

PRODUCT BULLETIN



DRUM CRUSHING ON BOOM HOISTS

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Causes of crushing

When wire rope is properly spooled in multiple layers on a drum, crushing will occur first at the cross-over points on the drum. These are the points where the wire rope coming onto the drum moves from one valley to the next on the layer below and “crosses over” a wrap of wire rope on the layer below. Because there is a single rope-to-rope contact point here (versus two when it is in the valley), the contact pressure is higher, thus this is where crushing occurs first.

Each layer of wire rope on a drum crosses over two wraps on the layer below during each revolution of the drum. When crushing occurs at these points, it creates a repeating pattern of two crushed areas that match the wire rope’s circumference around the drum.

Effect of crushing

Crushing can affect the strength and service life of a wire rope. This is recognized in OSHA regulations on crawler, locomotive and truck cranes when it states:

1910.180(g) “Rope inspection.” -

1910.180(g)(1) “Running ropes.” A thorough inspection of all ropes in use shall be made at least once a month ... Any deterioration, resulting in appreciable loss of original strength shall be carefully observed and determination made as to whether further use of the rope would constitute a safety hazard. Some of the conditions that could result in an appreciable loss of strength are the following:...

1910.180(g)(1)(vi) Severe kinking, crushing, cutting, or unstranding.

The OSHA requirement recognizes that some deterioration doesn’t reach the “appreciable loss of original strength” level and that crushing can be less than “severe”. The person doing wire rope inspections, qualified by training and/or experience, must evaluate the severity of the crushing.

ASME B30.5 (Mobile & Locomotive Crane) has this to say about crushing and removal criteria:

5-2.4.3 Rope Replacement

(a) No precise rules can be given for determination of the exact time for rope replacement since many variable factors are involved. Once a rope reaches any one of the specified removal criteria...[it must be replaced before the next work shift].

(b) Removal criteria for rope replacement shall be as follows:...

(4) kinking, crushing, birdcaging, or any damage resulting in distortion of the rope structure.

It begins by saying “no precise rules”, but then doesn’t quantify the crushing. A strict reading of this would require retirement of many wire ropes after their initial lift! Once again, the person doing wire rope inspections, qualified by training and/or experience, must evaluate the severity of the crushing.

In an attempt to show the effect of crushing, a section of used 6X26WS RR IWRC wire rope that exhibited crushing was tensile tested. Photograph 1 shows the crushing present in the tensile sample.



Photograph 1

The results of the tensile test performed on the section of wire rope containing this crushing indicated that there was about a 5% reduction in strength from the tensile test done at the time the wire rope was made. More severe crushing would, of course, result in a greater loss of strength, thus the need for an inspector, qualified by training and/or experience.

Evaluation of crushing

Two factors must be considered when evaluating wire rope crushing. The first is the location of the crushing and the second is the severity of the crushing.

If the crushed areas are in sections of the wire rope that don’t experience the full loading (i.e., area that spools on the drum when a boom hoist wire rope raises the mast, but not the main boom), they are of less concern. These sections become “dead” wraps on the drum during the raising of the main boom and provide only back tension as the drum absorbs most of the loading. If the crushed area is in the active part of the reeving during the raising of the main boom, there is both the strength loss to be considered and the potential for accelerated fatigue in the crushed areas.

If the area exhibiting the greatest crushing is similar to that seen in Photograph 1, the reduction in the wire rope’s strength is only about 5% and not a reason by itself for removal. It should be noted that wire rope end terminations made with wire rope clips or wedge sockets reduce the wire rope’s strength far more (up to 20% or more) and are frequently subject to the full load experienced by the wire rope.

Observations about drum crushing

Select the proper wire rope for the conditions on your crane. A 6X26WS RR IWRC wire rope has historically been used for boom hoists. It is a good wire rope, but there are wire ropes with more crushing resistance. The next step in increased resistance to drum crushing is a Flex-X 6 RR IWRC wire rope. The compacted strands of this wire rope provide greater resistance to crushing than a 6X26 RR IWRC wire rope. The best resistance to drum crushing is achieved with Flex-X 9 wire rope. Both the strands and the completed wire rope are compacted to resist crushing.

Install the wire rope under tension. When a wire rope is tensioned, the wires and strands are pulled toward the center axis of the wire rope. This increases the wires’ and strands’ resistance to deformation and makes the wire rope more resistant to crushing. Frequently the section of a boom hoist wire rope that raises the mast is crushed by the layer spooling over the top of it. The lower layer (that raises the mast) exhibits crushing but the upper layer (that raises the boom) doesn’t exhibit crushing. It is the same wire rope - the only difference is the loading that the wire rope has experienced.

Crushing will occur most rapidly on an uncrushed wire rope. A round wire rope has only a single contact location at a cross-over point and this causes very high contact pressure. High contact pressure causes crushing. As crushing takes place, this causes a larger contact area which reduces the contact pressure and the rate of crushing decreases. This means that crushing occurs most rapidly on a new wire rope, but the rate of crushing decreases as the amount of crushing increases.