Care, Use & Maintenance of Wire Ropes on Cranes

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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
The Crane System – yesterday and today

The Rope – Part of Crane’s System

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

Leonardo da Vinci
Our experience with crane ropes

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

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
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
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

IMPORTANT: must not be used with a swivel!
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! 

WireCo WorldGroup
Drum types used on cranes

- Single layer drum
  - Helical grooved

- Multilayer drum
  - Special grooved
Single Layer Drum

Common application - Overhead Cranes
Bad spooling behavior on a helical grooved drum with five layers leads to very poor rope service life and bad operation conditions.
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
Multilayer Drum System

LEBUS® 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
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.
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
“Breaking in” and pretensioning the new installed wire rope

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!
Load distribution between the individual layers depending on pretension

Demanding - pretension

With suitable pretension

Without suitable pretension

Winding direction
Ropes on Multilayer Drums – What must be considered

Demanding – climbing from layer to layer
Ropes on Multilayer Drums – What must be considered

Demanding – wear resistance
Ropes on Multilayer Drums – What must be considered

Demanding – wear resistance
Ropes on Multilayer Drums – What must be considered

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 an precondition for multilayer systems when high loads are applied
Ropes on Multilayer Drums – What must be considered

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
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
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!
Ropes on Multilayer Drums – What must be considered

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
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!

Advise: Renew pretension on regular basis!

Good spooling behavior

Bad spooling behavior

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

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

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

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

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

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

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

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
Sheave groove inspection

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

CASE B: groove is in order
- groove surface is smooth
- Ø 1.06 nominal rope Ø
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

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

![Image of a sheave groove inspection tool]

![Diagram showing the relationship between number of cycles and groove diameter]

Fig. 11
Sheave groove inspection
On site – birdcage
Thank you very much indeed!