

Chapter 30-1

Steel Wire Rope

SECTION 30-1.1: SCOPE

Chapter 30-1 includes provisions that apply to wire rope.

SECTION 30-1.2: TRAINING

Users of wire rope shall be trained, as applicable, in the use, selection, inspection, installation, maintenance, attachment, replacement, and effects of environment as covered by this Chapter.

SECTION 30-1.3: TYPES OF STEEL WIRE ROPE

30-1.3.1 Standard Wire Rope

Standard wire rope is a wire rope that has one of the following:

- (a) a steel core rope, WSC, or IWRC that has the same direction of lay as the wire rope in which it is used
- (b) a non-load-bearing fiber core
- (c) no core
- (d) load-bearing synthetic fibers in the strands, the core, or both (also known as a hybrid rope)

NOTE: Low-torque rope is considered standard wire rope.

30-1.3.2 Rotation-Resistant Wire Rope

Rotation-resistant wire rope is rope designed to generate reduced levels of torque and rotation when loaded and comprising an assembly of two or more layers of strands laid helically around a center, the direction of lay of the outer strands being opposite to that of the underlying layer. There are three categories of rotation-resistant rope. The applicable rotation resistance categories shall be identified by the rope manufacturer on the wire rope certificate as follows (see [para. 30-1.5.5](#)):

- (a) Category 1: a wire rope constructed in such a manner that it displays little or no tendency to rotate and has at least 15 outer strands.
- (b) Category 2: a wire rope constructed in such a manner that it has significant resistance to rotation and has at least ten outer strands.
- (c) Category 3: a wire rope constructed in such a manner that it has limited resistance to rotation and has no more than nine outer strands.

SECTION 30-1.4: ROPE SELECTION, MINIMUM BREAKING FORCE, DESIGN FACTORS, AND OTHER REQUIREMENTS

30-1.4.1 Selection

The wire rope shall be selected by the LHE manufacturer, the rope manufacturer, or a qualified person.

30-1.4.2 Selection Limitations

(a) Wire rope with fiber core shall not be used for boom hoist or luffing attachment reeving.

NOTE: This does not preclude the use of hybrid rope.

(b) Category 2 and 3 rotation-resistant rope shall not be used on single-layer drums unless approved by the LHE manufacturer or a qualified person.

(c) Rotation-resistant rope and fiber core rope shall not be used for the following:

- (1) boom support, boom hoist, or boom extension system rope, except as noted in (e)
- (2) boom support or boom hoist rope during erection, except as noted in (e)
- (3) standing rope that is used as live rope during erection

(d) Rotation-resistant wire rope shall not be used for hoisting on ASME B30.14 LHE.

(e) Rotation-resistant rope may be used as boom hoist reeving when load hoists are used as boom hoists for attachments, such as luffing attachments or boom and mast attachment systems. Under these conditions, the following requirements shall be met:

- (1) The load hoist drum being used as a boom hoist shall have a first-layer rope pitch diameter of not less than 18 times the nominal diameter of the rope used.
- (2) All sheaves used in the boom hoist reeving system shall have a rope pitch diameter of not less than 18 times the nominal diameter of the rope used.
- (3) The design factor shall be the total minimum breaking force of all parts of rope in the system divided by the load imposed on the rope system when supporting the static weights of the structure and the crane rated load.

(4) The frequency of inspection of the wire rope shall be increased when using rotation-resistant rope in boom hoist or luffing attachment service.

30-1.4.3 Minimum Breaking Force

The actual breaking force shall meet or exceed the minimum breaking force values given in ASTM A1023 or ISO 2408 for the rope grade specified. For rope not covered under the above standards, the rope shall meet or exceed the minimum breaking force specified by the rope manufacturer as tested in compliance with ASTM A931. The minimum breaking force shall be shown on the wire rope certificate.

30-1.4.4 Wire Rope Design Factors

Wire rope design factors shall be, at a minimum, as shown in [Table 30-1.4.4-1](#).

30-1.4.5 Multiple Lead Lines

If a load is hoisted by more than one lead line, the tension in the lines should be equalized.

30-1.4.6 Standing Rope (Pendants, Stay Rope, Guys, Nonoperating Rope, Track Cables, and Boom and Jib Support Rope)

(a) Standing rope shall be regular lay wire rope or structural strand.

(b) Only new and unused rope or structural strand shall be used to manufacture standing rope.

(c) New and replacement boom and jib support rope shall be proof tested to the LHE or fitting the manufacturer's recommendation. The proof test shall not exceed 50% of the minimum breaking force of the wire rope or structural strand.

(d) Swaged fittings shall not be used on fiber core rope; this does not preclude the use of hybrid rope.

(e) Rotation-resistant rope shall not be used.

(f) Terminations, such as turnbuckles, shall have provisions to prevent loosening during usage.

(g) Standing rope connected in series shall be of the same lay direction.

(h) Structural strand shall not be used as a running rope during erection.

30-1.4.7 Minimum D/d Ratios — Sheave and Drum

The minimum pitch diameter shall be determined by using the D/d ratios specified in [Table 30-1.4.7-1](#). If the D/d ratio is not specified, the minimum sheave and drum pitch diameter for any rope shall be specified by the LHE manufacturer or a qualified person.

NOTE: The life of wire rope is affected by the pitch diameters. Pitch diameters larger than the minimums determined by the D/d ratios listed in [Table 30-1.4.7-1](#) should achieve a longer service life.

SECTION 30-1.5: INSTALLATION, TESTING, MAINTENANCE, REPLACEMENT, AND ROPE CERTIFICATION

30-1.5.1 Storage and Installation

(a) Rope should be stored to prevent damage or deterioration from moisture, chemicals, steam, corrosive agents, and other contaminants.

(b) Before installing wire rope, the documents that accompany the reel or the rope should be checked to ensure the rope being installed on the LHE is correct as specified in [para. 30-1.5.4](#).

(c) Unreeling or uncoiling of rope should be done with care as recommended by the rope manufacturer or qualified person to avoid kinking or inducing a twist.

(d) Prior to cutting a wire rope, seizing should be placed on each side of the point to be cut as recommended by the rope manufacturer. In the absence of manufacturer-specific recommendations, the following minimums should be observed. The length of each seizing should be equal to or exceed the nominal diameter of the wire rope. Seizing material may consist of wire, strand, tape, or other material capable of holding the wires and strands firmly in place during cutting and handling. The recommended number of seizings is as follows:

(1) on preformed wire rope, one seizing on each side of the point to be cut, approximately two rope diameters apart

(2) on rotation-resistant and other nonpreformed rope, three seizings on each side of the point to be cut, with each seizing approximately two rope diameters apart

(e) During installation, avoid dragging the rope in dirt or around objects that will scrape, nick, crush, or induce sharp bends.

(f) The wire rope should be wound onto the top of the drum from the top of the reel or onto the bottom of the drum from the bottom of the reel.

(g) After the rope is installed, but before starting normal operation, the rope should be cycled with increasing loads and speeds as specified by the LHE manufacturer, the rope manufacturer, or a qualified person.

(h) For rope subject to multilayer spooling, the rope should be installed under tension to prevent excessive distortion on the bottom layers and to promote proper spooling. Unless otherwise specified by the LHE manufacturer, the rope manufacturer, or a qualified person, tension should be 2.5% to 5% of the minimum breaking force.

30-1.5.2 Testing

(a) LHE load testing shall be in accordance with the applicable ASME B30 volume.

(b) Load testing of rope end terminations shall be in accordance with [para. 30-1.7.4](#).

Table 30-1.4.4-1 Wire Rope Design Factors

ASME B30 Volume	Application	Usage	Rope Type	Minimum Design Factor
B30.2	Load hoist rope	Running	Standard	5.0
			Rotation resistant	5.0
B30.3	Load hoist rope	Running	Rotation resistant	5.0
	Boom support rope	Running	Standard	3.5
	Boom support rope during erection	Running	Standard	3.0
	Standing rope	Standing	Standard	3.0
	Standing rope used as live rope during erection	Standing	Standard	3.0
B30.4	Load hoist rope	Running	Rotation resistant	5.0
			Standard	3.5
	Boom support rope	Running	Standard	3.5
		Standing	Standard	3.0
	Boom support rope during erection	Running	Standard	3.0
		Standing	Standard	3.0
	In/out haul or trolley	Running	Rotation resistant	5.0
			Standard	3.5
B30.5	Load hoist rope	Running	Rotation resistant	5.0
			Standard	3.5
	Boom support (hoist) rope	Running	Standard	3.5
		Standing	Standard	3.0
	Boom support (hoist) rope during erection	Running	Standard	3.0
		Standing	Standard	2.5
	Load hoist rope used as boom hoists for luffing attachments or boom and mast attachment systems	Running	Rotation resistant	5.0
Internal boom extend/retract rope	Running	Standard	3.5	
B30.6	Load hoist rope	Running	Rotation resistant	5.0
			Standard	3.5
	Boom support rope	Running	Standard	3.5
	Guy rope	Standing	Standard	3.0
B30.7	Load movement rope	Running	Rotation resistant	5.0
			Standard	3.5
B30.8	Load hoist rope	Running	Rotation resistant	5.0
			Standard	3.5
	Boom support rope	Running	Standard	3.0
		Standing	Standard	3.0
	Boom support rope during erection	Running	Standard	3.0
Standing		Standard	2.5	
B30.13	Load hoist rope	Running	Rotation resistant	5.0
		Running	Standard	5.0
B30.14	Load hoist rope	Running	Standard	4.0
	Load support rope	Standing	Standard	3.5
B30.16	Load hoist rope	Running	Standard	5.0
		Running	Rotation resistant	5.0
B30.18	Load hoist rope	Running	Standard	5.0
B30.19	Load hoist rope	Running	Rotation resistant	5.0
			Standard	3.5
	Nonoperating rope	Standing	Standard or strand	3.0
	Track cables	Standing	Standard or strand	3.0

Table 30-1.4.4-1 Wire Rope Design Factors (Cont'd)

ASME B30 Volume	Application	Usage	Rope Type	Minimum Design Factor
B30.20	In accordance with ASME BTH-1			
B30.21	Load hoist rope	Running	Standard	4.0
B30.22	Load hoist rope	Running	Rotation resistant	5.0
			Standard	3.5
	Internal boom extend/retract rope	Running	Standard	3.5
B30.23	One leg lifting system	Standing	Standard	7.0
	Two or more leg lifting system with only two legs considered under stress	Standing	Standard	5.0
B30.24	Load hoist rope	Running	Standard	5.0
	Boom hoist	Running	Standard	7.0
	Trolley hoist rope/catenary trolley rope	Running	Standard	5.0
B30.28	Load hoist rope	Running	Standard	5.0
B30.29	Load hoist rope	Running	Standard	5.0
	Jib suspension or erection rope	Running	Standard	3.5
	Standing rope	Standing	Standard	3.0
	Standing rope used as live rope during erection	Standing	Standard	3.0
	Telescoping rope used during mast erection	Running	Standard	3.5
Any	Load hoist rope handling molten metal	Running	Standard	8.0

GENERAL NOTES:

- (a) Rope design factors are not applicable for volumes B30.10, B30.25, B30.26, and B30.27.
- (b) When rotation-resistant rope is used for load hoisting with an operating design factor less than 5, but in no case less than 3.5, the following special provisions shall apply:
- (1) For each such lifting assignment
 - (a) a designated person shall direct each lift
 - (b) a qualified person shall ascertain that the rope is in satisfactory condition (see Sections 30-1.8 and 30-2.8) both before and after lifting; more than one broken wire in any one lay shall be sufficient reason to consider not using the rope for such lifts
 - (c) operations shall be conducted in such a manner and at such speeds as to minimize dynamic effects
 - (2) Each lift under these provisions shall be recorded in the LHE inspection record, and such prior uses shall be considered before permitting another such lift.
 - (3) These provisions are not intended to permit duty cycle or repetitive lifts to be made with operating design factors less than 5.
- (c) For ASME B30.14 LHE, when the load lifted results in design factors of less than 4.0 for running rope or 3.5 for standing rope, the following requirements shall be met:
- (1) An inspection prior to and following the lift reveals no deficiencies of the rope, per para. 30-1.8.1(b).
 - (2) The maximum load capacity of the side boom tractor is not exceeded.
 - (3) The load can be and is handled in such a manner and at such speeds as to minimize dynamic effects.
 - (4) The lift and inspections are made under controlled conditions and under the direction of a qualified person.
- (d) For ASME B30.17, refer to ASME B30.16 for wire rope design factors.

30-1.5.3 Maintenance

(a) Wire rope should be maintained in a well-lubricated condition in order to reduce internal friction and prevent corrosion. It is important that lubricant applied as part of a maintenance program be compatible with the original rope manufacturer-specified lubricant. The LHE manufacturer, the rope manufacturer, or a qualified person should be consulted before using alternative lubricants. Ensure sections of rope that are normally hidden (e.g., rope located over equalizer sheaves) are properly lubricated.

(b) When operating conditions will cause localized wear areas on a running rope, and if reducing the rope length is allowable, a section may be cut off the drum

end to reposition and distribute these areas throughout the remaining length.

(c) To prevent a crown break from causing additional damage to other components, where both ends are visible, it is acceptable to remove both ends of the broken wire. Removal may be accomplished by grasping the protruding ends and bending them back and forth until they break between the strands. This action and location shall be documented and counted as one crown break (not a valley break) for future inspections. This action is not considered a repair.

(d) No attempt shall be made to lengthen or repair a wire rope.

Table 30-1.4.7-1 Minimum D/d Ratios — Sheave and Drum

ASME B30 Volume	Boom Hoist		Load Hoist		Load Block, Sheave	Luffing, Sheave or Drum	In/Out Haul or Trolley or Catenary Trolley		Nonrunning/ Equalizer, Sheave	Extend/ Retract, Sheave
	Sheave	Drum	Sheave	Drum			Sheave	Drum		
B30.2	...	...	x	x	x	...	...	...	x	...
B30.3	x	x	18	18	18	15	x	x	x	...
B30.4	15	15	18	18	16	15	16	18	15	...
B30.5	15	15	18	18	16	18	...	...	x	x
B30.6	15	15	18	18	x	...	...	...	Guy rope: 6 Boom pendants: 7	...
B30.7	...	...	...	15	...	...	...	...	...	...
B30.8	15	15	18	18	16	x	...	...	x	...
B30.13	...	...	20	20	...	...	...	...	18	...
B30.14	10	10	10	10	10	...	...	...	...	...
B30.16	...	...	16	18	16	...	...	...	...	...
B30.18	...	...	x	x	x	...	...	...	x	...
B30.19	18	18	18	18	16	18	16	18	x	...
B30.20	In accordance with ASME BTH-1									
B30.21	...	...	x	x	x	...	...	...	...	...
B30.22	...	...	18	18	16	...	...	...	...	15
B30.24	18	15	18	15	x	...	18	15	...	...
B30.26	...	...	...	...	6	...	...	...	...	...
B30.28	...	...	x	x	...	...	...	...	...	...
B30.29	...	...	18	18	16	...	16	18	x	...

GENERAL NOTES:

- (a) An "x" entry in a column indicates D/d ratios are not specified for the application or component.
 (b) A "..." entry in a column indicates D/d ratios are not applicable for the specified application or component.
 (c) For ASME B30.17, refer to ASME B30.16 for sheave and drum requirements. Drums and sheaves are not addressed in volume B30.10, B30.23, B30.25, or B30.27.

30-1.5.4 Replacement Rope

(a) Any deviation from the original size, grade, type, or construction shall be specified by the LHE manufacturer, the rope manufacturer, or a qualified person and shall comply with Section 30-1.4.

(b) Metric-size wire rope shall not be substituted for inch-size wire rope and vice versa without the approval of the LHE manufacturer, the wire rope manufacturer, or a qualified person.

30-1.5.5 Wire Rope Certificate

A wire rope certificate from the rope manufacturer shall be provided with the information listed below as a minimum. The certificate shall be available to the LHE owner and should be available to the operator.

- (a) certificate number
 (b) name and address of original purchaser of wire rope
 (c) date supplied from rope manufacturer
 (d) name and address of the rope manufacturer

(e) number traceable to rope manufacturer's production run

(f) standard under which wire rope was manufactured (e.g., ASTM, ISO, EN)

(g) nominal rope diameter

(h) rope classification (e.g., 6X19, 6X37, 19X19, 35X7)

(i) ASTM A1023 rotation resistance Category 1, 2, or 3 (if applicable)

(j) swivel prohibited or allowed (see para. 30-1.7.1)

(k) wire finish (e.g., bright, galvanized)

(l) rope grade (e.g., IPS, EEIP, 1770, 2160)

(m) rope core (e.g., IWRC, fiber core)

(n) lay direction and lay type (e.g., RRL, RLL, LAL, sZ, zZ)

(o) minimum breaking force (e.g., short tons, pounds, kilonewtons)

(p) approximate weight per foot or meter

NOTE: Other items may be included on the rope certificate at the request of the purchaser (e.g., actual rope diameter at time of manufacture, number of load-bearing wires in outer strands).

SECTION 30-1.6: ENVIRONMENTAL CONDITIONS

30-1.6.1 Temperature

(a) Wire rope exposed to ambient temperatures in excess of 180°F (82°C) shall have an IWRC, WSC, or other temperature-resistant core.

(b) Wire rope shall not be used in environmental conditions where temperature and prolonged exposure cause the rope temperature to exceed 400°F (204°C) or be less than -40°F (-40°C), unless approved by the LHE manufacturer, the wire rope manufacturer, or a qualified person.

(c) Common types of wire rope lubricants may be adversely affected by temperature extremes. For temperatures greater than 160°F (71°C) or less than -20°F (-29°C), the LHE manufacturer, the rope manufacturer, or a qualified person should be consulted for recommended lubricants for these conditions.

30-1.6.2 Chemically Active Environments

The strength of wire rope and wire rope fittings may be degraded by chemically active environments. This includes exposure to chemicals in the form of solids, liquids, gases, vapors, or fumes. The LHE, wire rope, or fitting manufacturer or a qualified person should be consulted before operating in chemically active environments.

SECTION 30-1.7: ROPE-LIFTING COMPONENTS

30-1.7.1 Swivels

Active in-line swivels may be used on Category 1 rotation-resistant rope. Swivels shall not be used with Category 2 or Category 3 rotation-resistant rope or standard rope without the approval of the LHE manufacturer, the rope manufacturer, or a qualified person.

30-1.7.2 Sheaves

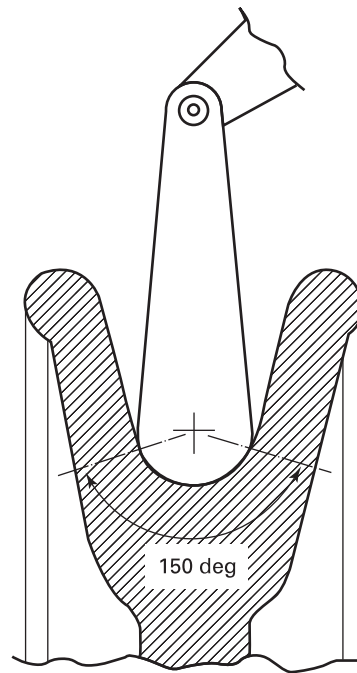
(a) Sheave grooves shall be smooth and free from surface defects that could cause rope damage. The cross-sectional radius at the bottom of the groove should be such as to form a close-fitting saddle for the size of rope used.

(b) The sides of the groove shall be tapered outward and rounded at the rim to facilitate entrance of the rope into the groove. Flange rims shall run true about the axis of rotation.

(c) Groove diameters of new sheaves should be 6% to 10% larger than the nominal rope diameter.

(d) Groove diameters of worn sheaves should not be less than the nominal rope diameter plus 2.5%. Sheaves with grooves worn smaller than the minimum should be replaced or reconditioned.

Figure 30-1.7.2-1 Arc of Contact



(e) The arc of contact of a sheave groove should support the rope between 120 deg and 150 deg (see Figure 30-1.7.2-1).

(f) Sheaves carrying rope that can be momentarily unloaded shall be provided with close-fitting guards, or other devices, to guide the rope back into the groove when the load is reapplied.

(g) Sheaves in the lower load blocks of machines shall be equipped with close-fitting guards, or other devices, that will minimize the possibility of rope becoming fouled.

(h) Recommended maximum fleet angle is 2.5 deg.

30-1.7.3 Drums

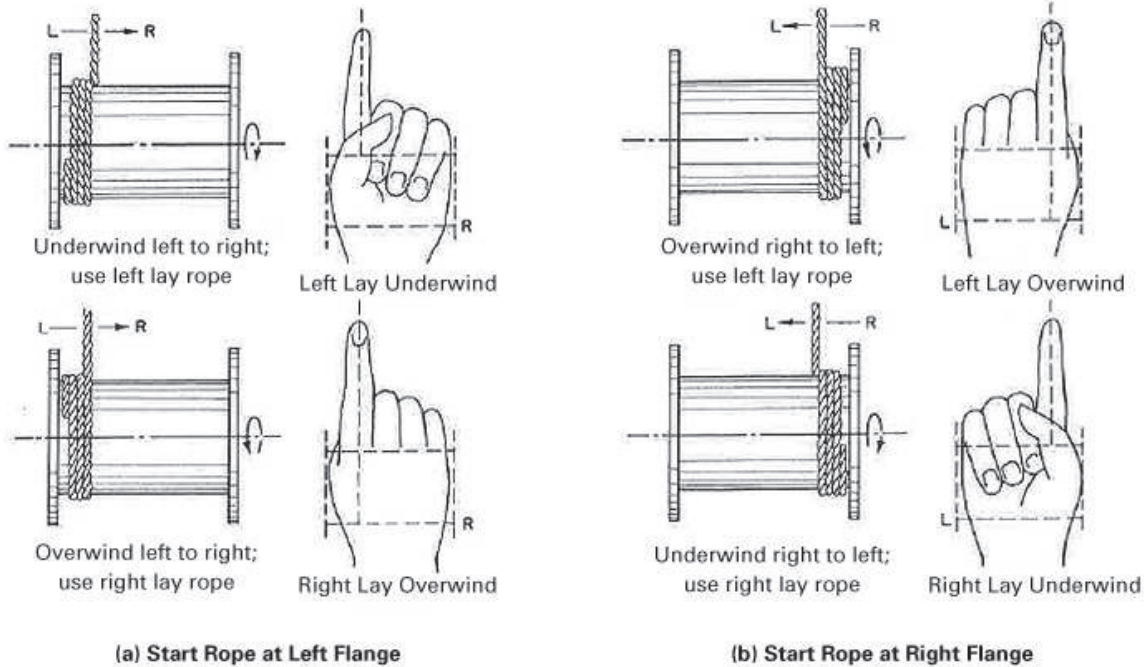
(a) The drum surface shall be free from surface defects that could cause rope damage. When rope drums are grooved, the radius at the bottom of the groove should be such as to form a close-fitting saddle for the size of rope used.

(b) Grooves of new drums should be 6% to 10% larger than the nominal rope diameter.

(c) Drum flanges shall extend a minimum of one-half rope diameter but not less than 0.5 in. (13 mm) above the top layer of rope during operation.

(d) Utilizing a full base layer on a smooth drum may solve multilayer spooling problems because the base layer guides the upper layers of rope.

(e) The pitch of the drum grooves (center-to-center distance between grooves) shall allow adequate room for maximum rope diameter, plus rope ovalization, and maximum fleet angle.

Figure 30-1.7.3-1 Recommended Rope Lays for a Smooth Drum or a Single-Layer Grooved Drum

(f) When the LHE is provided by the manufacturer with a smooth drum or a single-layer grooved drum, recommended rope lays are as follows (also, see Figure 30-1.7.3-1):

- (1) left-handed drum: right lay rope
- (2) right-handed drum: left lay rope

(g) The minimum number of dead wraps of wire rope during normal operation shall be two at each drum termination, unless otherwise specified by the applicable volume or by the LHE manufacturer, the rope manufacturer, or a qualified person.

(h) The recommended fleet angle is as follows:

- (1) smooth drum: 0.5 deg minimum, 1.5 deg maximum
- (2) grooved drum: 0.5 deg minimum, 2.0 deg maximum

30-1.7.4 Rope End Terminations

(a) The connection method and rating efficiency of the drum end termination of the wire rope shall be as specified by the LHE manufacturer, the rope manufacturer, or a qualified person.

(b) When selecting or changing to a new termination, consideration should be given to the effects of the environment, shock loads, load cycle fatigue, physical abuse and wear, and improper alignment. For guidance concerning end terminations, refer to EN 13411-3 through EN-13411-6 and EN-13411-8, or ASME B30.26. The rating efficiency and integrity of the end termination can be affected by the rope diameter, rope

construction, the rope's minimum breaking force, the rope core type, and the type and efficiency of the termination. The end termination at the working end of the wire rope shall be applied as specified and according to the procedures of the LHE manufacturer, the fitting manufacturer, or a qualified person. Wire rope end terminations for use on the working end include, but are not limited to, the following:

- (1) forged-base wire rope clips
- (2) mechanical splice Flemish eye or loop-back swaged eye
- (3) poured socket
- (4) poured button
- (5) swaged socket
- (6) swaged button
- (7) threaded compression fitting
- (8) wedge socket (selection and installation shall comply with ASME B30.26)

(c) Selection of end terminations should be made after consideration for the mating attachment dimensions, required termination efficiency, and environmental conditions.

(d) A hand-tucked eye shall not serve as the end termination for the working end of a wire rope.

(e) If a poured socket is used, the external and/or internal plastic covering of a plastic-coated core and/or a plastic-filled valley wire rope shall be removed in the end termination contact area to ensure positive adhesion of the socketing material to all wires of the rope.

(f) Lubrication removed during the process of adding an end termination shall be replaced in the affected areas of rope.

(g) Swaged sockets shall not be applied to fiber core rope, lang lay rope, or Category 3 rotation-resistant rope.

(h) When an end fitting is to be applied to a used rope, a periodic inspection shall be performed on a length of 60 rope diameters from the rope end to be terminated. This length of rope shall have a diameter equal to or greater than the rope's specified nominal diameter.

(i) When selecting terminations for corrosion-resistant wire rope, consideration should be made for accelerated corrosion rates in some combinations of dissimilar metals.

(j) End terminations shall not be modified without the approval of the fitting manufacturer or LHE manufacturer.

(k) Replacement of field-installed swaged and poured running rope terminations shall be proof tested to a minimum of 95% of the LHE's maximum rated line pull when the termination is installed by a documented procedure. Otherwise, the swaged or poured termination shall be proof tested to 40% of minimum breaking force.

(l) The inspection of end terminations shall be performed in accordance with [Section 30-1.8](#). For wedge socket inspection, refer to ASME B30.26 for removal criteria.

SECTION 30-1.8: ROPE INSPECTION AND REMOVAL CRITERIA, AND RECORDS

30-1.8.1 Inspection

(a) *General.* All inspections shall be performed by a designated person. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard and, if so, what steps need to be taken to address the hazard.

(b) *Frequent*

(1) Running rope in service shall be visually inspected daily, unless a qualified person determines it should be performed more frequently. The visual inspection shall consist of observation of all rope that can reasonably be expected to be in use during the day's operations. The inspector should focus on discovering gross damage that may be an immediate hazard.

(2) Specific types of damage include the following:

- (-a) distortion to the uniform structure of the rope
- (-b) broken wires
- (-c) corrosion
- (-d) gross damage or deterioration of the end connection(s)
- (-e) evidence of heat, electrical, or lightning damage
- (-f) localized change in lubrication condition

(3) When damage is discovered, a qualified person shall inspect the affected section(s) to determine if the rope needs to be removed from service using criteria defined in [para. 30-1.8.2](#).

(c) *Periodic*

(1) The inspection frequency shall be based on such factors as rope life on the particular installation or similar installations, severity of environment, percentage of capacity lifts, frequency rates of operation, and exposure to shock loads. Inspections need not be at equal calendar intervals and should be more frequent as the rope approaches the end of its useful life. Close visual inspection of the entire rope length shall be made to evaluate inspection and removal criteria.

NOTE: Use of nondestructive rope testing should be considered as an additional inspection method.

Periodic inspections shall cover the surface of the entire rope length and focus on uncovering the types of damage listed in (b). No attempt should be made to open the rope. Additionally, sections prone to rapid deterioration, such as the following, require special attention:

(-a) repetitive wear sections, such as the following:

- (-1) flange step-up, crossover, and repetitive pickup points on the drum
- (-2) reverse bends in the reeving system
- (-3) equalizer sheaves
- (-4) end connections
- (-5) sheave/drum groove wear or corrugation

NOTE: If the corrugation pattern is minor and rope performance is acceptable, the wire rope, sheave, or drum may not have to be replaced. However, if the wire rope is developing broken wires or showing signs of distortion, such as waviness, in areas that contact corrugated grooves, then the affected parts should be replaced or remachined.

(-b) known wear areas based on previous experience with the machine being inspected

(-c) locations where rope vibrations are damped, such as the following:

- (-1) sections in contact with equalizer sheaves or other sheaves where rope travel is limited
- (-2) sections of the rope at or near end connections where corroded or broken wires may protrude
- (-3) rope in the bridle reeving in boom hoists
- (-4) repetitive pickup points and crossover and change of layer points at flanges on drums
- (-5) fleeting or deflector sheaves

(2) Unless otherwise specified by the LHE manufacturer, the rope manufacturer, or a qualified person, the periodic inspection shall be performed at intervals according to the rope service descriptions below.

(-a) *Boom Hoist Rope*

- (-1) normal rope service: not to exceed 3 months or 500 hr of rope operation, whichever comes first
- (-2) heavy rope service: not to exceed 2 months or 335 hr of rope operation, whichever comes first

(-3) severe rope service: not to exceed 1 month or 165 hr of rope operation, whichever comes first

(-4) special rope service: less than 165 hr of rope operation

(-b) All Other Rope

(-1) normal rope service: not to exceed 12 months or 2,000 hr of rope operation, whichever comes first

(-2) heavy rope service: not to exceed 6 months or 1,000 hr of rope operation, whichever comes first

(-3) severe rope service: not to exceed 3 months or 500 hr of rope operation, whichever comes first

(-4) special rope service: less than 500 hr of rope operation

Certain types of rope and applications require special attention and may require reduced time intervals between periodic inspections. Examples include rotation-resistant rope (due to its unique construction and susceptibility to damage and increased deterioration when it is used under difficult conditions, such as duty cycle operations), rope operating in chemically active environments, rope other than Category 1 rotation-resistant rope operating with active in-line swivels, and rope operating over synthetic sheaves with single-layer drums [see General Note in [Table 30-1.8.2-1](#)].

(d) *Inspections After Unusual Occurrences.* After an unusual occurrence, such as a lightning strike, abnormal shock load, or overload on a wire rope, the wire rope shall be inspected in accordance with (c) or as determined by a qualified person.

30-1.8.2 Inspection and Removal Criteria

There are no precise rules to determine the exact time for the removal of the rope, since many factors are involved. Once a rope reaches any one of the removal criteria, it shall be replaced before the LHE is returned to service. Specific inspection attributes and removal criteria are as follows:

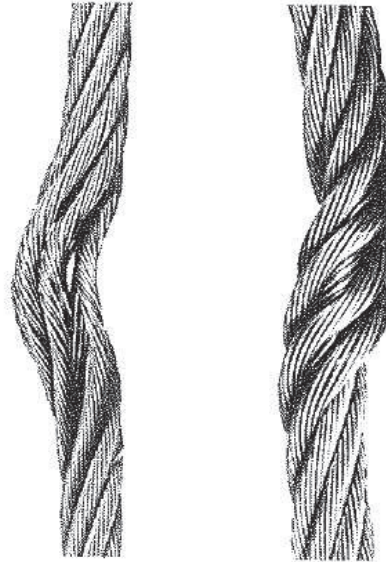
(a) Measure the rope diameter in numerous locations to assess loss of diameter along the entire length of rope. Removal criteria include a reduction from nominal diameter greater than 5% at any location.

NOTE: Loss of diameter in rotation-resistant rope could indicate core failure, and a qualified person shall immediately inspect the affected section(s) to determine if the rope needs to be removed from service. This condition will likely be characterized by lengthening of lay and diameter reduction in localized areas.

(b) *Distortion of Rope Structure.* Distortions of rope structure include kinking, severe doglegs, birdcaging, and crushing (see [Figures 30-1.8.2-1](#) through [30-1.8.2-4](#)).

Removal criteria include steel core protrusion between the outer strands, kinking, severe doglegs (minor doglegs should be noted in inspection documents), and changes in original geometry due to crushing where the minimum dimension across the distorted section is less than or equal to $\frac{5}{6}$ of the nominal diameter.

Figure 30-1.8.2-1 Distortion of Rope Structure — Kink



(c) *Corrosion.* Removal criteria include widespread or localized external corrosion as evidenced by pitting and obvious signs of internal corrosion, such as magnetic debris coming from valleys (see [Figure 30-1.8.2-5](#)).

NOTE: In the early stages, corrosion causes a discoloration of the wires, and, though at this time it does not account for the loss of very much metal, it does detract from the rope's ability to resist abrasion. As corrosion advances, wires become deeply pitted, and their strength is appreciably reduced, abrasion resistance is lowered, and the rope loses much of its flexibility and elasticity.

(d) *Waviness (Corkscrew Effect) of Rope.* Removal criteria include when the overall envelope diameter [see d_1 in [Figure 30-1.8.2-6](#), illustration (c)] has increased to a value greater than 110% of nominal rope diameter, d .

(e) *Heat Damage.* Removal criteria include any apparent damage from a heat source, such as welding, powerline strikes, or lightning (see [Figure 30-1.8.2-7](#)).

(f) *High or Low Strand.* Removal criteria include a high or low strand that is higher or lower than half of the strand diameter above or below the surface of the rope (see [Figure 30-1.8.2-8](#)).

(g) *End Terminations.* Removal criteria include severely corroded, cracked, deformed, worn, grossly damaged, or improperly installed end terminations (see [Figure 30-1.8.2-9](#)).

(h) *Visible Broken Wires.* For removal criteria, see [Table 30-1.8.2-1](#).

30-1.8.3 Rope Not in Regular Use

(a) Wire rope that has been idle for a period of 1 month to 6 months due to shutdown or storage of the machine shall be inspected in accordance with [para. 30-1.8.1\(b\)](#).

Figure 30-1.8.2-2 Distortion of Rope Structure — Dogleg



Figure 30-1.8.2-3 Distortion of Rope Structure — Birdcaging Examples

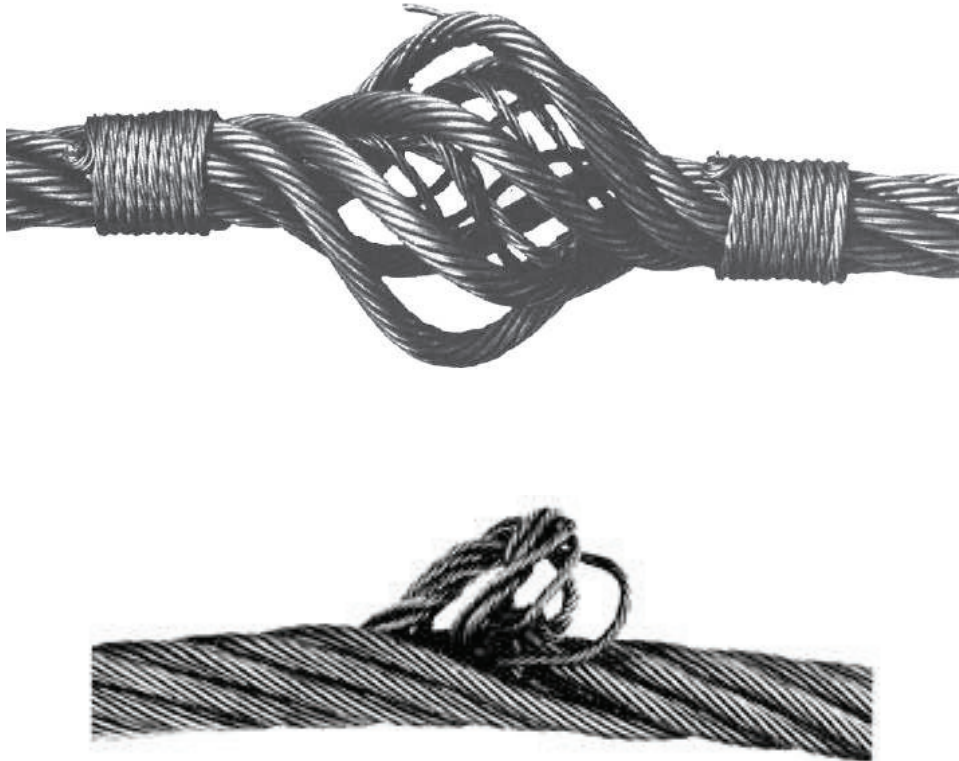


Figure 30-1.8.2-4 Distortion of Rope Structure — Crushing



Figure 30-1.8.2-5 Corrosion



(b) Wire rope that has been idle for a period of over 6 months due to shutdown or storage of the machine shall be inspected in accordance with [para. 30-1.8.1\(c\)](#).

30-1.8.4 Records

- (a) *Frequent Inspections.* No records are required.
- (b) *Periodic Inspections.* To establish a basis for judging the proper time for replacement, a dated report of rope condition at the latest periodic inspection shall be kept on

file. This report shall cover points of deterioration listed in [para. 30-1.8.2](#). If the rope is replaced, only the fact that the rope was replaced needs to be recorded.

(c) *Long-Term Inspection Program.* A long-term inspection program should be established and should include records on the examination of rope removed from service so that a relationship can be established between visual observation and actual condition of the internal structure.

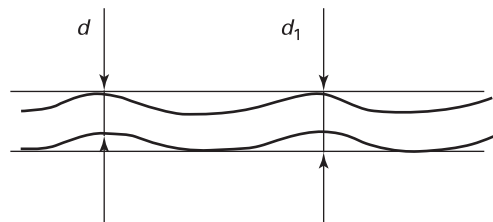
Figure 30-1.8.2-6 Waviness



(a)



(b)



(c)

Figure 30-1.8.2-7 Heat Damage

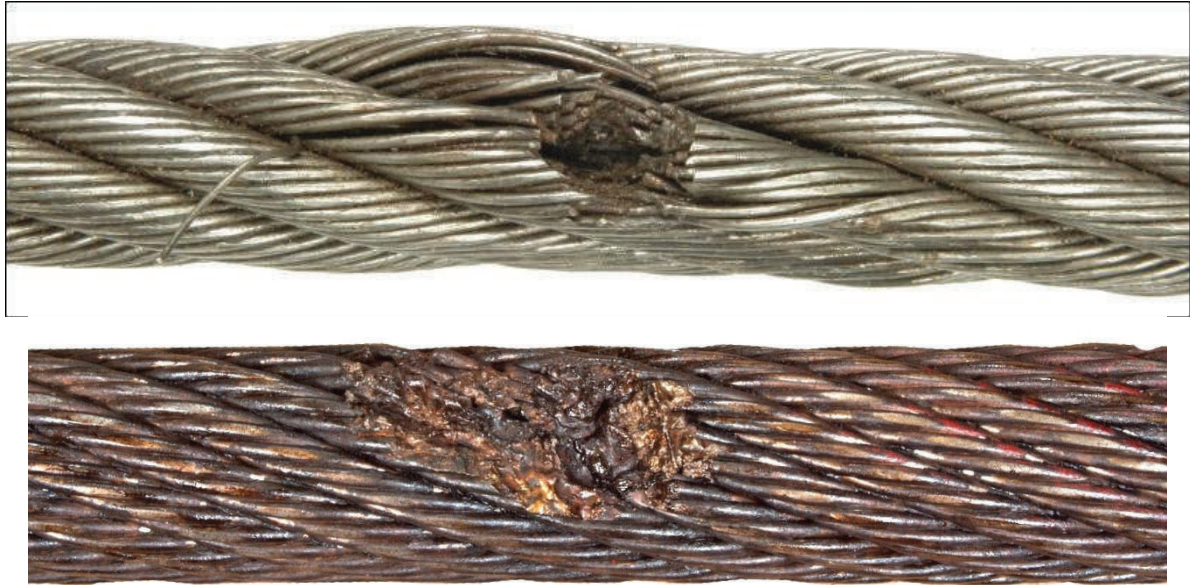


Figure 30-1.8.2-8 High or Low Strand



Figure 30-1.8.2-9 Damaged End Terminations



Table 30-1.8.2-1 Broken Wire Criteria Indicating Rope Removal

Rope Type	Number of Visible Broken Wires Requiring Removal of Rope				
	Over Length of 6 × Nominal Rope Diameter		Over Length of 30 × Nominal Rope Diameter		
	Within a Single Strand	Across All Strands	Across All Strands	Of the Valley Break Type [Note (1)]	At End Termination [Note (2)]
Running rope					
≤6 strands, 19 class	3	6	12	2	2
>6 strands, 19 class	4	8	16	2	2
≤6 strands, 36 class	5	10	20	2	2
>6 strands, 36 class	6	12	24	2	2
Rotation-resistant Category 1	N/A	6	12	2	2
Rotation-resistant Category 2	N/A	2	4	2	2
Rotation-resistant Category 3	N/A	2	4	2	2
Standing rope					
All	...	3	...	...	2

GENERAL NOTE: Broken wire rope-removal criteria cited in this Volume apply to wire rope operating on steel and cast iron sheaves and drums and wire rope operating on multilayer drums, regardless of sheave material. When drum spooling is single layer, synthetic sheaves or sheaves with synthetic linings should not be used because there are no broken wire criteria for this configuration, and internal wire breaks may occur in large numbers before any breaks or signs of substantial wear are visible on the outside wires of the rope.

NOTES:

- (1) If one valley break is detected, sections of rope 30 × nominal rope diameter in length on both sides of the detected valley break should be inspected over a bend. For additional information, see [Figure 30-0.2-7](#).
- (2) Broken wires at end terminations may be eliminated by cutting and reattaching the end termination, if reducing the length is allowable.