

LIFTING CRANE, WIRE-ROPE STRENGTH FACTORS

Foreword—This Document has also changed to comply with the new SAE Technical Standards Board format.

1. Scope—This SAE Standard applies to all mobile, construction-type, lifting cranes as equipped for operation with hook, clamshell, magnet, and grapple attachments. It is not applicable to excavating and demolition attachments such as shovels, hoes, draglines, and wrecking balls.

1.1 Purpose—The purpose of this document is to set forth wire-rope strength factors that have been proved by design and operating practice to be consistent with safety, economy, space, weight, and other requirements peculiar to mobile, construction-type, lifting cranes.

2. References

2.1 Related Publications—The following publications are provided for information purposes only and are not required part of this document.

2.1.1 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd St., New York, NY 10036.

ISO 4308-1—Cranes and lifting appliances—Selection of wire ropes—Part 1: General

ISO 4308-2—Cranes and lifting appliances—Selection of wire ropes—Part 2: Mobile cranes—Coefficient of utilization

3. Basis for Determinations

3.1 Strength Factors—Strength factors shall be based on the numerical values obtained by dividing the nominal breaking strength of the rope in a load supporting system by the total force applied to the system.

3.2 Wire-Rope Strength Factors—Wire-rope strength factors shall be not less than those specified in Section 4 of this document with the combination of listed boom length, recommended wire rope, listed operating radius, and rated load or other recommended operating condition that produces the maximum force in the particular rope system under consideration.

3.3 Forces—All forces shall be considered static as produced by the boom and suspended load without the effects of motion from lifting, lowering, swinging, or traveling.

3.4 Total Force—Total force in the rope system under consideration shall be the force resulting from the effects of the suspended load and structures.

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4. **Wire-Rope Strength Factors**

4.1 **For Supporting Rated Loads (including Boom Suspensions)**

- a. The strength factor for live or running ropes that wind on drums or pass over sheaves shall be not less than 3.55
- b. The strength factor for standing or guy ropes shall be not less than 3.0.
- c. The strength factor for rotation resistant live or running rope shall not be less than 5.0.

4.2 **For supporting the Boom and the Working Attachments at Recommended Travel Positions and Boom Lengths:**

- a. The strength factor for live or running ropes shall be not less than 3.55.
- b. The strength factor for standing or guy ropes shall be not less than 3.0.

4.3 **For supporting the Boom under Recommended Erection Conditions**

- a. The strength factor for live or running ropes shall be not less than 3.05.
- b. The strength factor for standing or guy ropes shall be not less than 2.5.

5. **Wire-Rope Inspection**—Assurance of safety and economy in use of construction-type cranes dictates the requirement for a program of periodic inspections of the condition of all load supporting wire-rope. Environmental and use factors such as abrasion, wear, fatigue, corrosion, improper reeving, and kinking, are often of greater significance in determining the safety usable life of wire-rope than are conservative strength factors based on new-rope conditions. Appendices A and B of this document set forth recommended considerations for inspection of wire-rope and a suggested format for recording pertinent observations. The crane operator should inspect wire-rope daily when the crane is in service and prior to operation after a period of standby. Critical inspection of all ropes should be made by a competent rope inspector and pertinent observations recorded not less often than weekly when the crane is in continuous service and prior to operation when the crane is removed from storage.

6. **Notes**

6.1 **Marginal Indicia**—The change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE OFF-ROAD MACHINERY TECHNICAL
COMMITTEE SC31—CRANES & LIFTING DEVICES

APPENDIX A

WIRE-ROPE INSPECTION

- A.1** Evidence of rope deterioration from corrosion should be cause for replacement.
- A.2** More than one broken wire in any one strand should be cause for caution. Breaks that occur on the worn crowns of the outside wires indicate normal deterioration. Breaks that occur in the valleys between strands indicate some abnormal condition, possibly fatigue and breakage of other wires not readily visible. One or more valley breaks should be cause for replacement.
- A.3** Wire breaks generally occur in those portions of a wire rope which pass over sheaves, wind onto drums, or receive mechanical abuse. Breaks that occur near attached fittings are apt to result from fatiguing stresses concentrated in these localized sections. Breaks of the latter type should be cause for replacement of the rope or renewal of the attachment to eliminate the locally fatigued area.
- A.4** Heavy wear or broken wires may occur in sections under equalizer sheaves or other sheaves where rope travel is limited, or in contact with saddles. Particular care should be taken to inspect ropes at these points.
- A.5** Rope stretch is generally greatest during initial stages of operation when the strands are becoming adjusted and seated. This is accompanied by some reduction in rope diameter, but not to the extent that the condition of the rope can be judged on this basis.
- A.6** Time for rope replacement is indicated by the extent of abrasion, scrubbing, and peening on the outside wires, broken wires, evidence of pitting or severe corrosion, kink damage, or other mechanical abuse resulting in distortion of the rope structure.
- A.7** Sheaves, guards, guides, drums, flanges, and other surfaces contacted by wire rope during operation should be examined at the time of inspections. Any condition harmful to the rope in use at the time should be corrected. The same equipment, and particularly sheave and drum grooves, should be inspected and placed in proper condition before a new rope is installed.
- A.8** Any of the following listed conditions should be cause for rope replacement.
 - a. In running ropes, six randomly distributed broken wires in one rope lay, or three broken wires in one strand in one rope lay. For rotation resistant ropes having eight or more outer strands, two broken wires in six rope diameters or four broken wires in thirty rope diameters. A rope lay is the length along the rope in which one strand makes a complete revolution around the rope.



FIGURE A1—TYPICAL ROPE CONSTRUCTION

- b. In pendants or standing ropes, evidence of more than one broken wire in one rope lay.
- c. Abrasion, scrubbing, or peening causing loss of more than 1/3 the original diameter of the outside wires.
- d. Evidence of rope deterioration from corrosion.
- e. Severe kinking, severe crushing, or other damage resulting in distortion of the rope structure.

- f. Evidence of heat damage from any cause.
- g. Reduction from nominal diameter of more than 1.191 mm (3/64 in) for diameters up to and including 19.050 mm (3/4 in); 1.587 mm (1/16 in) for diameters 0.875 mm (7/8 in) to 28.575 mm (1 1/8 in); 2.381 (3/32 in) for diameters 31.750 mm (1 1/4 in) to 38.100 mm (1 2/2 in). Marked reduction in diameter indicates deterioration of the core resulting in lack of proper support for the load carrying strands. Excessive rope stretch or elongation may also be an indication of internal deterioration.
- h. Evidence of "bird-caging" or other distortion resulting in some members of the rope structure carrying more load than other. See Figure A2.

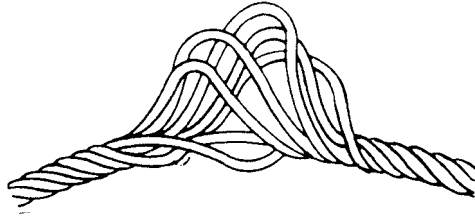


FIGURE A2—BIRD CAGING

- i. Noticeable rusting or development of broken wires in the vicinity of attachments.

NOTE—If this condition is localized in an operating rope and the section in question can be eliminated by making a new attachment, this can be done rather than replacing the entire rope.