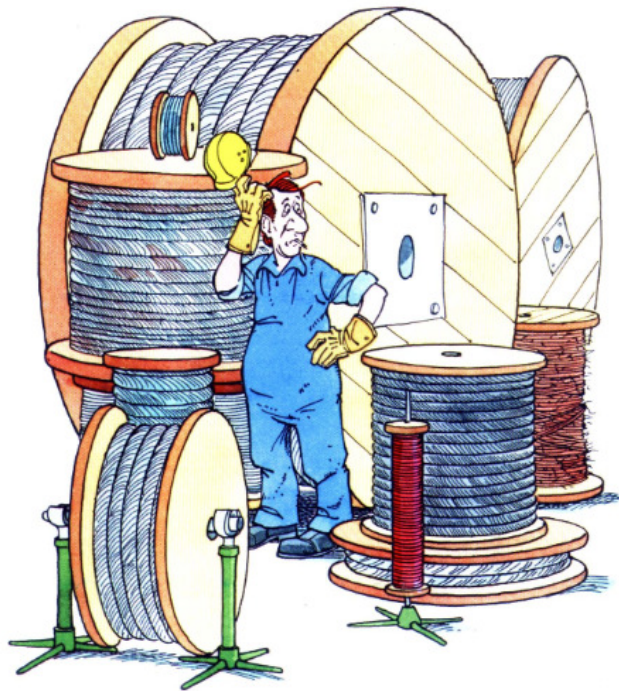




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# RECAP



## Crane Ropes on Multilayer Drums –

What must be considered for safe operation and appropriate rope service life?



# Ropes on Multilayer Drums – What must be considered

First and foremost: Monitor the spooling behavior!



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Advise:  
Renew pretension  
on regular basis!



Needless to say that significant gaps between the wraps and significant spooling problems require immediate action!





# **RECAP: Ropes on Multilayer Drums**

## **– What must be considered**



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**Q: How to renew lost pretension?**

A: Unwind and rewind the entire wire rope length under tension  
- so the rope is spooled tightly around the drum

**Q: Which load is appropriate?**

A: The recommended pretension load is 10% of the wire rope's  
safe working load!





# **RECAP: Ropes on Multilayer Drums**

## **– What must be considered**



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**Q: What to do if 10% of the wire rope's SWL can't be applied ?**

A: If the recommended 10 % value is not possible due to lack of weight on site or in the yard, any pretension that can be applied will help to seat the wire rope.



# RECAP: Ropes on Multilayer Drums

## – What must be considered



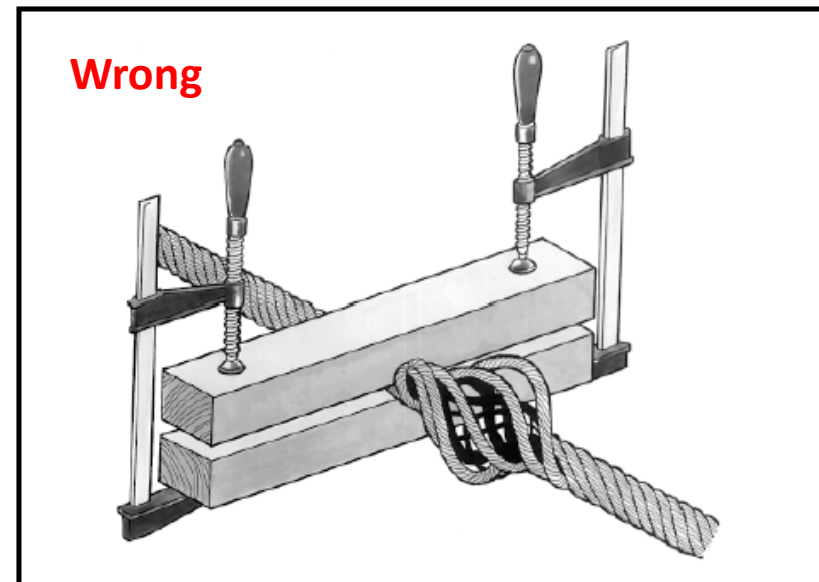
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**Q: Should you attempt to generate the pretension load by ‘jamming’ the wire rope, such as between two boards or other parallel objects?**

**A: No, under no circumstances, please! That can destroy wire rope’s balance and cause operational problems.**

**Only pretension a wire rope by adding weight to the hook!**





# **RECAP: Ropes on Multilayer Drums – What must be considered**



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**Q: Will applied pretension last forever when only the top layers of wire rope on the drum are used?**

A: No, unfortunately not!

**Q: Why doesn't the applied pretension last forever?**

A: The lower layers of wire rope will change their elongation and lose some stiffness created by the former pretension due to repeated spooling of the layers above



# RECAP: Ropes on Multilayer Drums – What must be considered



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The rope is loaded with 10% SWL and marked under load



The rope is unloaded - illustrating the affects of elongation.



# RECAP: Ropes on Multilayer Drums

## – What must be considered



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**Q: How to identify the need to renew the pretension?**

A: Typically, the first indications of a loss of pretension are small but visible gaps between the wraps in the top layers.





# **RECAP: Ropes on Multilayer Drums**

## **– What must be considered**



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**Q: When is action required to renew pretension?**

A: As long as such small gaps do not destroy the spooling behavior, they can be accepted for a short period but have to be monitored.

Advise:

At the first opportunity it is worth the time and effort to renew the pretension in the wire rope and drum spooling. That makes a great contribution to longer wire rope service life and better operation conditions on multilayer spooling drums!



# Error-free spooling is possible considering what was discussed



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# Sheave groove inspection



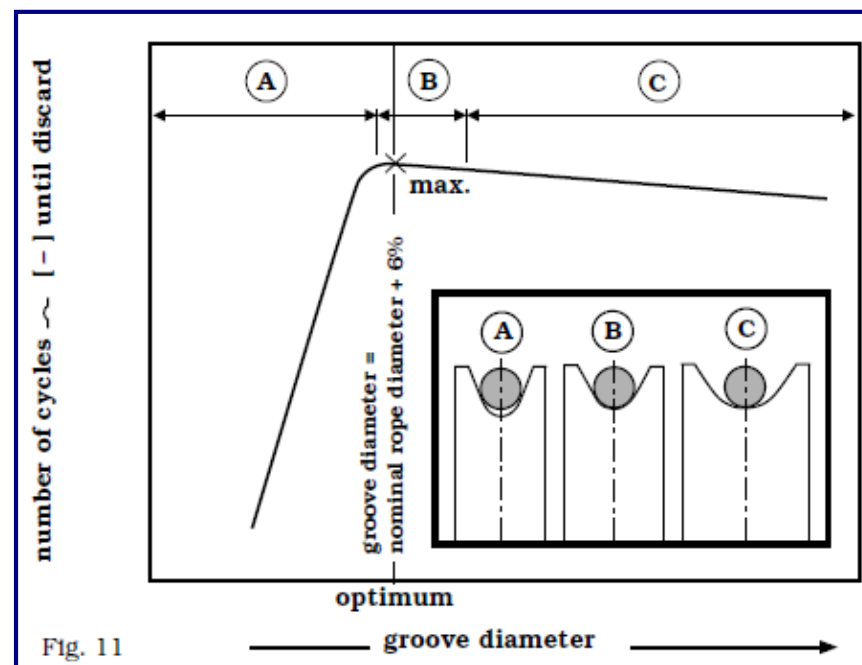
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The sheaves have to be inspected at regular intervals, because they have a significant influence for the entire rope lifetime !

What to consider?

- Measure the actual groove diameter
- Check groove bottom surface visually
  - any corrugations or other wear?



# Sheave groove inspection

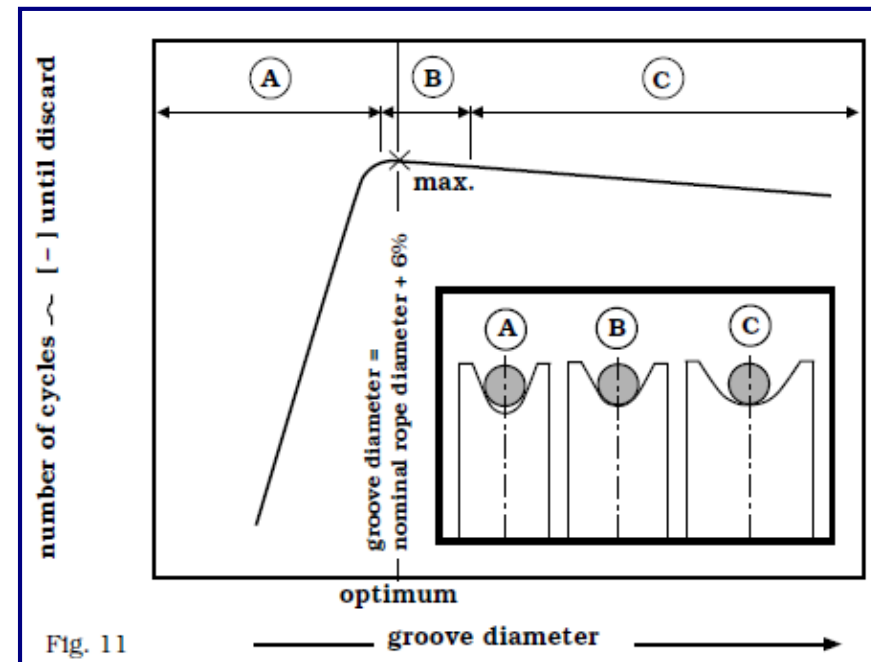
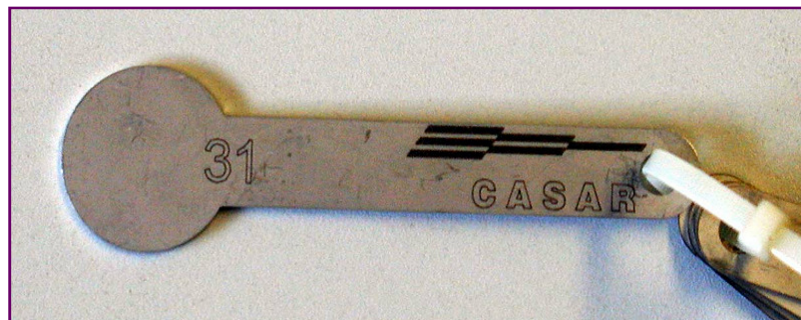


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## CASE B: groove is in order

- groove surface is smooth
- $\varnothing$  1.06 nominal rope  $\varnothing$







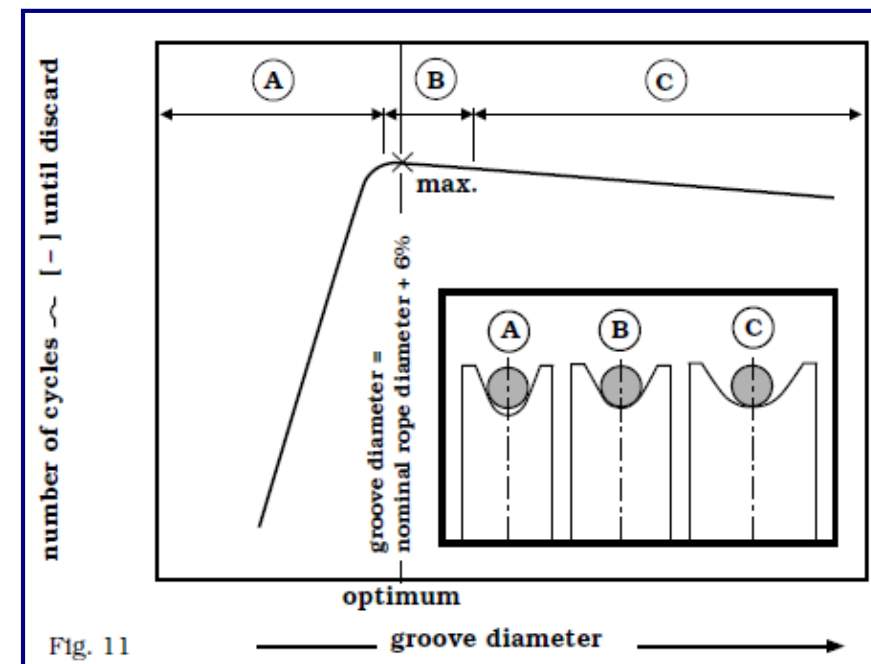
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# Sheave groove inspection

## CASE C: groove is too wide

- Due to reduced contact area the increased pressure in the groove base will reduce the rope lifetime in general. But the reduction is not that significant.
- To do: normally nothing to do



# Sheave groove inspection

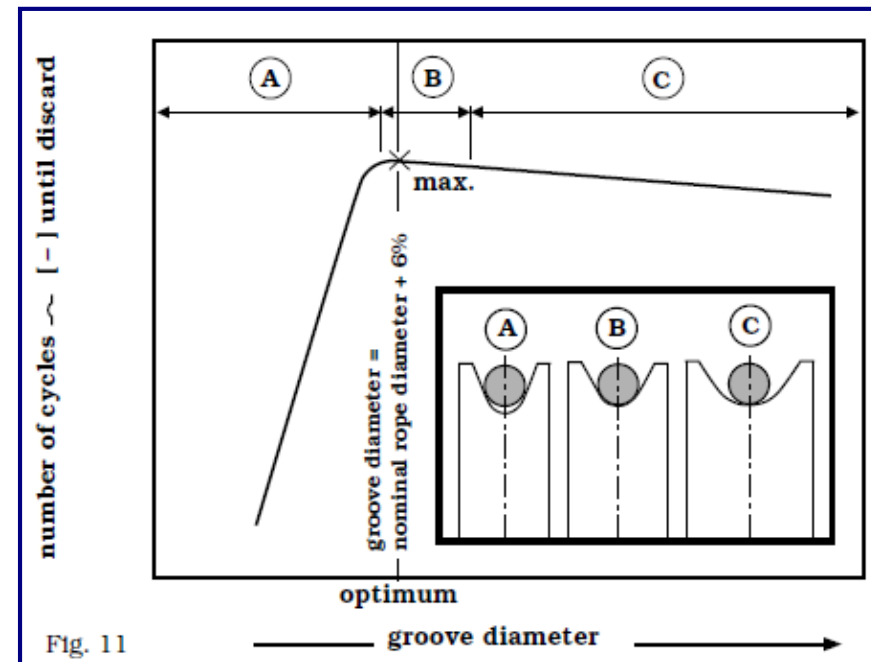
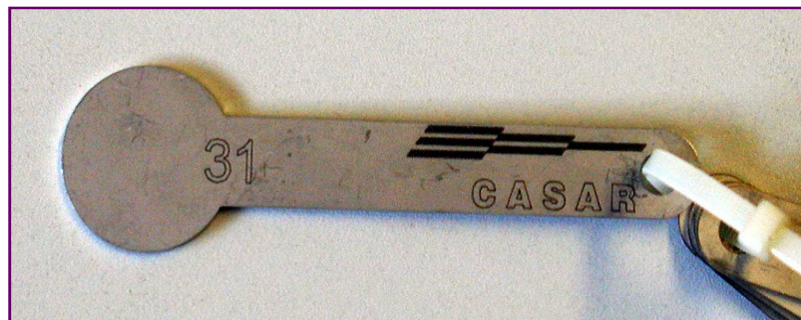


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## CASE A: groove is too tight – very critical!

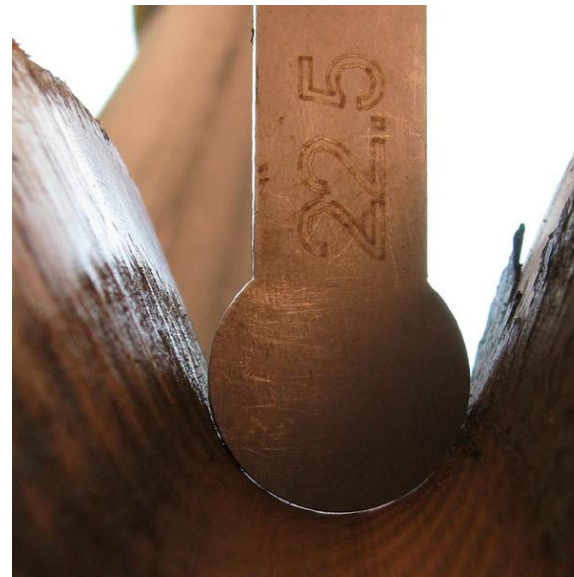
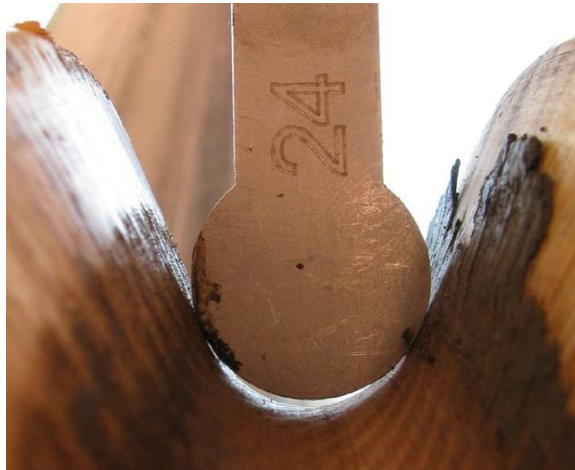
- The rope is exposed to heavy compression in the radial direction. This stress leads to
  - wire breaks
  - hook twist
  - structural changes
    - e.g. birdcages or waviness



# Sheave groove inspection



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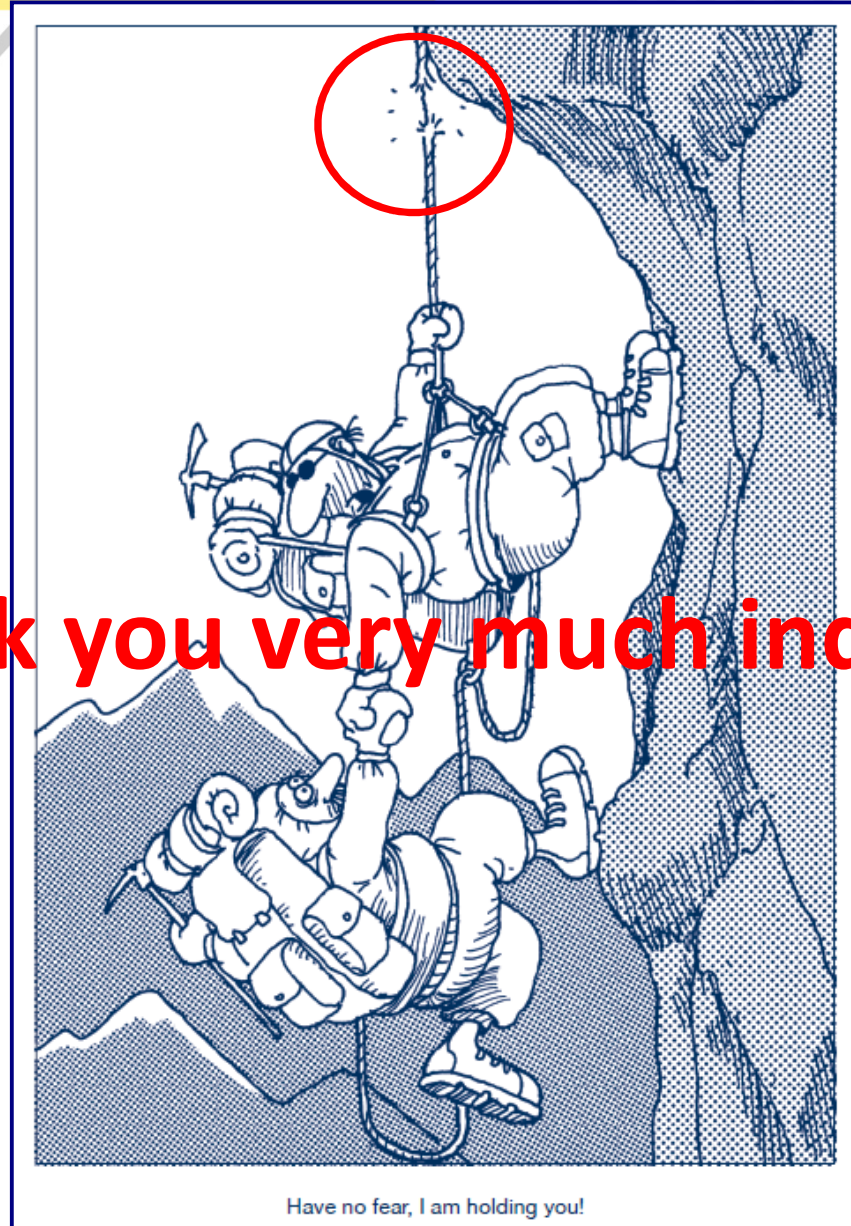
# On site – birdcage



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Q+A



Thank you very much indeed!



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