A17.6-2010 Suspension Code

Rope Replacement Criteria – Steel Wire Ropes

Presented by: Rene Karavas, Regional Supervisor
TSSA Elevating and Amusement Devices
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Wire Rope Replacement Criteria

• Summary of Presentation
  ➢ A17.6 – 2010
  ➢ Rope Replacement due to Loss of Diameter
  ➢ Rope Replacement due to Broken Wires
  ➢ Other Rope Replacement Conditions
  ➢ Winding Drum Machines
Standard for Elevator Suspension, Compensation and Governor Systems

- **ASME A17.6 – 2010**
  - Standard for Elevator Suspension, Compensation, and Governor Systems
  - Part 1 – Stranded Carbon Steel Wire Ropes
  - Part 2 – Aramid Fiber Ropes
  - Part 3 – Non-Circular Elastomeric Coated Steel Suspension Members
ASME A17.6 – 2010

- Adopted in Ontario as of May 1st, 2012
- Section 1.10 outlines rope replacement criteria for steel wire ropes
Loss of Diameter – Use of Rope Gauge

- Replacement Criteria due to Loss of Diameter using Rope Gauge
  
  - Blue gauge – for imperial ropes
  - Red gauge – for metric ropes
  - Gold gauge – for metric ropes less than 8mm
• Measurement Method

- Ensure that the gauge slot being used corresponds to original rope diameter (verify on rope data tag).
- The **outer stepped slot** is to be used for rope measurement where **rouge is evident**.
- The **inner stepped slot** is to be used for rope measurement for all other rope conditions.
Wire Rope Gauge

Rope that does not fit into slot is acceptable (even with rouge)

Rope with rouge that fits here (up to first step in slot) must be replaced

Rope that has no rouge must fit to the bottom of slot to warrant replacement
Loss of Diameter – Measuring with Gauge

- **Measurement Method**
  - Measurement for diameter to be taken on a straight portion of rope at worst location.
  - Two measurements at the same position at right angles to be taken. Ropes shall be replaced if both of these measurements are below the replacement value.
  - If only one measurement below replacement value, criteria for wire breaks under “Unfavourable Wear Conditions” shall apply. See Table 1.10.1.2-1.
• 9.5 mm ropes

➢ Ropes that are 9.5 mm should be measured using the 3/8” imperial gauge slot.
Rope Gauge

Acceptable Condition

Rope fits in outer stepped slot.

There is no sign of rouge on the rope.
Rope Gauge

Ropes Require Replacement

Rope fits in outer stepped slot.

Rouge is evident.
Rope Gauge

Ropes Require Replacement

Rope fits in inner stepped slot (or bottom of slot).
Broken Wires

- Rope Replacement - Wire Breaks

  - Criteria for replacement to include at least one of the following:
    
    a) Crown breaks – equally distributed
    b) Crown breaks – unequally distributed
    c) Crown breaks - Four wires side-by-side across crown of strand
    d) Unfavourable wear conditions
    e) Ropes showing rouge
    f) Valley break – more than one per lay
    g) Valley break – where rouge exists

  - See Table 1.10.1.2-1 for a) to e) for number of breaks required in a rope lay
Wire Rope – Construction Basics

- Understanding rope basics
  - Critical to understand rope specs before inspecting for damage
  - How many strands?
  - Diameter?
  - Rope Data Tag essential
Wire Rope - Lay Measurement

- Lay measurement
  - Example – six strand rope
  - Count six strands and add one
  - Measure from centre to centre
  - Estimate is 6.5 times rope diameter (ie. ½” rope will have 3 ¼” lay length)
## Table 1.10.1.2-1  Wire Breaks: Crown Wire Breaks Per Lay Length

<table>
<thead>
<tr>
<th></th>
<th>Normal Wear Conditions</th>
<th>Unfavorable Wear Conditions</th>
<th>Ropes Showing Rouge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed Breaks (max)</td>
<td>32</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Unequal Breaks (max)</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4 Side by Side Breaks</td>
<td>16</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
# Crown Wire Breaks – 6 Strand Ropes

## Table 1.10.1.2-1 Wire Breaks: Crown Wire Breaks Per Lay Length

<table>
<thead>
<tr>
<th>6-Strand Rope Applications</th>
<th>Normal Wear Conditions</th>
<th>Unfavorable Wear Conditions</th>
<th>Ropes Showing Rouge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed Breaks (max)</td>
<td>24</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Unequal Breaks (max)</td>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>4 Side by Side Breaks</td>
<td>12</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
a) Equally Distributed Crown Wire breaks

- Observe number of breaks in one lay.
- If number of breaks in lay exceed 24 for 6-strand, or 32 for 8/9 strand – replace all ropes.
b) Unequally Distributed Crown Wire Breaks

- Observe number of broken crown wires that predominate in one or two strands.
- If number of breaks in any one lay exceeds 8 for 6-strand, or 10 for 8/9 strand – replace all ropes.
Crown Wire Breaks – 4 side-by-side

c) Four Side-by-Side Crown Wire Breaks

- Observe if there are four broken crown wires, side by side.
- If number of breaks in any one lay exceeds 12 for 6-strand, or 16 for 8/9 strand – replace all ropes.
Crown Wire Breaks – Unfavourable Conditions

d) **Unfavourable conditions** - such as but not limited to:

- corrosion due to external conditions
- excessive wear of individual wires in the strands
- unequal tension
- poor sheave grooves.

For any of the above conditions, the criteria for broken crown wires (see 3 previous slides) shall be the values indicated in the “Unfavorable Wear Conditions,” column of Table 1.10.1.2-1. **Number of wires = half.**
e) If red dust or rouge exists, the criteria for broken wires shall be the values indicated in the “Rope Showing Rouge,” column of Table 1.10.1.2-1.

Again, the number of broken wires is one half of the normal wear condition.
Valley Breaks

Valley break - defined in ASME A17.6

- **1.3.7.4 Valley Breaks:**
  
  *Wire breaks that are visible* and occur outside of the crown wear area with the crown wire intact
f) Valley Breaks - If there is **more than one valley break per rope lay** – all ropes to be replaced.

g) Valley Breaks - If there are **any valley breaks at any location where rouge exists** - all ropes to be replaced.
All Ropes Replaced!
Valley Breaks – Additional Considerations

- Where ropes are subjected to reverse bends or where ropes are installed on non-metallic coated, plastic, fiber-reinforced plastic sheaves or sheaves with non-metallic liners or inserts, extra attention must be given to any steel wire rope (6, 8, or 9 strand) due to possible acceleration of valley breaks.
Wire Ropes – Other Replacement Criteria

• Additional Rope Replacement Criteria:
  - Ropes showing **rouge that are less than 8 mm** must be replaced, even if there is no diameter loss or breaks.
  - Rope(s) shall be replaced if the rope is permanently **kinked, bent, or deformed** in any way.
Wire Ropes - Additional Replacement Criteria for Governor Ropes

Governor Ropes:

- **Governor ropes shall not be lubricated** after installation.
- If lubricants have been applied to governor ropes, they shall be replaced, or the lubricant removed, and the governor and safety shall be tested (B44-10 8.6.4.2.2).
Table 1.10.1.2-1 does not apply to suspension ropes on winding drum machines. Suspension ropes shall be replaced on winding drum machines if any of the following conditions are noted (See Section 1.10.2):

1. Number of broken crown wires per rope lay that are **equally distributed among strands** in worst section of rope **must exceed 12** (See Section 1.10.2(a));

2. Number of broken crown wires per rope lay that **predominate in only one or two strands** in worst section of rope **must exceed 6** (See Section 1.10.2(b));
3. Valley breaks - **More than one valley break per rope lay** (See Section 1.10.2(c)); or

4. Valley Breaks - **Any valley breaks at any location where rouge exists** (See 1.10.1.2 (d)).
## Winding Drum Machine Ropes

<table>
<thead>
<tr>
<th>Drum Machines Wire Breaks Per Lay Length</th>
<th></th>
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<tbody>
<tr>
<td>Distributed Breaks (max)</td>
<td>12</td>
</tr>
<tr>
<td>Unequal Breaks (max)</td>
<td>6</td>
</tr>
<tr>
<td>Valley Breaks per rope lay (max)</td>
<td>1</td>
</tr>
<tr>
<td>Valley Breaks where rouge exists</td>
<td>None Permitted</td>
</tr>
</tbody>
</table>
Rope Replacement Criteria

Queries?

- Contact TSSA’s Customer Contact Centre toll-free 1-877-682-TSSA (8772)
- Visit www.tssa.org; www.tssablog.org