ASME B30.30-2019

# Ropes

## Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings



AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: March 4, 2019

The next edition of this Standard is scheduled for publication in 2024. This Standard will become effective 1 year after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME website under the Committee Pages at http://cstools.asme.org/ as they are issued.

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The American Society of Mechanical Engineers
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# FOREWORD

This American National Standard, Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings, has been developed under the procedures accredited by the American National Standards Institute (ANSI). This Standard had its beginning in December 1916, when an eight-page "Code of Safety Standards for Cranes," prepared by The American Society of Mechanical Engineers (ASME) Committee on the Protection of Industrial Workers, was presented at the annual meeting of ASME.

Meetings and discussions regarding safety on cranes, derricks, and hoists were held from 1920 to 1925 involving the ASME Safety Code Correlating Committee, the Association of Iron and Steel Electrical Engineers, the American Museum of Safety, the American Engineering Standards Committee (AESC) [later changed to American Standards Association (ASA), then to the United States of America Standards Institute (USASI), and finally to ANSI], Department of Labor — State of New Jersey, Department of Labor and Industry — State of Pennsylvania, and the Locomotive Crane Manufacturers Association. On June 11, 1925, the AESC approved the ASME Safety Code Correlating Committee's recommendation and authorized the project with the U.S. Department of the Navy, Bureau of Yards and Docks, and ASME as sponsors.

In March 1926, invitations were issued to 50 organizations to appoint representatives to a Sectional Committee. The call for organization of this Sectional Committee was sent out October 2, 1926, and the Committee was organized on November 4, 1926, with 57 members representing 29 national organizations.

Commencing June 1, 1927, and using the eight-page Code published by ASME in 1916 as a basis, the Sectional Committee developed the "Safety Code for Cranes, Derricks, and Hoists." The early drafts of this safety code included requirements for jacks, but due to inputs and comments on those drafts, the Sectional Committee decided in 1938 to make the requirements for jacks a separate code. In January 1943, ASA B30.2-1943 was published addressing a multitude of equipment types, and in August 1943, ASA B30.1-1943 was published addressing only jacks. Both documents were reaffirmed in 1952 and widely accepted as safety standards.

Due to changes in design, advancement in techniques, and general interest of labor and industry in safety, the Sectional Committee, under the joint sponsorship of ASME and the Bureau of Yards and Docks (now the Naval Facilities Engineering Command), was reorganized on January 31, 1962, with 39 members representing 27 national organizations. The new Committee changed the format of ASA B30.2-1943 so that the multitude of equipment types it addressed could be published in separate volumes that could completely cover the construction, installation, inspection, testing, maintenance, and operation of each type of equipment that was included in the scope of ASA B30.2. This format change resulted in B30.3, B30.5, B30.6, B30.11, and B30.16 being initially published as "Revisions" of B30.2, with the remainder of the B30 volumes being published as totally new volumes. ASA changed its name to USASI in 1966 and to ANSI in 1969, which resulted in B30 volumes from 1943 to 1968 being designated as ASA B30, USAS B30, or ANSI B30, depending on their date of publication. In 1982, the Committee was reorganized as an Accredited Organization Committee operating under procedures developed by ASME and accredited by ANSI.

This Standard presents a coordinated set of rules that may serve as a guide to government and other regulatory bodies and municipal authorities responsible for the guarding and inspection of the equipment falling within its scope. The suggestions leading to accident prevention are given both as mandatory and advisory provisions; compliance with both types may be required by employers of their employees. In case of practical difficulties, new developments, or unnecessary hardship, the administrative or regulatory authority may grant variances from the literal requirements or permit the use of other devices or methods, but only when it is clearly evident that an equivalent degree of protection is thereby secured. To secure uniform application and interpretation of this Standard, administrative or regulatory authorities are urged to consult the B30 Committee, in accordance with the format described in Section IX of the B30 Standard Introduction, before rendering decisions on disputed points.

Safety codes and standards are intended to enhance public safety. Revisions result from committee consideration of factors such as technological advances, new data, and changing environmental and industry needs. Revisions do not imply that previous editions were inadequate.

This first edition of B30.30, which was approved by the B30 Committee and ASME, was approved by ANSI and designated an American National Standard on January 29, 2019.

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# Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

(The following is the roster of the Committee at the time of approval of this Standard.)

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# B30 STANDARD INTRODUCTION

## SECTION I: SCOPE

The ASME B30 Standard contains provisions that apply to the construction, installation, operation, inspection, testing, maintenance, and use of cranes and other lifting and material-movement-related equipment. For the convenience of the reader, the Standard has been divided into separate volumes. Each volume has been written under the direction of the ASME B30 Standards Committee and has successfully completed a consensus approval process under the general auspices of the American National Standards Institute (ANSI).

As of the date of issuance of this Volume, the B30 Standard comprises the following volumes:

B30.1 Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries
B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
B30.3 Tower Cranes
B30.4 Portal and Pedestal Cranes
B30.5 Mobile and Locomotive Cranes
B30.6 Derricks
B30.7 Winches
B30.8 Floating Cranes and Floating Derricks
B30.9 Slings
B30.10 Hooks
B30.11 Monorails and Underhung Cranes (withdrawn 2018 — requirements found in latest revision of B30.17)
B30.12 Handling Loads Suspended From Rotorcraft
B30.13 Storage/Retrieval (S/R) Machines and Associated Equipment
B30.14 Side Boom Tractors
B30.15 Mobile Hydraulic Cranes (withdrawn 1982 — requirements found in latest revision of B30.5)
B30.16 Overhead Underhung and Stationary Hoists
B30.17 Cranes and Monorails (With Underhung Trolley or Bridge)
B30.18 Stacker Cranes (Top or Under Running Bridge, Multiple Girder With Top or Under Running Trolley Hoist)
B30.19 Cableways
B30.20 Below-the-Hook Lifting Devices
B30.21 Lever Hoists
B30.22 Articulating Boom Cranes
B30.23 Personnel Lifting Systems
B30.24 Container Cranes
B30.25 Scrap and Material Handlers
B30.26 Rigging Hardware
B30.27 Material Placement Systems
B30.28 Balance Lifting Units
B30.29 Self-Erecting Tower Cranes
B30.30 Ropes
B30.31 Self-Propelled, Towed, or Remote-Controlled Hydraulic Platform Transporters[1]
B30.32 Unmanned Aircraft Systems (UAS) Used in Inspection, Testing, Maintenance, and Lifting Operations[1]

## SECTION II: SCOPE EXCLUSIONS

Any exclusion of, or limitations applicable to, the equipment, requirements, recommendations, or operations contained in this Standard are established in the affected volume's scope.

## SECTION III: PURPOSE

The B30 Standard is intended to

*(a)* prevent or minimize injury to workers, and otherwise provide for the protection of life, limb, and property by prescribing safety requirements

*(b)* provide direction to manufacturers, owners, employers, users, and others concerned with, or responsible for, its application

*(c)* guide governments and other regulatory bodies in the development, promulgation, and enforcement of appropriate safety directives

## SECTION IV: USE BY REGULATORY AGENCIES

These volumes may be adopted in whole or in part for governmental or regulatory use. If adopted for governmental use, the references to other national codes and standards in the specific volumes may be changed to refer to the corresponding regulations of the governmental authorities.

[1] This volume is currently in the development process.

## SECTION V: EFFECTIVE DATE

*(a) Effective Date.* The effective date of this Volume of the B30 Standard shall be 1 yr after its date of issuance. The effective date of any Volume of the B30 Standard that adopts and references this Volume shall be in accordance with the effective-date provisions of that Volume.

*(b) Existing Installations.* Equipment manufactured and facilities constructed prior to the effective date of this Volume of the B30 Standard shall be subject to the inspection, testing, maintenance, and operation requirements of this Standard after the effective date.

It is not the intent of this Volume of the B30 Standard to require retrofitting of existing equipment. However, when an item is being modified, its performance requirements shall be reviewed relative to the requirements within the current volume. The need to meet the current requirements shall be evaluated by a qualified person selected by the owner (user). Recommended changes shall be made by the owner (user) within 1 yr.

## SECTION VI: REQUIREMENTS AND RECOMMENDATIONS

Requirements of this Standard are characterized by use of the word *shall*. Recommendations of this Standard are characterized by the word *should*.

## SECTION VII: USE OF MEASUREMENT UNITS

This Standard contains SI (metric) units as well as U.S. Customary units. The values stated in U.S. Customary units are to be regarded as the standard. The SI units are a direct (soft) conversion from the U.S. Customary units.

## SECTION VIII: REQUESTS FOR REVISION

The B30 Standards Committee will consider requests for revision of any of the volumes within the B30 Standard. Such requests should be directed to

Secretary, B30 Standards Committee
ASME Codes and Standards
Two Park Avenue
New York, NY 10016-5990

Requests should be in the following format:

Volume: Cite the designation and title of the volume.

Edition: Cite the applicable edition of the volume.

Subject: Cite the applicable paragraph number(s) and the relevant heading(s).

Request: Indicate the suggested revision.

Rationale: State the rationale for the suggested revision.

Upon receipt by the Secretary, the request will be forwarded to the relevant B30 Subcommittee for consideration and action. Correspondence will be provided to the requester defining the actions undertaken by the B30 Standards Committee.

## SECTION IX: REQUESTS FOR INTERPRETATION

The B30 Standards Committee will render an interpretation of the provisions of the B30 Standard. An Interpretation Submittal Form is available on ASME's website at http://cstools.asme.org/Interpretation/InterpretationForm.cfm.

Phrase the question as a request for an interpretation of a specific provision suitable for general understanding and use, not as a request for approval of a proprietary design or situation. Plans or drawings that explain the question may be submitted to clarify the question. However, they should not contain any proprietary names or information. Read carefully the note addressing the types of requests that the B30 Standards Committee can and cannot consider.

Upon submittal, the request will be forwarded to the relevant B30 Subcommittee for a draft response, which will then be subject to approval by the B30 Standards Committee prior to its formal issuance. The B30 Standards Committee may rewrite the question for the sake of clarity.

Interpretations to the B30 Standard will be available online at https://cstools.asme.org/Interpretation/SearchInterpretation.cfm.

## SECTION X: ADDITIONAL GUIDANCE

The equipment covered by the B30 Standard is subject to hazards that cannot be abated by mechanical means, but only by the exercise of intelligence, care, and common sense. It is therefore essential to have personnel involved in the use and operation of equipment who are competent, careful, physically and mentally qualified, and trained in the proper operation of the equipment and the handling of loads. Serious hazards include, but are not limited to, improper or inadequate maintenance, overloading, dropping or slipping of the load, obstructing the free passage of the load, and using equipment for a purpose for which it was not intended or designed.

The B30 Standards Committee fully realizes the importance of proper design factors, minimum or maximum dimensions, and other limiting criteria of wire rope or chain and their fastenings, sheaves, sprockets, drums, and similar equipment covered by the Standard, all of which are closely connected with safety. Sizes, strengths, and similar criteria are dependent on many different factors, often varying with the installation and uses. These factors depend on

*(a)* the condition of the equipment or material
*(b)* the loads

(c) the acceleration or speed of the ropes, chains, sheaves, sprockets, or drums

(d) the type of attachments

(e) the number, size, and arrangement of sheaves or other parts

(f) environmental conditions causing corrosion or wear

(g) many variables that must be considered in each individual case

The requirements and recommendations provided in the volumes must be interpreted accordingly, and judgment used in determining their application.

# Chapter 30-0
# Scope, Definitions, Personnel Competence, Translations, and References

## SECTION 30-0.1: SCOPE OF ASME B30.30

Volume B30.30 includes provisions that apply to the construction, selection, installation, attachment, testing, inspection, maintenance, repair, use, and replacement of wire rope, hybrid rope, and synthetic fiber rope and rope-lifting components used in conjunction with equipment addressed in the volumes of the ASME B30 Standard. These provisions apply to a particular volume when B30.30 is referenced and as specified in that volume.

## SECTION 30-0.2: DEFINITIONS

*aramid fiber:* a manufactured, high modulus fiber made from a long-chain synthetic aromatic polyamide in which at least 85% of the amide linkages join two aromatic rings.

*birdcage:* a rope condition that results in deformation with the outer strands being displaced away from the rope axis. It is usually the result of shock loading or localized twisting in a rope (see Figure 30-0.2-1).

*braid:* a rope or textile structure formed by intertwining strands.

*double braid:* a rope constructed from an inner hollow braided rope (core) surrounded by another hollow braided rope (cover) (also known as braid-on-braid or two-in-one braid).

*single braid:* rope structure consisting of multiple strands that may be intertwined in a plain or twill pattern.

*crown break:* a wire break located on the outside of the rope that occurs above the strand-to-strand contact points with both ends visible (see Figure 30-0.2-2).

*D/d ratio:* the ratio of the pitch diameter of the sheave or drum, *D*, to the nominal rope diameter, *d* (see Figure 30-0.2-3).

*denier:* a mass-per-unit-length measure equal to the weight in grams of 9 000 m of the material. Denier is a direct numbering system in which the lower numbers represent the finer sizes and the higher numbers the coarser sizes.

*design factor:* the minimum breaking force of the rope in a rope system divided by the maximum static tension in the rope.

*dogleg, minor:* a bend or deformation exhibiting no associated strand distortion and that cannot be observed while the rope is under tension.

*dogleg, severe:* a permanent, localized, irreparable bend or deformation in a wire rope that restricts the natural adjustment of the rope's components during operation due to strand distortion. It is caused by improper use or handling and results in an indeterminate loss of strength in the rope (see Figure 30-0.2-4).

*fiber core:* a wire rope center component consisting of man-made or natural (vegetable) materials whose purpose is to support the outer strands of the wire rope and is not included as one of the load-bearing components of the wire rope when calculating the minimum breaking force.

*fleet angle:* the angle between the rope's position on a drum or sheave and the line drawn perpendicular to the axis of the drum or sheave through the center of the nearest fixed sheave (see Figure 30-0.2-5).

*groove corrugation:* a repetitive pattern in the groove of a sheave or drum caused by wear at the contact point with each rope strand that may cause rope wear and distortion.

*guy:* a fixed length of strand or rope for stabilizing or maintaining a structure in a fixed position or a constant distance between the two components connected by the rope.

*heavy rope service:* service that involves operating at 85% to 100% of rope rated load or in excess of ten lift cycles per hour as a regular specified procedure.

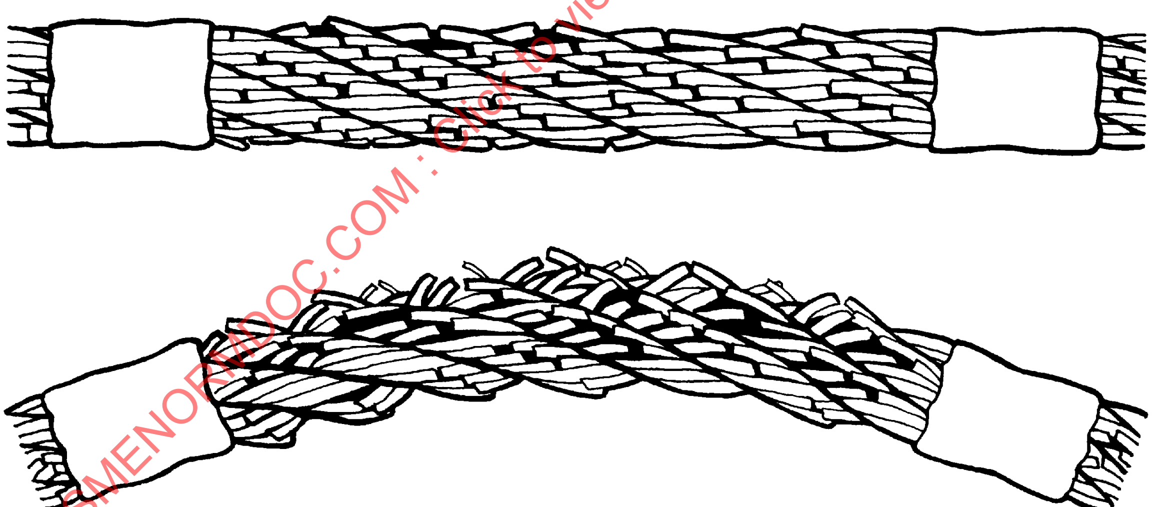
*high modulus polyethylene (HMPE):* a polyolefin fiber produced by gel spinning or solid-state extrusion of an ultra-high-molecular-weight polyethylene (UHMWPE) feedstock to produce extremely high tenacity [also known as extended-chain polyethylene (ECPE) or high-performance polyethylene (HPPE)].

*hours of rope operation:* the actual or estimated operating time of the rope.

*hybrid rope:* a wire rope consisting of both synthetic and steel components. The synthetic components are included as load-bearing components of the rope when calculating its minimum breaking force.

**Figure 30-0.2-1 Birdcage Examples**

**Figure 30-0.2-2 Crown Breaks**





*independent wire rope core (IWRC):* a wire rope used as the axial member of a larger wire rope.

*kink:* a deformation in a wire rope caused by a loop of rope being pulled tight. It represents irreparable damage and an indeterminate loss of strength in the rope.

*lang lay:* a lay type where the wires in the strand are laid in the same direction as the lay of the strands.

*lay length:* the length along a rope for a complete revolution of a single strand in laid, twisted, or braided rope.

*lead line:* the fastest moving section of a rope in a multipart reeving system that pays directly on and off of the drum and to the first sheave.

*linear density:* the mass-per-unit length of a fiber, yarn, or rope.

**Figure 30-0.2-3 *D/d* Ratio**

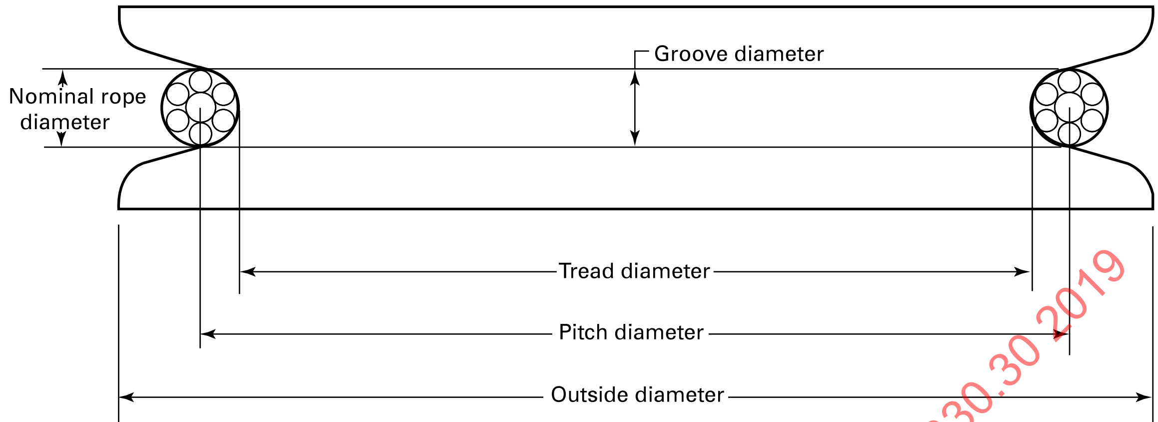
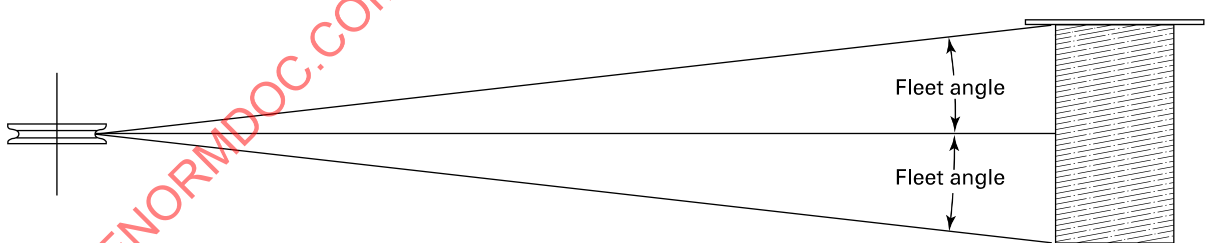



**Figure 30-0.2-4 Dogleg**

**Figure 30-0.2-5 Fleet Angle**




*liquid crystal polyester (LCP):* a thermotropic liquid crystal aromatic polyester fiber produced by melt spinning. It is a high-performance multifilament yarn with high tenacity and modulus (also known as polyester-arylate).

*load-handling equipment (LHE):* equipment used to move a load vertically or horizontally.

*low-torque (reduced-torque) wire rope:* single-layer-stranded wire rope the design of which is intended to reduce load-induced torque without the use of contra-helically laid strand layers.

*minimum breaking force:* the minimum load at which a new and unused rope will break when loaded to destruction in direct tension.

*nonoperating rope:* see *guy*.

*normal rope service:* service that involves operating at less than 85% rated load and not more than ten lift cycles per hour, except for isolated instances.

*nylon:* a manufactured fiber in which the fiber-forming substance (polyamide) is characterized by recurring amide groups (–NH–CO–) as an integral part of the polymer chain.

*para-aramid:* see *aramid fiber*.

*pendant:* see *guy*.

*polyester (PET):* a manufactured fiber in which the fiber-forming substance (polyester) is characterized by a long-chain polymer having 85% by weight of an ester of a substituted aromatic carboxylic acid.

*preformed wire rope:* wire rope in which the strands are permanently formed during fabrication into the helical shape they will assume in the wire rope.

*qualified person:* a person who, by possession of a recognized degree or certificate of professional standing in an applicable field, or who, by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

*rated load:* the maximum allowable force in the rope at the applicable design factor.

*regular lay:* a lay type where the wires in the strand are laid in the opposite direction to the lay of the strands.

*rotation-resistant wire rope:* stranded wire rope consisting of at least two layers of strands where the outer layer of strands is laid opposite to the underlying layer. The design results in a reduction in load-induced torque.

*running rope:* a rope that travels around sheaves or drums (e.g., main, auxiliary, and boom hoist rope).

*severe rope service:* service that involves normal or heavy service with abnormal operating conditions (e.g., corrosive environment, extreme temperatures).

*shall:* a word indicating a requirement.

*should:* a word indicating a recommendation.

*special rope service:* service that involves operation, other than normal, heavy, or severe, that is identified by a qualified person.

*splice:* the joining of two ends of yarn, strand, or cordage by intertwining or inserting these ends into the body of the product. An eye splice may be formed by using a similar process to join one end into the body of the product.

*standard wire rope:* stranded wire rope, the design of which is not intended to reduce load-induced torque (also known as non-rotation-resistant wire rope).

*standing rope:* see *guy*.

*stay rope:* see *guy*.

*strand, fiber:* the largest individual element used in the final synthetic rope-making process and obtained by joining and twisting together several yarns or groups of yarns (see Figure 30-0.2-6).

*strand, wire:* an arrangement of wires laid helically about an axis or another wire or fiber center to produce a symmetrical cross section.

*strength member:* any fiber in a rope construction that supports a portion of the applied load during use.

*structural strand:* a single-strand wire product used in static applications as a structural support member.

*synthetic rope:* a rope made up of synthetic fibers, tapes, or films twisted or braided around an axis (see Figure 30-0.2-6).

*tenacity:* the tensile stress when expressed as force-per-unit linear density of the unstrained specimen (e.g., grams-force per denier or newtons per tex).

*tex:* a unit for expressing linear density, equal to the mass in grams of 1 km of yarn, filament, fiber, or other textile strand.

*torque-neutral synthetic rope:* a rope with construction designed such that, without any externally applied twist distorting the structure, it does not exert torque while under tension.

*track cable:* see *guy*.

*valley break:* a wire break that occurs at or below the strand-to-strand contact points (see Figure 30-0.2-7).

*whipping:* wrapping small-diameter cord or twine around a synthetic fiber rope to prevent the rope from unlaying or unbraiding.

*wire:* a long, slender, pliable, steel component that is typically cylindrical in shape, drawn from rod, and used as smaller load-bearing components of a strand or wire rope.

*wire rope:* a rope made up of steel wire strands helically laid around an axis (see Figure 30-0.2-8).

*wire strand core (WSC):* a wire strand used as the axial member of a wire rope.

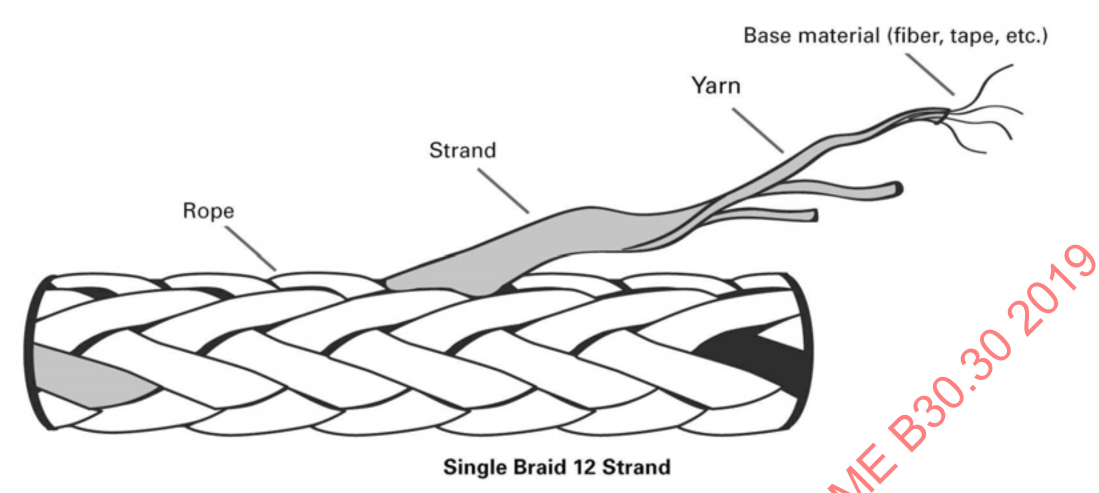
*working end:* the nondrum end of the wire rope.

*yarn:* a generic term for a continuous collection of textile materials (fibers, tapes, etc.) in a form suitable for intertwining to form a textile structure via any one of a number of textile processes (e.g., twisting or braiding) and used as smaller load-bearing components of a strand or synthetic rope (see Figure 30-0.2-6).

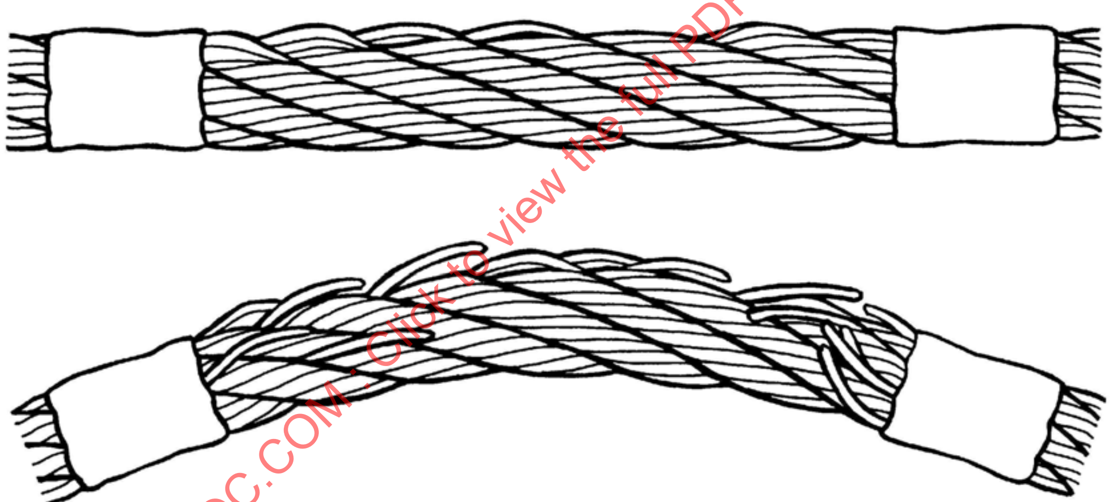
## SECTION 30-0.3: PERSONNEL COMPETENCE

Persons performing the functions identified in this Volume shall, through education, training, experience, skill, and physical fitness, as necessary, be competent and capable to perform the functions as determined by the employer or employer's representative.

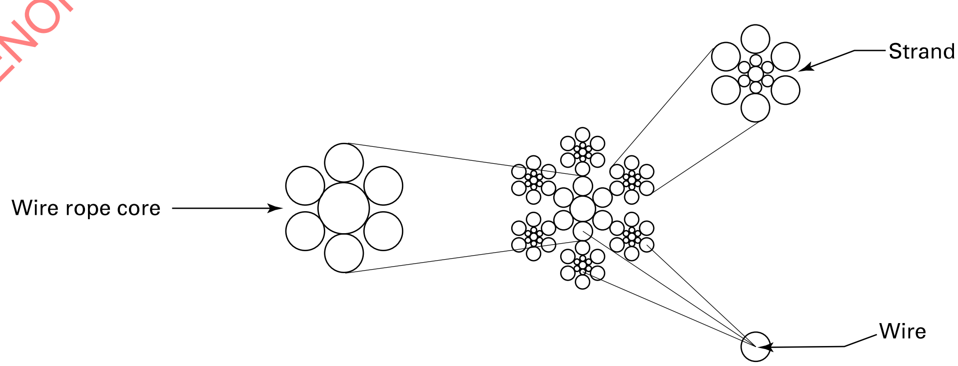
### Figure 30-0.2-6 Synthetic Rope, Strand, and Yarn




### Figure 30-0.2-7 Valley Breaks



### Figure 30-0.2-8 Wire Rope



## SECTION 30-0.4: TRANSLATION OF SAFETY-RELATED INFORMATION

*(a)* Documentation shall be provided in English.

*(1)* The wording of written non-English safety information and manuals regarding use, inspection, and maintenance shall be translated into English by professional translation industry standards, which include, but are not limited to, the following:

*(-a)* translating the complete paragraph message, instead of word by word

*(-b)* ensuring grammatical accuracy

*(-c)* preserving the source document content without omitting or expanding the text

*(-d)* translating the terminology accurately

*(-e)* reflecting the level of sophistication of the original document

*(2)* The finished translation shall be verified for compliance with (1)(-a) through (1)(-e) by a qualified person having an understanding of the technical content of the subject matter.

*(b)* Any non-English documentation provided in addition to the English documentation shall be translated and reviewed in accordance with the requirements listed in (a)(1) and (a)(2).

## SECTION 30-0.5: REFERENCES

ASME B30.26-2015, Rigging Hardware
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

ASTM A931-08(2013), Standard Test Method for Tension Testing of Wire Ropes and Strand
ASTM A1023-15, Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 (www.astm.org)

CI-1500A (2015), Test Methods for Fiber Rope — Physical Properties
CI-1500B (2015), Test Methods for Fiber Rope — Performance Properties
CI-2001 (2004), Fiber Rope Inspection and Retirement Criteria
Publisher: The Cordage Institute (CI), 994 Old Eagle School Road, Wayne, PA 19087 (www.ropecord.com)

EN 13411-3:2004+A1:2008, Terminations for steel wire ropes — Safety — Part 3: Ferrules and ferrule-securing
EN 13411-4:2011, Terminations for steel wire ropes — Safety — Part 4: Metal and resin socketing
EN 13411-5:2003+A1:2008, Terminations for steel wire ropes — Safety — Part 5: U-bolt wire rope grips
EN 13411-6:2004+A1:2008, Terminations for steel wire ropes — Safety — Part 6: Asymmetric wedge socket
EN 13411-8:2011, Terminations for steel wire ropes — Safety — Part 8: Swage terminals and swaging
Publisher: European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium (www.cen.eu)

ISO 2307:2010(E), Fiber Ropes — Determination of certain physical and mechanical properties
ISO 2408:2004, Steel wire ropes for general purposes — Minimum requirements
Publisher: International Organization for Standardization (ISO), Central Secretariat, Chemin de Blandonnet 8, Case Postal 401, 1214 Vernier, Geneva, Switzerland (www.iso.org)

Wire Rope User's Manual, 4th Edition, 2005
Publisher: Wire Rope Technical Board (WRTB), P.O. Box 151387, Alexandria, VA 22315-1387 (www.wireropetechnicalboard.org)

# 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<br>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

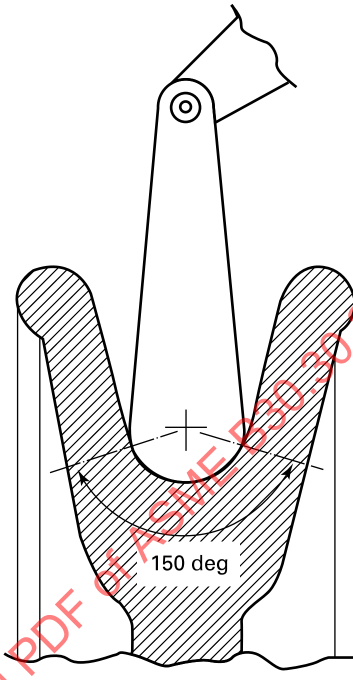
*(a)* Sheave grooves shall be smooth and free from surface defects that could cause rope damage. The cross-sectional radius at the bottom of the groove should be such as to form a close-fitting saddle for the size of rope used.

*(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.

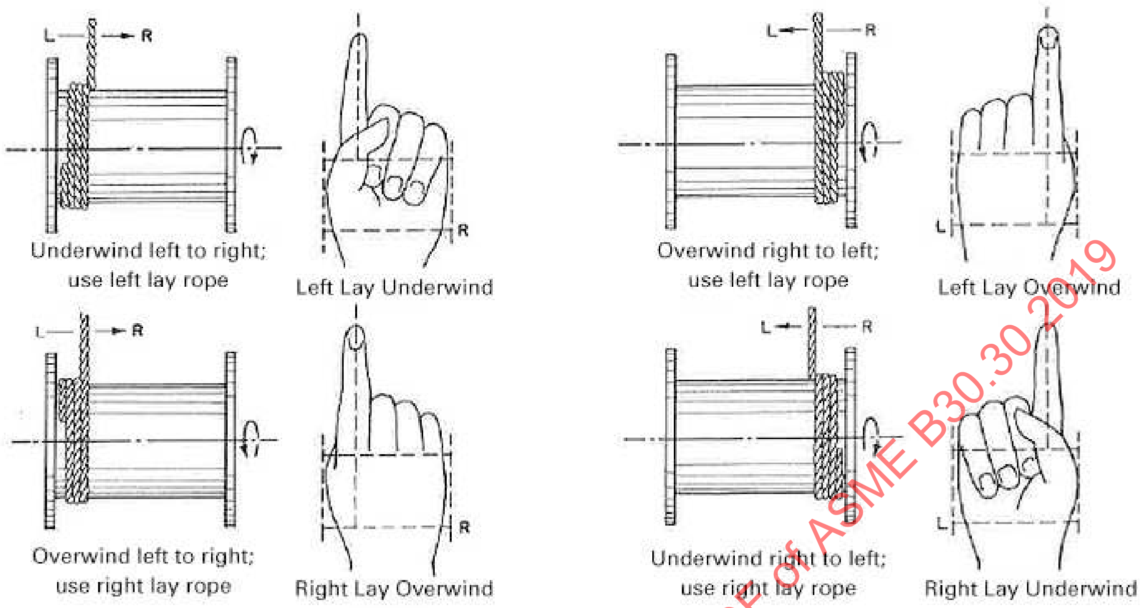
*(b)* Grooves of new drums should be 6% to 10% larger than the nominal rope diameter.

*(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 $^5/_6$ 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**

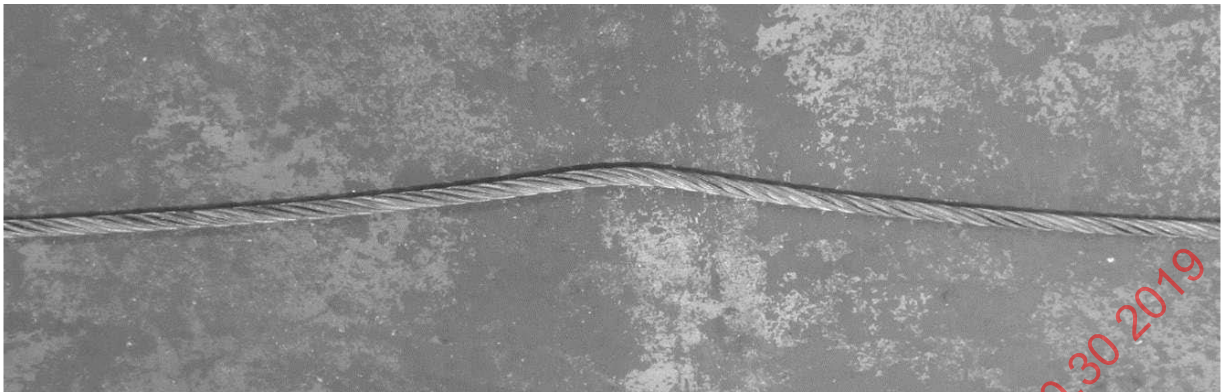


**Figure 30-1.8.2-3 Distortion of Rope Structure — Birdcaging Examples**

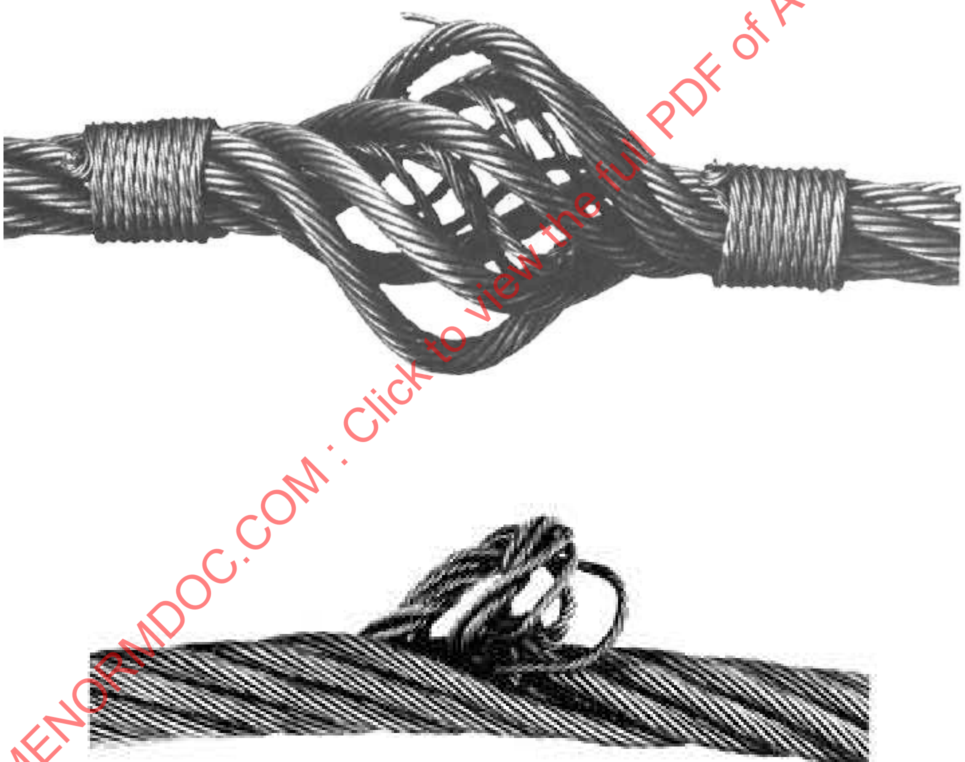


Figure 30-1.8.2-4 Distortion of Rope Structure — Crushing

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.

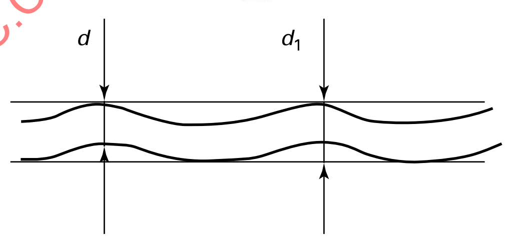
(b) *Periodic Inspections.* To establish a basis for judging the proper time for replacement, a dated report of rope condition at the latest periodic inspection shall be kept on file. This report shall cover points of deterioration listed in para. 30-1.8.2. If the rope is replaced, only the fact that 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**

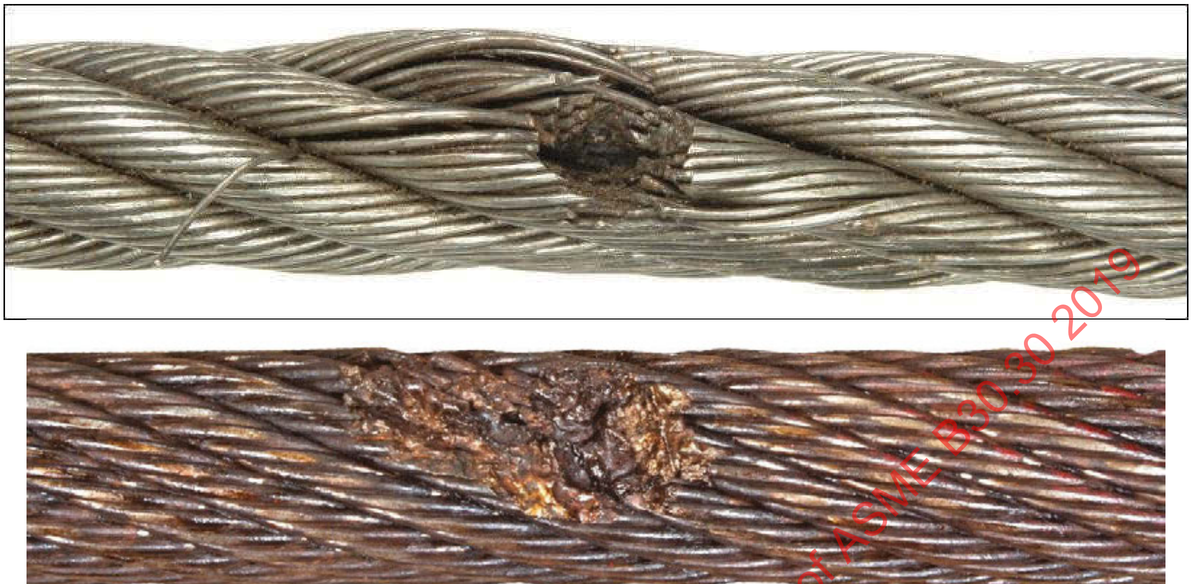


**Figure 30-1.8.2-8 High or Low Strand**

**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.

# Chapter 30-2
# Synthetic Rope

## SECTION 30-2.1: SCOPE

Chapter 30-2 includes provisions that apply to synthetic rope.

## SECTION 30-2.2: TRAINING

Users of synthetic 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 30-2.3: TYPES OF AND MATERIALS USED IN SYNTHETIC ROPE

### 30-2.3.1 Rope Constructions

*(a)* single braid (e.g., 8 strand, 12 strand) (see Figure 30-2.3.1-1)

*(b)* cable-laid (e.g., 3 strand, 4 strand) (see Figure 30-2.3.1-2)

*(c)* jacketed (e.g., double braid, core dependent) (see Figure 30-2.3.1-3)

*(d)* parallel: a collection of multiple rope of one of the above constructions secured into a single structure through the use of an outer sheath (e.g., braided jacket, extruded sheath) (see Figure 30-2.3.1-4)

### 30-2.3.2 High-Performance Synthetic Rope

High-performance synthetic rope has a strength member made up of one or a combination of load-bearing materials with a tenacity greater than 15 g/denier. It may have, size-for-size, breaking force and elongation characteristics similar to wire rope. Examples include, but are not limited to, the following:

*(a)* high modulus polyethylene (HMPE)

*(b)* aromatic polyamide (aramid)

*(c)* liquid crystal polyester (LCP)

### 30-2.3.3 Standard Performance Synthetic Rope

Standard performance synthetic rope has a strength member made up of one or a combination of load-bearing materials with tenacity less than or equal to 15 g/denier. It has, size-for-size, significantly lower breaking force and higher elongation characteristics than high-performance synthetic rope. Examples include, but are not limited to, the following:

*(a)* polyester

*(b)* nylon

### 30-2.3.4 Coatings

Finishes and coatings shall be compatible with the other components and shall not impair the performance of the rope. Changes or additions to the coatings shall be approved by the rope manufacturer or a qualified person.

## SECTION 30-2.4: ROPE SELECTION, MINIMUM BREAKING FORCE, DESIGN FACTORS, AND OTHER REQUIREMENTS

### 30-2.4.1 Selection

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

### 30-2.4.2 Selection Considerations

*(a)* Application considerations such as the following shall be taken into account during rope selection:

*(1)* Loads are not accurately known.

*(2)* Dynamic or shock loads are anticipated.

*(3)* Heavy or severe rope service is likely to occur.

*(4)* Tension is maintained on the rope for extended periods of time.

*(5)* Procedures for operation or use are not well defined and/or controlled.

*(6)* Severe abrasion is likely to occur from exposure to rough surfaces or cutting edges or by contamination from debris and grit.

*(7)* Rope elongation properties are critical to the application as change in rope length under load varies between rope made with different materials.

*(8)* LHE is operated in chemically or environmentally hazardous conditions.

*(b)* The spooling performance of synthetic rope may vary due to the rope type or the configuration of the LHE. For rope stored on drums, the LHE manufacturer or a qualified person should consult with the rope manufacturer to ensure suitable performance in the selected application, with attention paid to the following considerations:

**Figure 30-2.3.1-1 Single Braid**

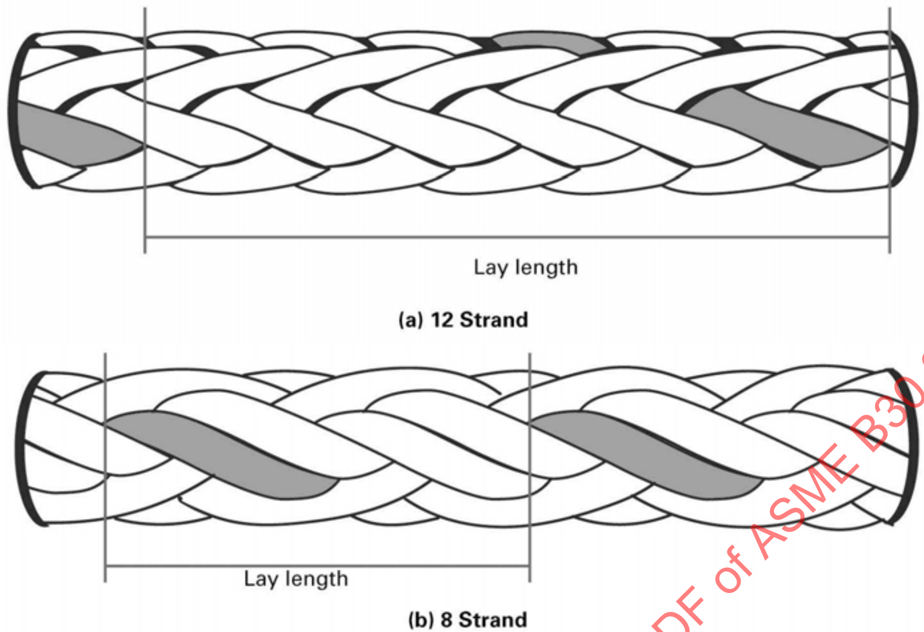
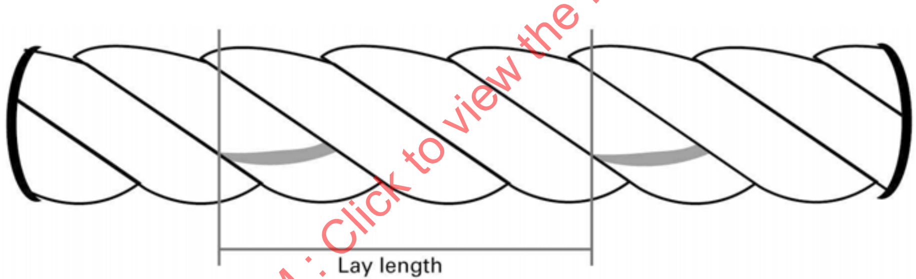



**Figure 30-2.3.1-2 Three-Strand Cable Laid**






*(1)* rope attachment to the drum

*(2)* drum profile (e.g., smooth, spiral, and parallel groove)

*(3)* minimum number of wraps required

*(4)* number of layers required

*(5)* fleet angle

*(6)* loading cycles expected

*(c)* Synthetic rope shall not be used for applications in which there are immediate hazards, such as contact with heat sources in excess of the rope critical temperature limit, welding slag, or edges from surrounding obstructions.

### 30-2.4.3 Minimum Breaking Force

The rope shall meet or exceed the minimum breaking force specified by the rope manufacturer as tested in compliance with ISO 2307 or CI 1500B. The minimum breaking force shall be shown on the synthetic rope certificate.

### 30-2.4.4 Synthetic Rope Design Factors

Unless otherwise specified by the LHE manufacturer, the rope manufacturer, or a qualified person, as a minimum, synthetic rope design factors shall be as shown in the following table:

| Rope Usage | Design Factor |
|---|---|
| Running | 5 |
| Standing | 4 |
| Running, under boom erection conditions | 4 |
| Standing, under boom erection conditions | 3 |
| LHE handling molten metal | Not allowed |