

Chapter 9-2

Wire Rope Slings: Selection, Use, and Maintenance

SECTION 9-2.0: SCOPE

Chapter 9-2 includes provisions that apply to wire rope slings. (See Figures 9-2.0-1 and 9-2.0-2.)

NOTE: Boom pendants are not within the scope of this Chapter.

SECTION 9-2.1: TRAINING

Wire rope sling users shall be trained in the selection, inspection, cautions to personnel, effects of environment, and rigging practices as covered in this Chapter.

SECTION 9-2.2: COMPONENTS

9-2.2.1 Wire Rope

The wire rope shall be manufactured and tested in accordance with ASTM A1023/A1023M and ASTM A586.

(a) Only new or unused wire rope shall be used for fabricating slings covered in this Chapter.

(b) Only regular-lay wire rope shall be used for fabricating slings covered in this Chapter.

(c) Rotation-resistant wire rope shall not be used for fabricating slings covered in this Chapter.

(18) 9-2.2.2 Fittings

(a) Fittings such as sleeves and sockets shall be used in accordance with the component manufacturer's recommendations.

(b) When employed, hooks shall meet the requirements of ASME B30.10.

(c) Welding of handles or any other accessories to end attachments, except covers to thimbles, shall be performed prior to the assembly of the sling.

(d) When employed, rigging hardware shall meet the requirements of ASME B30.26.

(e) Fitting surfaces in contact with the sling shall be finished to remove edges that could damage the sling.

9-2.2.3 Other Components

(18)

Slings that employ wire ropes and fittings, other than those listed in paras. 9-2.2.1 and 9-2.2.2, may be used. When such components are employed, the sling manufacturer or a qualified person shall provide specific data regarding deviations from the applicable section of this Chapter. These slings shall comply with all other requirements of this Chapter.

SECTION 9-2.3: FABRICATION AND CONFIGURATIONS

9-2.3.1 Fabrication

(18)

Methods of fabrication include hand-tucked splicing, turnback eye (return loop), or flemish eye mechanical splicing, and poured or swaged socketing. Mechanical wire rope terminations requiring periodic adjustment to maintain efficiency shall not be used to fabricate slings.

(a) Knots shall not be used to fabricate slings.

(b) Other fabrication methods not covered by this Chapter shall be rated in accordance with the recommendation of the sling manufacturer or a qualified person, and shall conform to all other provisions of this Chapter.

Figure 9-2.0-1 Wire Rope Sling

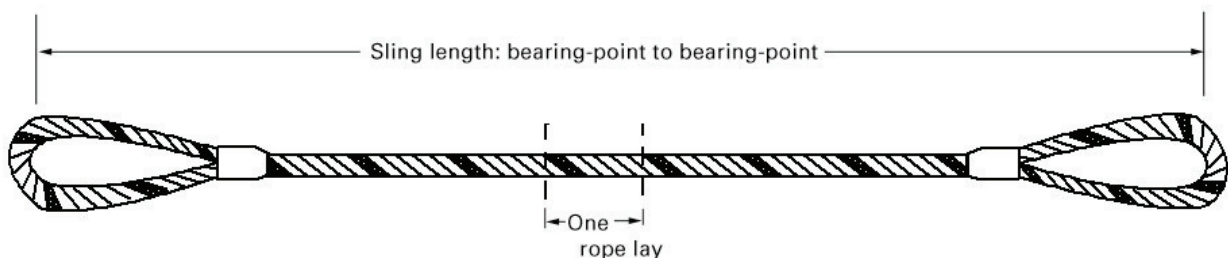
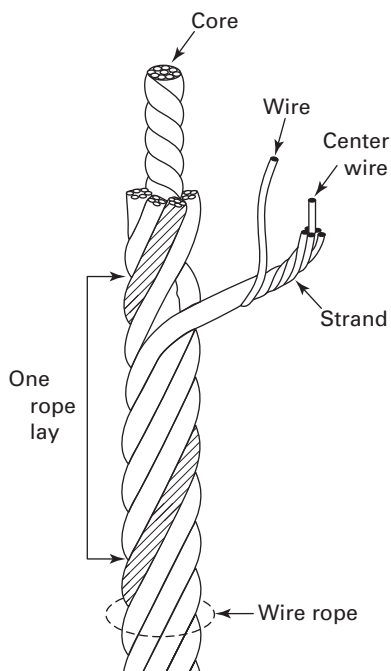


Figure 9-2.0-2 Wire Rope



9-2.3.2 Configurations

(a) Single-leg slings and two-leg, three-leg, and four-leg bridle slings used in straight-line, choker, and basket hitches are covered by this Chapter.

NOTE: A straight-line hitch is commonly referred to as a vertical hitch.

(b) Slings made of rope with 6×19 and 6×36 classification and cable-laid slings shall have a minimum clear length of rope 10 times the rope diameter between splices, sleeves, or end fittings (see Figure 9-2.3.2-1), unless approved by the manufacturer or a qualified person.

(c) Braided slings shall have a minimum clear length of rope 40 times the component rope diameter between the loops or end fittings (see Figure 9-2.3.2-2), unless approved by the manufacturer or a qualified person.

(d) Grommets and endless slings shall have a minimum circumferential length of 96 times the body diameter of the grommet or endless sling unless approved by the manufacturer or a qualified person.

(e) Other configurations may be used. When used, the sling manufacturer or a qualified person shall provide specific data. These slings shall comply with all other requirements of this Chapter.

SECTION 9-2.4: DESIGN FACTOR

The design factor for wire rope slings shall be a minimum of 5.

SECTION 9-2.5: RATED LOAD

(a) The sling manufacturer shall establish the sling's rated load.

(b) At a minimum, the rated load shall be based on the following factors:

- (1) component strength
- (2) number of legs
- (3) design factor
- (4) type of hitch
- (5) angle of loading (see Figure 9-2.5-1)
- (6) fabrication efficiency

SECTION 9-2.6: PROOF TEST REQUIREMENTS

9-2.6.1 General

(a) Prior to initial use, all new swaged socket, poured socket, or turnback swaged eye type slings, and mechanical joint endless wire rope slings shall be proof tested by the sling manufacturer or a qualified person.

(b) Prior to initial use, all wire rope slings incorporating previously used or welded fittings and all repaired slings shall be proof tested by the sling manufacturer or a qualified person.

(c) All other new wire rope slings are not required to be proof tested unless specified by the purchaser.

9-2.6.2 Proof Load Requirements

(a) For single- or multiple-leg slings and endless slings, each leg shall be proof loaded to the following load requirements based on fabrication method.

(1) *Mechanical Splice Slings.* The proof load shall be a minimum of 2 times and a maximum of 2.5 times the single-leg straight-line hitch rated load.

(2) *Swaged Socket and Poured Socket Slings.* The proof load shall be a minimum of 2 times and a maximum of 2.5 times the single-leg straight-line hitch rated load.

(3) *Hand-Tucked Slings.* If proof tested, the proof load shall be a minimum of 1 times and a maximum of 1.25 times the single-leg straight-line hitch rated load.

(b) The proof load for components (fittings) attached to single legs shall be the same as the requirement for single-leg slings in (a).

(c) Master links for two-leg bridle slings shall be proof loaded to a minimum of 4 times the single-leg straight-line hitch rated load.

(d) Master links for three-leg bridle slings shall be proof loaded to a minimum of 6 times the single-leg straight-line hitch rated load.

(e) Master links for four-leg bridle slings shall be proof loaded to a minimum of 8 times the single-leg straight-line hitch rated load.

Figure 9-2.3.2-1 Minimum Sling Length

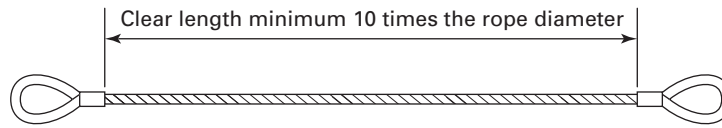


Figure 9-2.3.2-2 Minimum Braided Sling Length

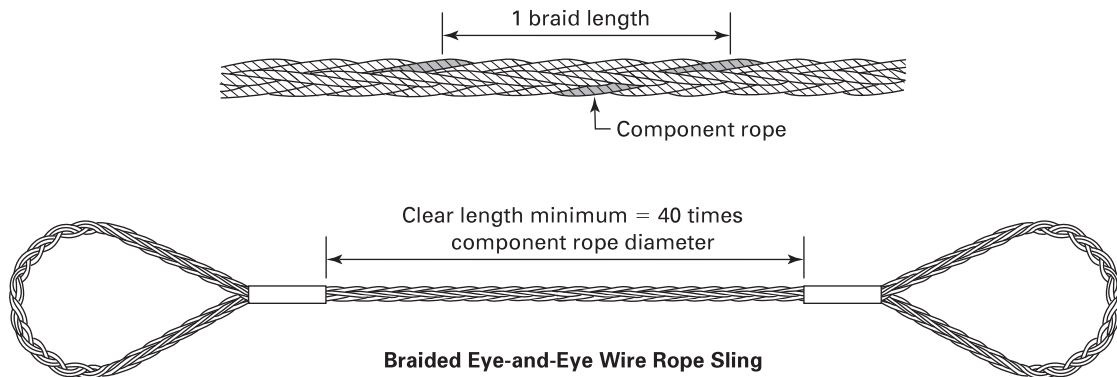
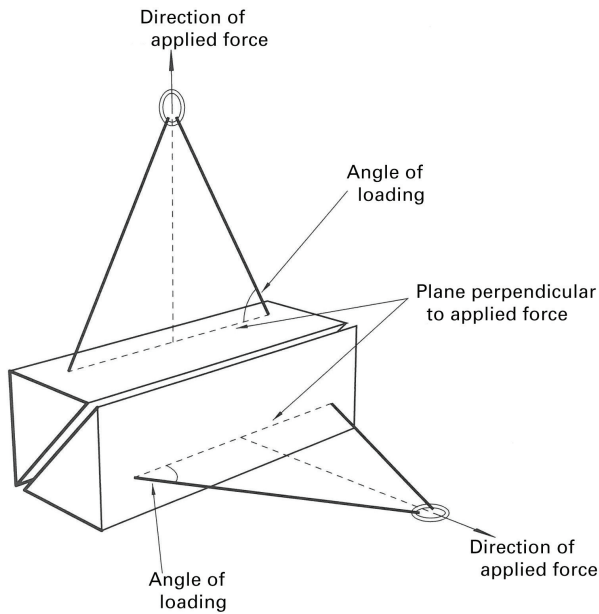


Figure 9-2.5-1 Angle of Loading



SECTION 9-2.7: SLING IDENTIFICATION

9-2.7.1 Identification Requirements

Each sling shall be marked to show

- (a) name or trademark of manufacturer, or if repaired, the entity performing repairs
- (b) rated load for at least one hitch type and the angle upon which it is based
- (c) diameter or size

(d) number of legs, if more than one

9-2.7.2 Initial Sling Identification

Sling identification shall be done by the sling manufacturer.

9-2.7.3 Maintenance of Sling Identification

Sling identification should be maintained by the user so as to be legible during the life of the sling.

9-2.7.4 Replacement of Sling Identification

Replacement of the sling identification shall be considered a repair as specified in [paras. 9-2.9.6\(a\)](#) and [9-2.9.6\(b\)](#). Additional proof testing is not required.

SECTION 9-2.8: EFFECTS OF ENVIRONMENT

9-2.8.1 Temperature

(a) Fiber core wire rope slings of all grades shall not be exposed to temperatures in excess of 180°F (82°C).

(b) When fiber core wire rope slings are to be used at temperatures below -40°F (-40°C), the sling manufacturer should be consulted.

(c) When IWRC wire rope slings are to be used at temperatures above 400°F (204°C) or below -40°F (-40°C), the sling manufacturer should be consulted.

9-2.8.2 Chemically Active Environments

The strength of wire rope slings may be degraded by chemically active environments. This includes exposure to chemicals in the form of solids, liquids, gases, vapors, or

fumes. The sling manufacturer or a qualified person should be consulted before slings are used in chemically active environments.

SECTION 9-2.9: INSPECTION, REMOVAL, AND REPAIR

(18) 9-2.9.1 General

All inspections shall be performed by a designated person. Any deficiency identified shall be examined and a determination made by a qualified person as to whether it constitutes a hazard, and if so, what additional steps need to be taken to address the hazard.

9-2.9.2 Initial Inspection

Prior to use, all new, altered, modified, or repaired slings shall be inspected to verify compliance with the applicable provisions of this Chapter. Written records are not required for initial inspections.

(18) 9-2.9.3 Frequent Inspection

(a) Each shift, before the sling is used, a visual inspection for damage shall be performed. Slings used in severe or special service should be inspected before each use.

(b) Slings found with conditions such as those listed in [para. 9-2.9.5](#) shall be removed from service. Slings shall not be returned to service until approved by a qualified person.

(c) Written records are not required for frequent inspections.

(18) 9-2.9.4 Periodic Inspection

(a) A complete inspection of the sling shall be performed. Inspection shall be conducted on the entire length, including splices and fittings. Slings found with conditions such as those listed in [para. 9-2.9.5](#) shall be removed from service. Slings shall not be returned to service until approved by a qualified person.

(b) *Periodic Inspection Frequency.* Periodic inspection intervals shall not exceed 1 yr [see (d)]. The frequency of periodic inspections should be based on

- (1) frequency of sling use
- (2) severity of service conditions
- (3) nature of load-handling activities
- (4) experience gained on the service life of slings used in similar circumstances

(c) Guidelines for the time intervals are

- (1) normal service — yearly
- (2) severe service — monthly to quarterly
- (3) special service — as recommended by a qualified person

(d) Periodic inspection is not required for a sling that is in storage or idle. However, if more than 1 yr has passed since the last periodic inspection, the sling shall be

inspected in accordance with the requirements listed in (a) and (e) before being placed back into service."

(e) Documentation that the most recent periodic inspection was performed shall be maintained.

(f) Inspection records of individual slings are not required.

9-2.9.5 Removal Criteria

A wire rope sling shall be removed from service if any of the following conditions are present:

(a) missing or illegible sling identification (see [Section 9-2.7](#))

(b) broken wires

(1) for strand-laid and single-part slings, 10 randomly distributed broken wires in one rope lay, or 5 broken wires in one strand in one rope lay (see [Figure 9-2.0-2](#))

(2) for cable-laid slings, 20 broken wires per lay (see [Figure 9-2.9.5-1](#))

(3) for less than eight-part braided slings, 20 broken wires per braid length (see [Figure 9-2.3.2-2](#))

(4) for eight-part or more than eight-part braided slings, 40 broken wires per braid length (see [Figure 9-2.3.2-2](#))

(c) severe localized abrasion or scraping resulting in a reduction from nominal diameter of more than 5%

(d) kinking, crushing, birdcaging, or any other damage resulting in damage to the rope structure

(e) evidence of heat damage

(f) fittings that are cracked, deformed, or worn to the extent that the strength of the sling is substantially affected

(g) severe corrosion of the rope or fittings

(h) for hooks, removal criteria as stated in ASME B30.10

(i) for rigging hardware, removal criteria as stated in ASME B30.26

(j) other conditions, including visible damage, that cause doubt as to the continued use of the sling

9-2.9.6 Repair

(a) Slings shall be repaired only by the sling manufacturer or a qualified person.

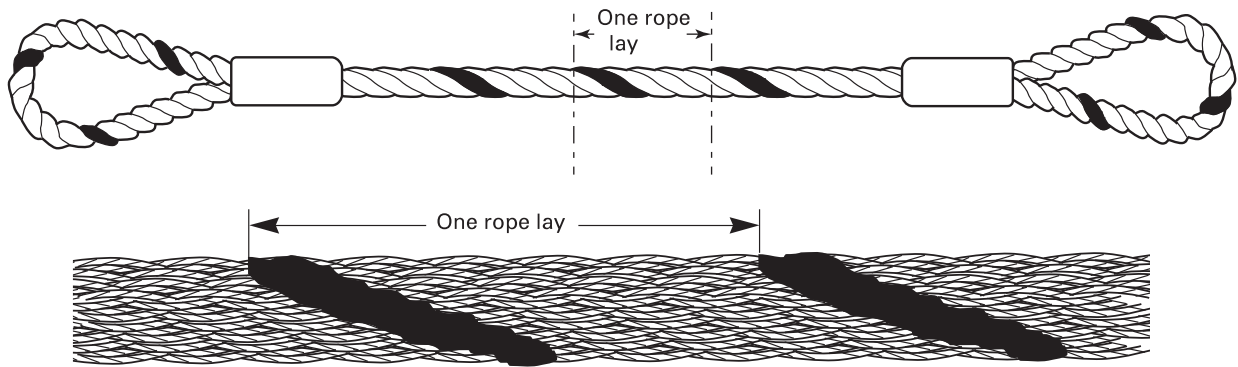
(b) A repaired sling shall be marked to identify the repairing entity per [Section 9-2.7](#).

(c) Components used for sling repair shall comply with the provisions of this Chapter.

(d) Repair of hooks shall be as specified in ASME B30.10. Repair of below-the hook lifting devices shall be as specified in ASME B30.20. Repair of all other components shall be as specified by the sling manufacturer, component manufacturer, or a qualified person.

(e) The wire rope used in the sling shall not be repaired.

(f) Modifications or alterations to a sling shall conform to all repair provisions of this Chapter.

Figure 9-2.9.5-1 Cable-Laid Wire Rope Sling

(g) All repairs shall comply with the proof test requirements of [Section 9-2.6](#).

SECTION 9-2.10: OPERATING PRACTICES

9-2.10.1 Sling Selection

(a) Slings that appear to be damaged shall not be used unless inspected and accepted as usable under [Section 9-2.9](#).

(b) Slings having suitable characteristics for the type of load, hitch, and environment shall be selected in accordance with the requirements of [Sections 9-2.5](#) and [9-2.8](#).

(c) The rated load of the sling shall not be exceeded. When using a multiple-leg sling, no leg shall be loaded beyond its single-leg rating.

(d) When the choker hitch rating is not identified on the sling, the choker hitch rating for single-leg and bridle slings shall be 75% of the sling's straight-line hitch rating (70% for cable-laid slings), unless other ratings are provided by the sling manufacturer or a qualified person. Consult the sling manufacturer or a qualified person for choker hitch ratings for grommets and endless slings.

(e) Rated loads for angles of choke less than 120 deg shall be determined by using the values in [Table 9-2.10.1-1](#), or by consulting the sling manufacturer or a qualified person.

(f) For multiple-leg slings used with nonsymmetrical loads, an analysis by a qualified person should be performed to prevent overloading of any leg.

(g) Multiple-leg slings shall be selected according to the sling's rated load based on the specific angle(s) as stated on the sling's identification. The rated load for use at other angles shall be provided by the sling manufacturer or a qualified person.

(h) When D/d ratios (see [Figure 9-2.10.1-1](#)) smaller than 15/1 for hand-tucked splice type slings and 25/1 for mechanical splice and swaged or poured socket-type slings are used in the body of the sling, the rated load of the sling shall be decreased according to the recommendations of the manufacturer, a qualified person, or

the Wire Rope Sling Users Manual. For other sling types, consult the sling manufacturer for specific data or refer to the Wire Rope Sling Users Manual.

(i) Slings shall not be used at an angle of loading less than 30 deg except as recommended by the sling manufacturer or a qualified person.

(j) When a sling leg is used as a basket hitch with the lower connector (hook) attaching to the master link (upper connector), the basket hitch rating shall be limited to its single-leg rating, unless the master link is rated to accommodate that configuration.

(k) Fittings shall be of a shape and size to ensure that they are properly seated in the hook, shackle, or other load-handling device.

9-2.10.2 Cautions to Personnel

(a) All portions of the human body shall be kept from between the sling and load, and from between the sling and hook, shackle, or other load-handling device.

(b) Personnel should not stand in line with or next to the leg(s) of a sling that is under tension.

(c) Personnel shall not stand or pass under a suspended load.

(d) Personnel shall not ride the sling.

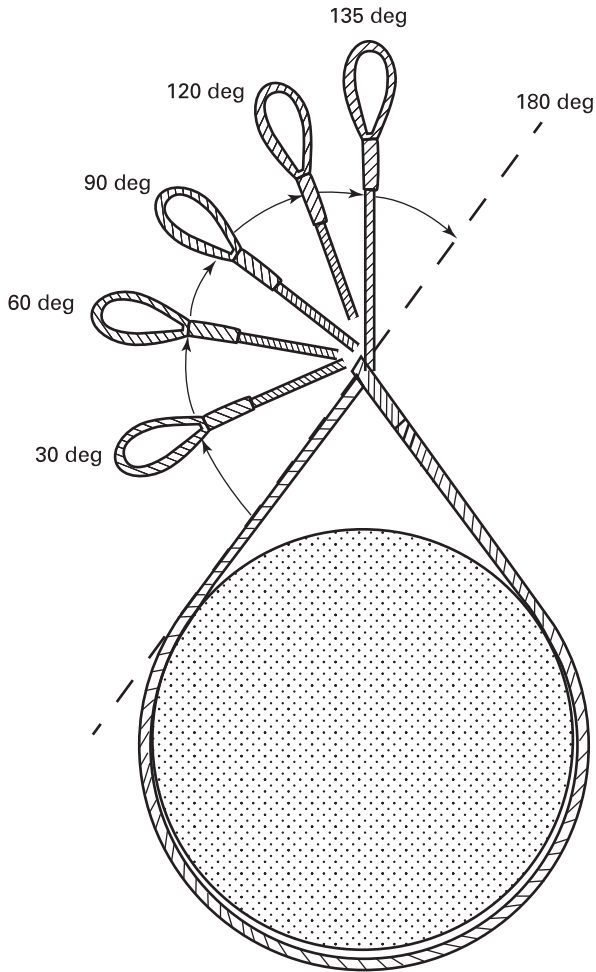
(e) Do not inspect a sling by passing bare hands over the wire rope body. Broken wires, if present, may puncture the hands.

9-2.10.3 Effects of Environment

(a) Slings should be stored in an area where they will not be subjected to mechanical damage, corrosive action, moisture, extreme temperatures, or kinking (see [Section 9-2.8](#)).

(b) Fiber core wire rope slings should not be subjected to degreasing or a solvent because of possible damage to the core.

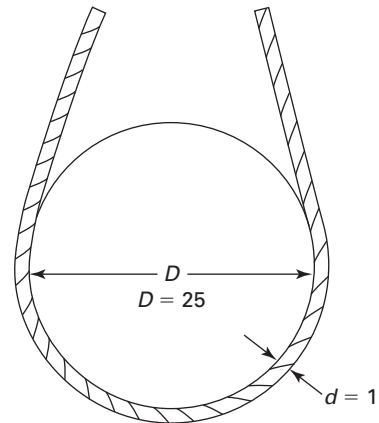
Table 9-2.10.1-1 Angle of Choke: Wire Rope Slings



Angle of Choke, deg	Rated Capacity, % [Note (1)]
Over 120	100
90-120	87
60-89	74
30-59	62
0-29	49

NOTE: (1) Percent of sling rated capacity in a choker hitch.

Figure 9-2.10.1-1 D/d Ratio: Wire Rope Slings



GENERAL NOTE: When D is 25 times the component rope diameter, d , the D/d ratio is expressed as 25/1.

9-2.10.4 Rigging Practices

(18)

(a) Slings shall be shortened or adjusted only by methods approved by the sling manufacturer or a qualified person.

(b) Slings shall not be shortened or lengthened by knotting or twisting, or by wire rope clips.

(c) The sling shall be hitched in a manner providing control of the load.

(d) Slings in contact with edges, corners, or protrusions should be protected with a material of sufficient strength, thickness, and construction to prevent damage to the sling.

(e) Shock loading should be avoided.

(f) Loads should not be rested on the sling.

(g) Slings should not be pulled from under a load when the load is resting on the sling.

(h) Twisting and kinking shall be avoided.

(i) During load-handling activities, with or without load, personnel shall be alert for possible snagging.

(j) When using multiple basket or choker hitches, the load should be rigged to prevent the sling from slipping or sliding along the load.

(k) When lifting with a basket hitch, the legs of the sling should contain or support the load from the sides, above the center of gravity, so that the load remains under control.

(l) Slings should not be dragged on the floor or over an abrasive surface.

(m) In a choker hitch, the choke point should only be on the sling body, not on a splice or fitting.

(n) Slings should not be constricted, bunched, or pinched by the load, hook, or any fitting.

(o) The load applied to the hook should be centered in the base (bowl) of the hook to prevent point loading on the hook, unless the hook is designed for point loading.

(p) An object in the eye of a sling should not be wider than one half the length of the eye nor less than the nominal sling diameter.

(q) When a hand-tucked sling is used, the sling, load, or load-handling device shall be prevented from rotating.