Which rope for my crane?

Welcome to CRC-Meeting in Edmonton/Canada Oct. 12-13 2011
Dr. Frank Jauch, Market Director Crane - WireCoWorldGroup Kansas City/MO CASAR Germany

Crucial wire rope properties in crane application
- High breaking strength
- Wire tensile strength grade
- Fill factor
- Parallel lay construction
- Compacted strands
- Swaged core
- Compacted strands and swaged rope
- Actual rope diameter
- Stable rope structure
- Crushing resistance
- Resistance to metal loss
- Resistance to rotation
- Fatigue resistance
- Cable rope diameter

Product knowledge

Crucial crane rope properties
- High breaking strength
- Wire tensile strength grade
  - C7 (IPS), 1960 (EIPS), 2160 (EEIPS), other special grades are provided for special applications
- Fill factor
- Parallel lay construction
- Compacted strands
- Swaged core
- Compacted strands and swaged rope
Slide 4

Compacted Strands - Compacted Ropes
Abrasion resistance improved by compacted strands

- un-compacted strand
- compacted strand

Conventional outer strands allow for indentations between outer strands
Compacted outer strands prevent indentations between outer strands

Slide 5

Product knowledge

Crucial crane rope properties
- Fatigue resistance
  - To have high fatigue resistance, wires must be capable of bending repeatedly under stress when passing over sheaves
  - Increased fatigue resistance is achieved in a rope design by using a larger number of wires and strands
  - D/d-ratio has a significant influence
    - precise recommendations exist

Slide 6

Bending Fatigue resistance

- Rope life under load
- Rope life under load
- Rope life under load

SAFE!
Product knowledge

Crucial crane rope properties

► Crushing resistance
  - Crushing is the effect of external pressure on rope, which damages it by distorting the cross section shape of the rope
  - Important on multilayer spooling drums
  - Important for boom hoist ropes

Boom hoist rope – excellent crushing resistance

Compacted strands and swaged rope provides excellent crushing resistance

Rope basics – rope selection

[Image of rope selection]
Rope categories used on cranes

Rope standpoint
1. Rotation resistant ropes ("Non-Rotating")
2. Non-rotation resistant ropes ("Rotational")

Both can be manufactured:
- Un-compacted or compacted
- Regular lay or langs lay
- Right or left hand
- With or without plastic coated steel core
- Bright or galvanized
- All tensile grades
Crane Ropes in use – Hoist Ropes

Rotation resistant ropes (Non-rotating)

EN 12385: Definition
- Designed to generate reduced levels of torque and rotation when loaded
- Designed with at least two layers of strands laid helically around a centre
- The direction of lay of the outer strands being opposite to that of the underlying layer

Note: Rotation resistant ropes are required
- Lifting is restricted to:
  - Lif o single fall
  - On several falls at a great lifting height
- Rope can be used with or without swivel

Typical rope classes are
- Class 18x7
- Class 35x7

Note: The rotational behavior depends on the rope construction!
Different levels of resistance to rotation

**ASTM A1023**
- There are three different types of rotation-resistant ropes categorized by their resistance to rotation.
  - Category 1: Has at least 15 outer strands. - Class 35x7
  - Category 2: Has 10 or more outer strands. - Class 18x7
  - Category 3: Has fewer than 10 outer strands.

**ISO 21669** is a general guidance on the use of a swivel:
- Less than or equal to 1 turn/1000d lifting a load equivalent to 20%MBF, a swivel can be used.
- Greater than 1 turn but no greater than 4 turns/1000d – a swivel may be used.
- Greater than 4 turns/1000d – a swivel should not be used.

---

Rotation resistant ropes

18x7 vers. CASAR Eurolift

---

Resistance to rotation

Contest: Rotation resistant rope

ASTMA 1023 category 1:
The metallic core section of the outer strands is twice that of the IWRC.

High performance rotation resistant rope

ASTMA 1023 category 2:
The metallic core section of the outer strands is considerably greater than that of the IWRC.
Resistance to rotation

"Contest": Rotation resistant rope

- 18x7 rotation resistant rope
  (ASTM A 1023 - Category 2)
  The metallic cross section of the outer strands is twice that of the IWRC.

- High performance rotation resistant rope
  (ASTM A 1023 - Category 1)
  The metallic cross section of the IWRC is considerably greater than that of the outer strands. Because of this, an equilibrium is established.

Crane Ropes in use – Hoist Ropes

- Rotation resistant ropes (Non-rotating)
  Typical rope classes are
  - Class 18x7
  - Class 35x7
  Note: The rotational behavior depends on the rope construction!

- Advice: Select rotation resistant ropes only if rotation resistance is required.
  Rotation resistant ropes are "sensitive" products due to its construction and therefore not suitable for all applications.

Crane Ropes in use – Hoist Ropes

- Non-rotation resistant ropes
  Typical rope classes are
  - 6 or 8-strand ropes are very common
  - 9 or 10-strand ropes are special constructions
Crane Ropes in use – Hoist Ropes

**Definition**
- Designed with at least two layers of strands laid helically around a centre.
- 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 (Rotational) must not be used with a swivel.

Non-rotation resistant ropes

Non-rotation resistant ropes are suitable as hoist ropes:
- Load is guided
- Low lifting height
- When used in pairs (right/left).

---

Rope categories used on cranes

<table>
<thead>
<tr>
<th>Application standpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoist Rope</td>
</tr>
<tr>
<td>Trolley ropes</td>
</tr>
<tr>
<td>Boom hoist rope</td>
</tr>
<tr>
<td>Retraction ropes</td>
</tr>
</tbody>
</table>

Tower erection rope pulls up the tower segments during the setup of the crane.

Boom pendant holds and stabilizes the boom.

Retraction ropes pull up and retract the boom of a telescopic mobile crane.
Crane Ropes in use

Non-rotation resistant ropes are suitable for all applications that don’t require rotation resistance!

- Boom hoist ropes
- Pendant ropes
- Trolley ropes
- Retraction ropes

Wire rope terminations

Classification – terminations
Slide 28

Classification – detachable terminations

Slide 29

Wedge socket – incorrect use

Slide 30

Wedge socket – incorrect use
Slide 31

**Wedge socket – correct and incorrect use**

Correct - align live end of the rope with center line of pin

Incorrect!

Slide 32

**End connection aluminum ferrules – often used e.g. for pendant ropes**

► Aluminum ferrules have a minimum efficiency rating of 90% of the SFB

Slide 33

**End connection aluminum ferrules – often used e.g. for pendant ropes**

Fig. 65: Illustration: Improved productivity by using wedge-reinforced end connections at high load.
Slide 34

Pendant ropes fitted with close and open swage sockets

Slide 35

DANGER:
Ropes must not be connected as shown!

Slide 36

Handling and installation of wire ropes
Handling and installation of wire ropes

Wrong handling can damage the new rope immediately

Wrong:
- Don't touch the rope by the fork of the fork lift truck

Correct:
- Use textile webbing slings or touch the reel as shown only

Wrong handling can damage the new rope immediately

How to store ropes?
- never rest ropes on the floor unprotected - place them on a pallet
- don't cover them completely
- condensation might not be able to escape and could damage the ropes
- Indoor storage preferred: cool, clean and dry
- Outdoor: like indoor but protected against environment like heat, dust

Unwinding a rope – extra care must be taken to bring the rope without tensions or any outer damages into the reeving
- Wrong:
  - The procedures shown will inevitably induce one torsion per wrap to the rope
Handling and installation of wire ropes

Unwinding a rope – extra care must be taken to bring the rope without tensions or any outer damages into the reeving

► Correct: Place the rope on a turntable or mount the reel on a suitable rack

Winding from the reel onto the drum

► Note: The rope receives its preferred bending direction as a result of the manufacturing process when being drawn from the reel. Hence, the bending takes place primarily by means of a capstan.

► Correct: Make sure that the rope bends in the same direction:
  - Top to top
  - Bottom to bottom

► Q: What will happen if you do it the wrong way?
  - The rope will either try to twist between reel and drum or it will later try to regain its preferred position when in operation. Both can cause structural changes.

How to provide ample rope tension during installation?

► Note: After proper installation the rope has to be tensioned by a certain load!
Wrong!

Under no circumstances should one attempt to generate the tensioning load by jamming the rope, e.g. between two boards!

"Breaking in" the new installed wire rope

- Target of "breaking in":
  - The components can settle and adjust themselves to the best position by bending the rope over sheaves more often.
- Steps:
  - Bring the whole rope length into the reeving.
  - Look for proper lubrication, after storage time.
  - Re-lubricate during installation if the ropes surface is too dry.
  - Apply a load up to 10% SWL.

Any questions?