"Haggie Hints"

by George Delorme

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Haggie North America - Meeting your hoisting needs!

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DRUM END CUTS

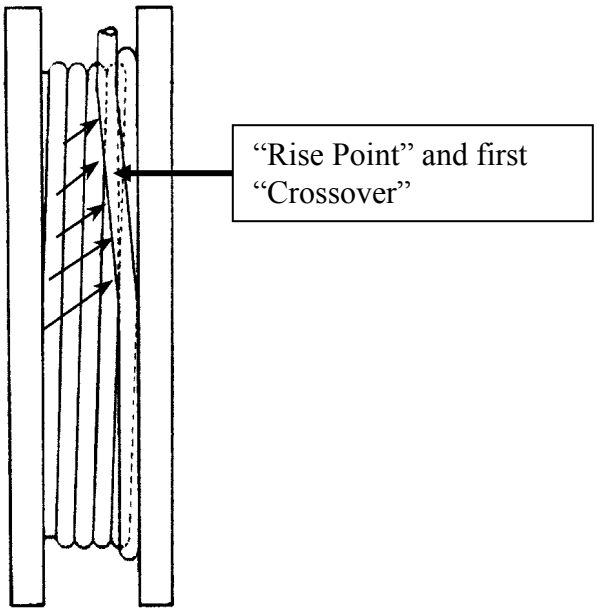
Drum end cuts are, unfortunately a necessary evil however, they are a simple and efficient means of introducing a "fresh" section of rope to an abused area or section. Many industries apply this "cut & slip" philosophy.

POTENTIAL CAUSES & BACKGROUND INFO

For a single layer of rope it is best to have spiral grooving of a drum shell. With this type of grooving there is no "rise point" nor "crossover" and the rope is not subjected to any crushing forces by other layers of rope. The only wear is due to the contact with the other wraps. In many cases, to avoid this contact, the drum pitch will be 7% larger than the rope diameter (this assumes an 80:1 drum to rope ratio and a fleet angle of $1^0 20'$). Drum end cuts are not necessary with a single layer of rope.

As the number of layers of rope increases, the rise points and cross-overs become a more severe wear problem. To minimize the wear at these critical points parallel grooving is highly recommended, although in Canada, it is not compulsory until there are four layers of rope. Experience has also shown that with any type of multi-layered grooving, rope damage at the drum increases exponentially as the speed increases.

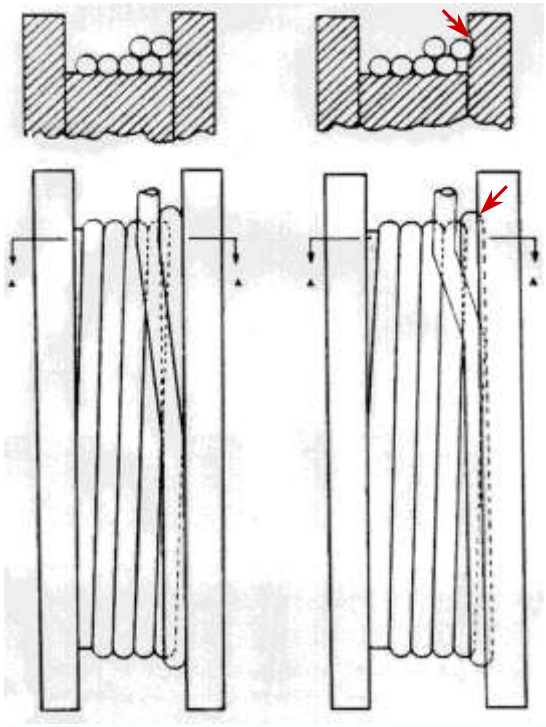
Diagram 1.



Although there are several factors that will increase the wear at the “rise point” and subsequent “crossover” the two main issues are:-

1. Worn drum flanges (this can also be worn “risers” and/or “kickers”)
2. There is a poor rope diameter to drum groove fit

1. – <u>Worn Flanges</u> Diagram 2

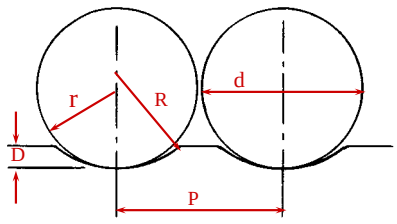


#1A-1 At the “Rise” point

- Worn Flange
  - Movement to the proper groove is delayed
  - Causes a hard “Slapping” after rising from one layer to the next
  - Sets up a pattern for all cross-overs

2. – <u>Rope to Drum Groove Fit</u> Diagram 3.

Proper Rope to Drum Fit



Note: On single layer, Pitch = 1.07

- **r** = Rope radius, actual maximum
- **d** = Act. rope dia
- **R** = Groove radius = r x 1.05
- **D** = Groove depth = d x 0.25
- **P** = Pitch = d x 1.015

Diagram 3. illustrates the best rope to drum groove fit to ensure the least amount of wear on the “dead wraps” and at every crossover. The critical figure is the rope diameter to drum pitch. On multi-layer winding, the best scenario is to have each wrap of a new rope just touching i.e. the rope diameter would be the same as the drum pitch. Since it is not possible for any rope maker to ensure this tight tolerance, we target the finished rope diameter at 1-1/2% less than the drum pitch. With this allowance, we can be sure that the rope will not be too big for the drum grooves. Excessive wear occurs when the rope is too small for the drum pitch and the space between each wrap, particularly on the bottom layers, allows the on-coming wraps of rope to fall deeply in the groove formed by the supporting wraps.

Experience shows, one of the most critical elements in rope life prediction is rope speed but it is often not taken into consideration. As an example, when there is 1/8” wear on the drum flanges of a service hoist which runs at 1500ft/min, the resultant rope wear at the crossovers is minimal and can be tolerated. On a production hoist running at 2850ft/min, the same level of flange wear will have a dramatic, negative impact on rope life.

Another factor that has less of an impact on wear but can also play a role is the selection of the correct lay direction of the hoist rope. The selection of a particular lay direction is used to overcome the effects on spooling when either too large or too small a fleet angle exists. The ideal fleet angle to assist good spooling is $1^0$20’ with the maximum recommended being 1^0 45’ and the minimum 0^0 30’. If the fleet angles are both close to $1^0$20’ or if both fleet angles happen to be equal, then right hand lay ropes are normally used. However, if the fleet angles are not equal at $1^0$20’, then the selection of the proper rope lay direction can improve the spooling on the drum and thus reduce wear on the rope.

While it is not always practical to change the drum to rope bending ratio on an existing system, it should also be recognized that if a rope were working at 100:1 versus another drum at 80:1, the former would have less compressive forces on the rope structure and therefore less impact at the rise points and crossovers. With a more sympathetic bending ratio, the frequency to complete drum end cuts will be reduced.

The formula for calculating tread pressure is:-

Relative tread pressure = [2 x (Max. rope Tension)] ÷ [(rope dia.) x (drum dia.)]

CONCLUSIONS

- Drum end cuts are normally beneficial if not critical on all hoists with multiple layers of rope. The main challenge is to determine the frequency of the cuts which are time consuming and expensive. On the other hand, if not carried out regularly, the rope life may be very short. The goal is to slip a new section of rope into the wear zone before too much damage occurs. Unfortunately, the frequency of cuts is largely determined by visual inspection and/or experience. The causes have been discussed, but in the end, from a practical point of view, the rope must be examined and the rope cut well before the removal criteria is reached (in general, 4 broken wires in 1 strand over 1 lay length or 8 to 9 broken wires in all strands over 1 lay length). To ensure consistency, the frequency should be based on the number of tons or cycles hoisted rather than time in service.

- The amount of rope removed should not coincide with the circumferential distance of the crossovers and can be relatively short i.e. the length of the crossover distance (approximately = 24”).
- If a broken wire is noticed, it is imperative to remove both ends of the wire ASAP. If these are not fatigued off at the strand valleys, then the ends may cross over neighboring wires and cause them to break.
- To illustrate the point, the following photo shows what actually happened when the drum end cut period was extended to twice the previously established frequency.