ASME B30.9-2003
(Revision of ASME B30.9-1996)

SLINGS

AN AMERICAN NATIONAL STANDARD



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ASME B30.9-2003

(Revision of ASME B30.9-1996)

SAFETY STANDARD FOR CABLEWAYS, CRANES, DERRICKS, HOISTS, HOOKS, JACKS, AND SLINGS

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The next edition of this Standard is scheduled for publication in 2006. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME Web site under the Committee Pages at http://www.asme.org/codes/ as they are issued, and are also published within this edition of the Standard.

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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 (formerly the United States of America Standards Institute). This Standard had its beginning in December 1916 when an eight-page Code of Safety Standards for Cranes, prepared by an ASME Committee on the Protection of Industrial Workers, was presented to the annual meeting of the 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 (later changed to American Standards Association and subsequently to the USA Standards Institute), 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 American Engineering Standards Committee 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 organized November 4, 1926, with 57 members representing 29 national organizations. The Safety Code for Cranes, Derricks, and Hoists, ASA B30.2-1943, was created from the eight-page document referred to in the first paragraph. This document was reaffirmed in 1952 and widely accepted as a safety standard.

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 Naval Facilities Engineering Command, U.S. Department of the Navy, was reorganized as an American National Standards Committee on January 31, 1962, with 39 members representing 27 national organizations.

The format of the previous code was changed so that separate volumes (each complete as to construction and installation; inspection, testing, and maintenance; and operation) would cover the different types of equipment included in the scope of B30.

In 1982, the Committee was reorganized as an Accredited Organization Committee, operating under procedures developed by ASME and accredited by the American National Standards Institute.

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 III, before rendering decisions on disputed points.

This volume of the Standard, which was approved by the B30 Standards Committee and by ASME, was approved by ANSI and designated as an American National Standard on June 20, 2003.

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.

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Safety Standards 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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SAFETY STANDARD FOR CABLEWAYS, CRANES, DERRICKS, HOISTS, HOOKS, JACKS, AND SLINGS

B30 SERIES INTRODUCTION

GENERAL

This Standard is one of a series of safety standards on various subjects that have been formulated under the general auspices of the American National Standards Institute. One purpose of the Standard is to serve as a guide to governmental authorities having jurisdiction over subjects within the scope of the Standard. It is expected, however, that the Standard will find a major application in industry, serving as a guide to manufacturers, purchasers, and users of the equipment.

For the convenience of the user, the Standard has been divided into separate volumes.

B30.1 Jacks
B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
B30.3 Construction Tower Cranes
B30.4 Portal, Tower, and Pedestal Cranes
B30.5 Mobile and Locomotive Cranes
B30.6 Derricks
B30.7 Base Mounted Drum Hoists
B30.8 Floating Cranes and Floating Derricks
B30.9 Slings
B30.10 Hooks
B30.11 Monorails and Underhung Cranes
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
Note: B30.15-1973 has been withdrawn. The revision of B30.15 is included in the latest edition of B30.5.
B30.16 Overhead Hoists (Underhung)
B30.17 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
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 Manually Lever Operated Hoists
B30.22 Articulating Boom Cranes
B30.23 Personnel Lifting Systems
B30.24 Container Cranes[1]
B30.25 Scrap and Material Handlers
B30.26 Rigging Hardware[1]
B30.27 Material Placement Systems[1]
B30.28 Balance-Lifting Units[1]

If these standards are 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.

The use of cableways, cranes, derricks, hoists, hooks, jacks, and slings is subject to certain hazards that cannot be met 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 safe operation of the equipment and the handling of the loads. Serious hazards are overloading, dropping or slipping of the load caused by improper hitching or slinging, obstructing the free passage of the load, and using equipment for a purpose for which it was not intended or designed.

The Standards Committee fully realizes the importance of proper design factors, minimum or maximum sizes, and other limiting dimensions 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 depend on many different factors, often varying with the installation and uses. These factors depend on the condition of the equipment or material; the loads; the acceleration or speed of the ropes, chains, sheaves, sprockets, or drums; the type of attachments; the number, size, and arrangement of sheaves or other parts; environmental conditions causing corrosion or wear; and many variables that must be considered in each individual case. The rules given in the Standard must be interpreted accordingly, and judgment must be used in determining their application.

The Standards Committee will be glad to receive criticisms of this Standard's requirements and suggestions

[1] B30.24, B30.26, B30.27, and B30.28 are in the developmental stage.

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for its improvement, especially those based on actual experience in application of the rules.

Suggestions for changes to the Standard should be submitted to the Secretary of the B30 Committee, ASME, Three Park Avenue, New York, NY 10016-5990, and should be in accordance with the following format:

(a) Cite the specific paragraph designation of the pertinent volume.

(b) Indicate the suggested change (addition, deletion, revision, etc.).

(c) Briefly state the reason and/or evidence for the suggested change.

(d) Submit suggested changes to more than one paragraph in the order that the paragraphs appear in the volume.

The B30 Committee will consider each suggested change in a timely manner in accordance with its procedures.

SECTION I: SCOPE OF B30 SERIES

This Standard applies to the construction, installation, operation, inspection, and maintenance of jacks; power-operated cranes, monorails, and crane runways; power-operated and manually operated derricks and hoists; lifting devices, hooks, and slings; and cableways.

This Standard does not apply to track and automotive jacks, railway or automobile wrecking cranes, shipboard cranes, shipboard cargo-handling equipment, well-drilling derricks, skip hoists, mine hoists, truck body hoists, car or barge pullers, conveyors, excavating equipment, or equipment falling within the scope of the following Committees: A10, A17, A90, A92, A120, B20, B56, and B77.

SECTION II: PURPOSE

This Standard is designed to

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

(b) provide direction to owners, employers, supervisors, 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 III: INTERPRETATIONS

Upon request, the B30 Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B30 Committee, ASME, Three Park Avenue, New York, NY 10016-5990.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his request utilizing the following format.

Subject: Cite the applicable paragraph number(s) and provide a concise description.

Edition: Cite the applicable edition of the pertinent volume for which the interpretation is being requested.

Question: Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain any proprietary names or information.

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which could change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

SECTION IV: NEW AND EXISTING INSTALLATIONS

(a) Effective Date. The effective date of this volume for the purpose of defining new and existing installations shall be 1 year after its date of issuance.

(b) New Installations. Construction, installation, inspection, testing, maintenance, and operation of equipment manufactured and facilities constructed after the effective date of this volume shall conform to the mandatory requirements of this volume.

(c) Existing Installations. Inspection, testing, maintenance, and operation of equipment manufactured and facilities constructed prior to the effective date of this volume shall be done, as applicable, in accordance with the requirements of this volume.

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

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SECTION V: MANDATORY AND ADVISORY RULES

Mandatory rules of this volume are characterized by use of the word *shall.* If a provision is of an advisory nature, it is indicated by use of the word *should* and is a recommendation to be considered, the advisability of which depends on the facts in each situation.

SECTION VI: METRIC CONVERSIONS

The values stated in U.S. Customary units are to be regarded as the standard.

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SLINGS

Chapter 9-0
Scope, Definitions, and References

SECTION 9-0.1: SCOPE OF ASME B30.9

Volume B30.9 includes provisions that apply to the fabrication, attachment, use, inspection, and maintenance of slings used for lifting purposes, used in conjunction with equipment described in other volumes of the B30 Standard, except B30.1 and except as specified in B30.12 and B30.23. Slings are not mentioned in B30.1 and are restricted by certain provisions in B30.12 and B30.23. Slings fabricated from alloy steel chain, wire rope, metal mesh, synthetic fiber rope, synthetic webbing, and synthetic fiber yarns in a protective cover(s) are addressed. Slings fabricated from other materials or constructions other than those detailed in this volume shall be used only in accordance with the recommendations of the sling manufacturer or a qualified person.

SECTION 9-0.2: DEFINITIONS

abnormal operating conditions: environmental conditions that are unfavorable, harmful, or detrimental to or for the operation of a sling, such as excessively high or low ambient temperatures; exposure to weather; corrosive fumes; dust laden or moisture laden atmospheres; and hazardous locations.

abrasion: the mechanical wearing of a surface resulting from frictional contact with other materials or objects.

angle of choke: angle formed in a sling body as it passes through the choking eye or fittings.

angle of loading: the acute angle between horizontal and the leg of the rigging, often referred to as horizontal angle.

assembly: a synonym for sling, see *sling*.

authorized: approved by a duly constituted administrative or regulatory authority.

body (sling): that part of a sling between the eyes, end fittings or loop eyes.

braided wire rope: a rope formed by plaiting component wire ropes.

braided wire rope sling: a sling made from braided rope.

bridle sling: a sling composed of multiple legs with the top ends gathered in a fitting that goes over the lifting hook.

cable-laid rope: a cable composed of six wire ropes laid as strands around a wire rope core.

cable-laid rope sling, mechanical joint: a wire rope sling made from a cable laid wire rope with eyes fabricated by swaging one of more metal sleeves over the rope junction.

component: see *fitting*.

cross rod: a wire used to join spirals of metal mesh to form the complete fabric.

D/d ratio: the relationship between the curvative upon which the sling is used (D) and the nominal sling diameter (d).

design factor: ratio between nominal or minimum breaking strength and rated load of the sling.

designated person: selected or assigned by the employer or employer's representative as being competent to perform specific duties.

end fitting: terminal hardware on the end of a sling. See *sling*.

endless and grommet wire rope slings:

cable-laid endless sling, mechanical joint: a wire rope sling made endless from one continuous length of cable laid rope with the ends joined by one or more metallic fittings.

cable-laid grommet, hand-tucked: an endless wire rope sling made from one continuous length of rope formed to make a body composed of six ropes around a rope core. The rope ends are tucked into the body, thus forming the core. No sleeves are used.

strand-laid endless sling, mechanical joint: a wire rope sling from one continuous length of wire rope with the ends joined by one or more metallic fittings.

strand-laid grommet, hand-tucked: an endless wire rope sling made from one continous length of strand formed to make a six-strand rope with a strand core. The strand ends are hand tucked into the body. No sleeves are used.

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eye opening: the opening in the end of a sling for the attachment of the hook, shackle, or other lifting device or the load itself.

fabric (metal mesh): the flexible portion of the sling exclusive of end fittings consisting of a series of transverse spirals and cross rods.

fabric length (metal mesh): the distance of metal mesh between the end fittings.

fabric thickness (metal mesh): the fabric thickness shall be the nominal overall thickness of the spirals.

fabrication efficiency: the sling assembly strength, as a percentage of the material strength prior to fabrication.

fitting: hardware on the end of a sling.

grommet sling: a variety of an endless sling.

hitch (hitched): a method of rigging (attaching) a sling temporarily to a load or object for the purpose of lifting.

hitch, basket: a method of rigging a sling in which the sling is passed around the load and both loop eyes or end fittings are attached to the lifting device.

hitch, choker: a method of rigging a sling in which the sling is passed around the load, then through one loop eye, end fitting, or other device, with the other loop eye or end fitting attached to the lifting device. This hitch can be done with a sliding choker hook or similar device.

hitch, vertical: a method of rigging a sling in which the load is attached to the loop eye or end fitting at one end of the sling and the loop eye or end fitting at the other end is attached to the lifting device. Any hitch less than 5 deg from the vertical may be considered a vertical hitch.

length, sling: the distance between the extreme bearing points of the sling.

single-leg slings without end fittings: measured from pull to pull or from bearing to bearing of eyes.

single-leg slings with end fittings: measured from pull to pull of end fittings or eyes.

multiple-leg wire rope slings: same as sling length above, except the gathering ring, master link, or similar fitting is not included in the length dimension.

link, master: forged or welded steel link used to support all members (legs) of an alloy steel chain or wire rope sling.

link, master coupling: alloy steel welded coupling link used as an intermediate link to join alloy steel chain to master links.

link, mechanical coupling (alloy steel chain): a nonwelded, mechanically closed link used primarily to attach fittings to alloy steel chain.

loop eye (web sling): a length of webbing that has been folded back upon itself, forming an opening, and joined to the sling body to form a bearing surface.

ply: a layer of load bearing webbing used in a web sling assembly.

proof load: the specific load applied in performance of the proof tests.

proof test: a nondestructive load test made to a specific multiple of the rated load of the sling.

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 working load established by the sling manufacturer. The terms "rated capacity" and "working load limit" are commonly used to describe rated load.

reach (alloy steel chain): see *length, sling.*

selvage edge: the woven or knitted edge of synthetic webbing so formed as to prevent raveling.

shock load: any condition of rapid lift, sudden shifting of load, or arrest of a falling load.

sling: an assembly to be used for lifting when connected to a lifting mechanism. The upper portion of the sling is connected to the lifting mechanism and the lower supports the load, as described in this volume.

sling body: see *body (sling).*

sling manufacturer (fabricator): a person or company assembling or fabricating sling components into their final form. The sling manufacturer and the manufacturer of the sling material may or may not be identical.

sling service:

normal: service that involves use of loads within the rated load.

severe: service that involves normal service coupled with abnormal operating conditions.

special or infrequent: service that involves operation, other than normal or severe, which is approved by a qualified person.

socket, poured: fitting into which a wire rope can be inserted and then permanently attached by filling the cavity into which the wire rope was inserted with special molten metal or resin materials. This method requires special fittings, materials, techniques, and equipment to produce an end termination to meet the requirements of this Standard.

socket, swaged: fitting into which a wire rope can be inserted and then permanently attached by mechanical compression applied to the shank that enclosed the rope. This method requires special fittings and equipment to produce an end termination to meet the requirements of this Standard.

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spiral: a single transverse coil that is the basic element from which metal mesh is fabricated.

splice (web sling): that part of a sling that is lapped and secured to become an integral part of the sling.

assembly splice (web sling): any splice that joins two or more parts of the sling without bearing any of the applied load.

load bearing splice (web sling): that part of a sling that is lapped and secured to become an integral load bearing part of the sling.

splice, hand tucked (wire rope): a loop or eye formed in the end of a rope by tucking the end of the strands back into the main body of the rope in a prescribed manner.

splice, mechanical (wire rope): swaging one or more metal sleeves over the wire rope to form a loop or eye.

splice, flemish eye (wire rope): mechanical splice formed by opening the rope up in a specific manner and reforming it to create a loop or eye. A metal sleeve is slipped over the ends of the splice and mechanically compressed to secure the ends. This method requires special fittings, techniques, and equipment to produce an end termination to meet the requirements of this Standard.

splice, turn back or returned loop (wire rope): mechanical splice in which the rope is looped back on itself and secured with one or more metal sleeves. This method requires special fittings, techniques, and equipment to produce an end termination to meet the requirements of this Standard.

strand laid rope: a wire rope made with strands (usually six to eight) formed around a fiber core, wire strand core, or independent wire rope core (IWRC).

strength (wire rope), minimum breaking: load at which a new and unused wire rope or structural strand could be expected to break when loaded to destruction in direct tension.

triangle choker fitting: an end fitting for metal mesh or synthetic web slings; similar to the *triangle fitting*, except that it also has a transverse slot through which a triangle fitting can be passed to facilitate a choker hitch on the load.

triangle fitting: an end fitting for metal mesh or synthetic web slings, containing a single eye opening for connecting the sling to the lifting device.

yarn: a generic term for a continuous strand of fibers.

SECTION 9-0.3: REFERENCES TO OTHER PUBLICATIONS

Within the text, references are made to the following publications, copies of which may be obtained from the publishers indicated.

ASME B30.10-1999, Hooks
ASME B30.12-1992, Handling Loads Suspended from Rotorcraft

Publisher: The American Society of Mechanical Engineers (ASME International), Three Park Avenue, New York, NY 10016-5990; ASME Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300

ASTM A 391/A 391M-98, Standard Specification for Grade 80 Alloy Steel Chain
ASTM A 906/A 906M-99, Standard Specification for Grade 80 and Grade 100 Alloy Steel Chain Slings for Overhead Lifting
ASTM A 952/A 952M-98, Standard Specification for Forged Grade 80 and Grade 100 Steel Lifting Components and Welded Attached Links
ASTM A 973/A 973M-97, Standard Specification for Grade 100 Alloy Steel Chain

Publisher: American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959

CI 1301-96, Polypropylene Fiber Rope, 3-Strand and 8-Strand Construction
CI 1303-96, Nylon (Polyamide) Fiber Rope, 3-Strand and 8-Strand Construction
CI 1304-96, Polyester (PET) Fiber Rope, 3-Strand and 8-Strand Construction
CI 1305-96, Single Braided Polyester Fiber Rope, 12-Strand Braid Construction
CI 1306-96, Nylon (Polyamide) Fiber Rope, Double Braid Construction
CI 1307-96, Polyester (PET) Fiber Rope, Double Braid Construction

Publisher: Cordage Institute (CI), 994 Old Eagle School Road, Suite 1019, Wayne, PA 19087-1802

Federal Specification RR-W-410, Wire Rope and Strand

Publisher: U.S. Government Printing Office, Washington, DC 20402

WRTB Wire Rope Sling Users Manual, 2nd Edition

Publisher: Wire Rope Technical Board (WRTB), 44 South Carriage Drive, St. Joseph, MO 64506-1233

WSTDA-RS-1, Recommended Standard Specification for Synthetic Polyester Roundslings
WSTDA-TH-1, Recommended Standard Specification for Synthetic Thread
WSTDA-WB-1, Recommended Standard Specification for Synthetic Webbing for Slings
WSTDA-WS-1, Recommended Standard Specification for Synthetic Web Slings

Publisher: Web Sling & Tie Down Association (WSTDA), 2105 Laurel Bush Road, Suite 200, Bel Air, MD 21015

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Chapter 9-1
Alloy Steel Chain Slings: Selection, Use, and Maintenance

SECTION 9-1.0: SCOPE

This Chapter applies to the selection, use, and maintenance of slings, for lifting purposes, fabricated from alloy steel chain (see Fig. 1).

SECTION 9-1.1: TRAINING

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

SECTION 9-1.2: MATERIALS AND COMPONENTS

9-1.2.1 Alloy Chain

The alloy steel chain shall be manufactured and tested in accordance with ASTM A 391/A 391M for Grade 80 chain and ASTM A 973/A 973M for Grade 100 chain.

9-1.2.2 Components

(a) Components for alloy steel chain slings shall be manufactured and tested in accordance with ASTM A 952/A 952M.

(b) Makeshift fasteners, hooks, or links formed from bolts, rods, etc., or other such components shall not be used.

(c) Where used, handles shall be welded to the master link or hook prior to heat treating according to the recommendations of the sling manufacturer or a qualified person.

(d) Hook characteristics shall meet the requirements of ASME B30.10.

9-1.2.3 Other Materials and Components

Chain or components other than those listed in paras. 9-1.2.1 and 9-1.2.2 may be used. When such materials are used, the sling manufacturer or a qualified person shall provide specific data. These slings shall comply with all other requirements of this Chapter.

SECTION 9-1.3: FABRICATION AND CONFIGURATIONS

9-1.3.1 Fabrication

(a) Grade 80 and Grade 100 alloy steel chain slings shall be fabricated in accordance with ASTM A 906/A 906M.

(b) Mechanical coupling links shall not be used within the body of an alloy chain sling to connect two pieces of chain.

9-1.3.2 Configurations

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

(b) 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 9-1.4: DESIGN FACTOR

The design factor for alloy steel chain slings shall be a minimum of 4.

SECTION 9-1.5: RATED LOADS

The term *working load limit* is commonly used to describe rated load.

9-1.5.1

These rated loads are based on the following factors:
(a) material strength(s)
(b) design factor
(c) type of hitch (see Fig. 1)
(d) angle of loading (see Fig. 1)

9-1.5.2

Tables 1 and 2 show rated loads for single-leg vertical, choker, basket hitches, and bridle slings for specific grades of chain. For angles other than those shown in these tables, use the rated load for the next lower angle, or a qualified person shall calculate the rated load.

9-1.5.3

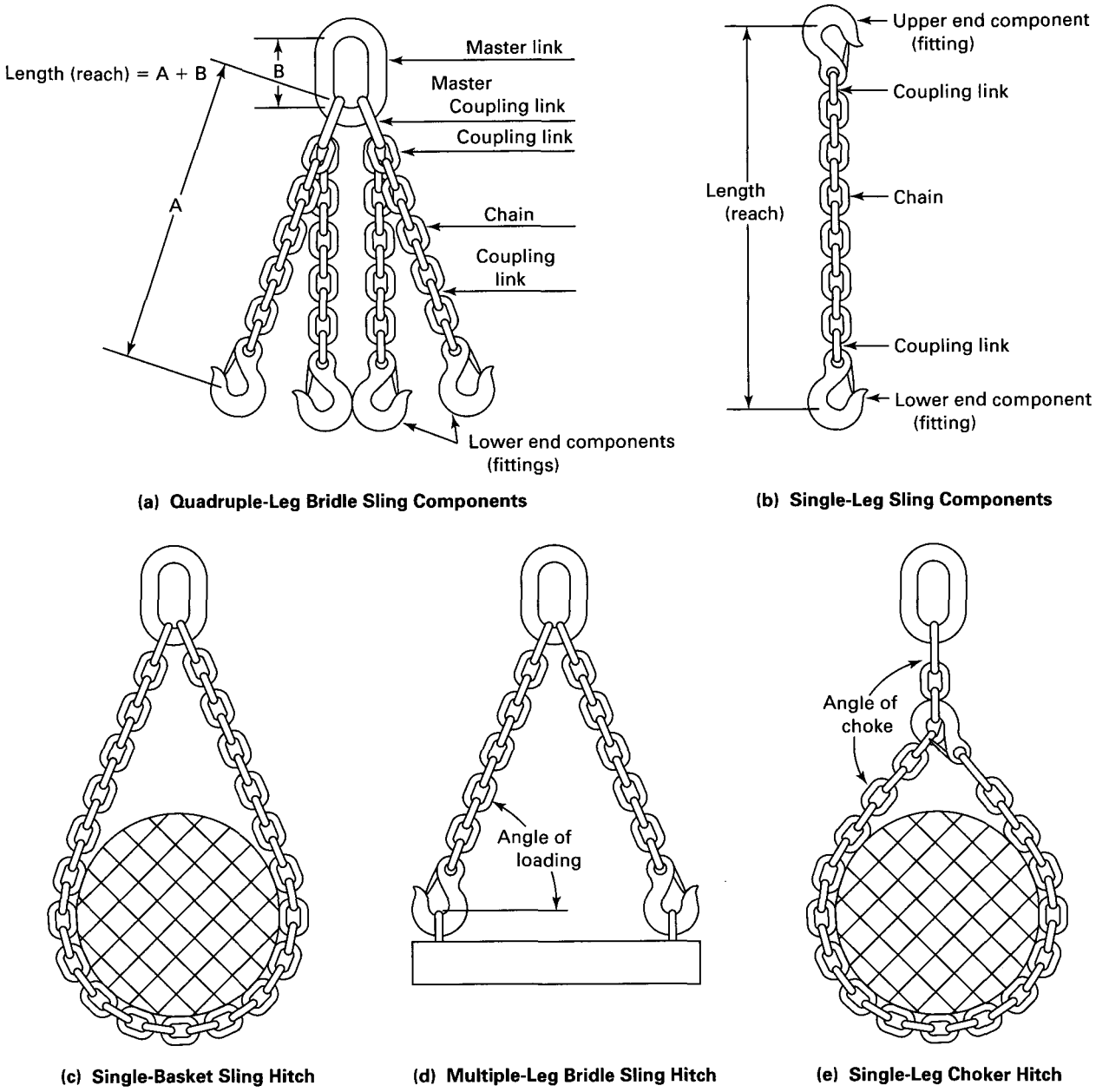
Horizontal sling angles less than 30 deg shall not be used except as recommended by the sling manufacturer or a qualified person (see Fig. 1).

NOTE: Rated loads for basket hitches and bridle slings are based on symmetrical loading. See para. 9-1.10.1(d) for nonsymmetrical loading.

9-1.5.4

Rated loads for slings used in a choker hitch shall conform to the values shown in Tables 1 and 2 provided that the angle of choke is 120 deg or greater (see Fig. 1).

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(a) Quadruple-Leg Bridle Sling Components

(b) Single-Leg Sling Components

(c) Single-Basket Sling Hitch

(d) Multiple-Leg Bridle Sling Hitch

(e) Single-Leg Choker Hitch

Fig. 1 Alloy Steel Chain Slings: Configurations, Components, and Hitches

9-1.5.5

Rated loads for angles of choke less than 120 deg shall be determined by using the values in Fig. 2, the sling manufacturer, or a qualified person.

9-1.5.6

Other materials and configurations 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.

9-1.5.7

When components of the sling have a lower rated load than the alloy chain with which it is being used, the sling shall be identified with a rated load consistent with the lowest load rating of any of the components.

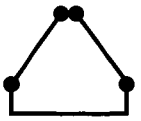
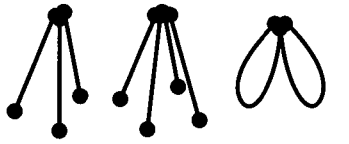
SECTION 9-1.6: PROOF TEST REQUIREMENTS

9-1.6.1

Prior to initial use, all new and repaired chain and components of an alloy steel chain sling, either

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Table 1 Rated Load for Grade 80 Alloy Steel Chain Slings

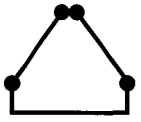
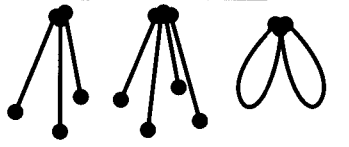
Nominal Chain Size		Single-Leg Vertical Choker Hitch [Note (1)]	Single-Leg Sling (Vertical Hitch)	Double-Leg Bridle Sling Single Basket Slings [Note (1)]			Triple- and Quadruple-Leg Bridle Slings Double Basket Slings [Note (1)]		
									
		Horizontal Angle, deg [Note (2)]							
		90	90	60	45	30	60	45	30
in.	mm	lb	lb	lb	lb	lb	lb	lb	lb
7/32	5.5	1,700	2,100	3,600	3,000	2,100	5,500	4,400	3,200
9/32	7	2,800	3,500	6,100	4,900	3,500	9,100	7,400	5,200
5/16	8	3,600	4,500	7,800	6,400	4,500	11,700	9,500	6,800
3/8	10	5,700	7,100	12,300	10,000	7,100	18,400	15,100	10,600
1/2	13	9,600	12,000	20,800	17,000	12,000	31,200	25,500	18,000
5/8	16	14,500	18,100	31,300	25,600	18,100	47,000	38,400	27,100
3/4	20	22,600	28,300	49,000	40,000	28,300	73,500	60,000	42,400
7/8	22	27,400	34,200	59,200	48,400	34,200	88,900	72,500	51,300
1	26	38,200	47,700	82,600	67,400	47,700	123,900	101,200	71,500
1 1/4	32	57,800	72,300	125,200	102,200	72,300	187,800	153,400	108,400

NOTES:

(1) For choker hitch, the angle at choke shall be 120 deg or greater (see para. 9-1.5.4).

(2) The horizontal angle is the angle formed between the inclined leg and the horizontal plane of the load [see Fig. 1(d)].

Table 2 Rated Load for Grade 100 Alloy Steel Chain Slings

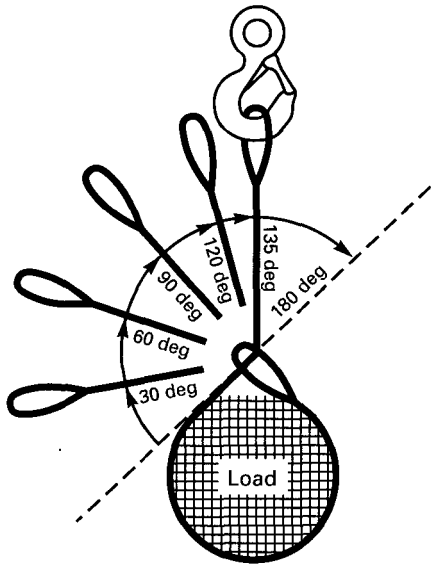
Nominal Chain Size		Single-Leg Sling Vertical Choker Hitch Hitch [Note (1)]	Single-Leg Sling (Vertical Hitch)	Double-Leg Bridle Sling Single Basket Slings [Note (1)]			Triple- and Quadruple-Leg Bridle Slings Double Basket Slings [Note (1)]		
									
		Horizontal Angle, deg [Note (2)]							
		90	90	60	45	30	60	45	30
in.	mm	lb	lb	lb	lb	lb	lb	lb	lb
7/32	5.5	2,100	2,700	4,700	3,800	2,700	7,000	5,700	4,000
9/32	7	3,500	4,300	7,400	6,100	4,300	11,200	9,100	6,400
5/16	8	4,500	5,700	9,900	8,100	5,700	14,800	12,100	8,500
3/8	10	7,100	8,800	15,200	12,400	8,800	22,900	18,700	13,200
1/2	13	12,000	15,000	26,000	21,200	15,000	39,000	31,800	22,500
5/8	16	18,100	22,600	39,100	32,000	22,600	58,700	47,900	33,900
3/4	20	28,300	35,300	61,100	49,900	35,300	91,700	74,900	53,000
7/8	22	34,200	42,700	74,000	60,400	42,700	110,900	90,600	64,000

NOTES:

(1) For choker hitch, the angle at choke shall be 120 deg or greater (see para. 9-1.5.4).

(2) The horizontal angle is the angle formed between the inclined leg and the horizontal plane of the load [see Fig. 1(d)].

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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.

Fig. 2 Angle of Choke

individually or as an assembly, shall be proof tested by the sling manufacturer or a qualified person.

9-1.6.2 Proof Load Requirements

(a) For single- or multiple-leg slings, each leg shall be proof loaded to a minimum of 2 times the single leg vertical hitch rated load.

(b) The proof load for components attached to single legs shall be a minimum of 2 times the single-leg vertical hitch rated load.

(c) Master links for double-leg bridle slings, single-basket slings, and master coupling links connected to two legs shall be proof loaded to a minimum of 4 times the single-leg vertical hitch rated load.

(d) Master links for triple- and quadruple-leg bridle slings and double basket bridle slings shall be proof loaded to a minimum of 6 times the single leg vertical hitch rated load.

SECTION 9-1.7: SLING IDENTIFICATION

9-1.7.1 Identification Requirements

Each sling shall be marked to show

(a) name or trademark of manufacturer

(b) grade

(c) nominal chain size

(d) number of legs

(e) rated loads for the type(s) of hitch(es) used and the angle upon which it is based

(f) length (reach)

9-1.7.2 Initial Sling Identification

Sling identification shall be done by the sling manufacturer.

9-1.7.3 Maintenance of Sling Identification

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

9-1.7.4 Replacement of Sling Identification

Replacement of the sling identification shall be considered a repair as specified in paras. 9-1.9.5(a) and (b). Additional proof testing is not required.

SECTION 9-1.8: EFFECTS OF ENVIRONMENT

9-1.8.1 Temperature

Extreme temperatures will reduce the performance of alloy steel chain slings. The sling manufacturer should be consulted when the slings are to be used in temperatures of −40°F (−40°C) or below. Guidance for rated load reductions for Grade 80 and Grade 100 alloy chain slings used at or after exposure to temperatures above 400°F (205°C) is given in Table 3.

9-1.8.2 Chemically Active Environments

The strength of alloy steel chain slings can be affected by chemically active environments. Sling materials may be susceptible to damage from caustic or acid substances, vapors, or fumes. Strongly oxidizing environments attack all common sling materials. The sling manufacturer should be consulted before slings are used in chemically active environments.

SECTION 9-1.9: INSPECTION, REMOVAL, AND REPAIR

9-1.9.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired slings shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter.

9-1.9.2 Frequent Inspection

(a) A visual inspection for damage shall be performed by the user or other designated person each day or shift the sling is used.

(b) Conditions such as those listed in para. 9-1.9.4 or any other condition that may result in a hazard shall

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Table 3 Effect of Elevated Temperature on Rated Load of Alloy Steel Chain

Temperature		Grade of Chain			
		Grade 80		Grade 100	
°F	°C	Temporary Reduction of Rated Load While at Temperature	Permament Reduction of Rated Load While at Temperature	Temporary Reduction of Rated Load While at Temperature	Permament Reduction of Rated Load While at Temperature
Below 400	Below 204	None	None	None	None
400	204	10%	None	15%	None
500	260	15%	None	25%	5%
600	316	20%	5%	30%	15%
700	371	30%	10%	40%	20%
800	427	40%	15%	50%	25%
900	482	50%	20%	60%	30%
1000	538	60%	25%	70%	35%
Over 1000	Over 538	Note (1)	Note (1)	Note (1)	Note (1)

NOTE:
(1) Remove from service.

cause the sling to 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.

9-1.9.3 Periodic Inspection

(a) A complete inspection for damage of the sling shall be periodically performed by a designated person. Each link and component shall be examined individually; taking care to expose and examine all surfaces including the inner link surfaces. The sling shall be examined for conditions such as those listed in para. 9-1.9.4 and a determination made as to whether they constitute a hazard.

(b) Periodic Inspection Frequency. Periodic inspection intervals shall not exceed one year. The frequency of periodic inspections should be based on

(1) frequency of sling use

(2) severity of service conditions

(3) nature of lifts being made

(4) experience gained on the service life of slings used in similar circumstances

Guidelines for the time intervals are:

Normal service — yearly

Severe service — monthly to quarterly

Special service — as recommended by a qualified person

(c) Written records of the most recent periodic inspection shall be maintained and shall include the condition of the sling.

9-1.9.4 Removal Criteria

An alloy steel chain sling shall be removed from service if conditions such as the following are present:

Table 4 Minimum Allowable Thickness at Any Point on a Link

Nominal Chain or Coupling Link Size		Minimum Allowable Thickness at Any Point on the Link	
in.	mm	in.	mm
7/32	5.5	0.189	4.80
9/32	7	0.239	6.07
5/16	8	0.273	6.93
3/8	10	0.342	8.69
1/2	13	0.443	11.26
5/8	16	0.546	13.87
3/4	20	0.687	17.45
7/8	22	0.750	19.05
1	26	0.887	22.53
1 1/4	32	1.091	27.71

(a) missing or illegible sling identification (see Section 9-1.7).

(b) cracks or breaks.

(c) excessive wear, nicks, or gouges. Minimum thickness on chain links shall not be below the values listed in Table 4.

(d) stretched chain links or components.

(e) bent, twisted, or deformed chain links or components.

(f) evidence of heat damage.

(g) excessive pitting or corrosion.

(h) lack of ability of chain or components to hinge (articulate) freely.

(i) weld splatter.

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

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

9-1.9.5 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 agency per Section 9-1.7.

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

(d) Repair of hooks shall comply with ASME B30.10.

(e) Cracked, broken, or bent chain links or components other than hooks shall not be repaired; they shall be replaced.

(f) Mechanical coupling links shall not be used within the body of an alloy chain sling to connect two pieces of chain.

(g) Modifications or alterations to the sling or components shall be considered as repairs and shall conform to all other provisions of this Chapter.

(h) All repairs shall comply with the proof test requirements of Section 9-1.6.

SECTION 9-1.10: OPERATING PRACTICES

9-1.10.1 Sling Selection

(a) Slings that appear to be damaged shall not be used unless inspected and accepted as usable under Section 9-1.9.

(b) Slings having suitable characteristics for the type of load, hitch, and environment shall be selected in accordance with the requirements of Sections 9-1.5 and 9-1.8.

(c) The rated load of the sling shall not be exceeded.

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

(e) Multiple-leg slings shall be selected according to Table 1 or 2 when used at the specific angles given in the tables. Operation at other angles shall be limited to rated load of the next lower angle given in the tables or calculated by a qualified person.

(f) The component shall be of the proper shape and size to ensure that it is properly seated in the hook or lifting device.

9-1.10.2 Cautions to Personnel

(a) All portions of the human body shall be kept from between the sling and the load, and from between the sling and the crane hook or hoist hook.

(b) Personnel should never 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.

9-1.10.3 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 9-1.8).

(b) When used at or in contact with extreme temperatures, the guidance provided in Section 9-1.8 shall be followed.

9-1.10.4 Rigging Practices

(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.

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

(d) Sharp edges in contact with the sling should be padded with material of sufficient strength to protect 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 lifting, with or without load, personnel shall be alert for possible snagging.

(j) In a basket hitch, the load should be balanced to prevent slippage.

(k) When using 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, never on a fitting.

(n) In a choker hitch, an angle of choke less than 120 degrees should not be used without reducing the rated load (see para. 9-1.5.5).

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

(p) 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.

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Chapter 9-2
Wire Rope Slings: Selection, Use, and Maintenance

SECTION 9-2.0: SCOPE

This Chapter applies to the selection, use, and maintenance of slings, for lifting purposes, fabricated from wire rope (see Fig. 3).

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 by this Chapter.

SECTION 9-2.2: MATERIALS AND COMPONENTS

9-2.2.1 Wire Rope Material

The wire rope shall be manufactured and tested in accordance with Federal Specification RR-W-410.

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

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

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

9-2.2.2 Components

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

(b) Hook characteristics 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.

9-2.2.3 Other Materials and Components

Other wire ropes and components may be used. When such materials are used, the sling manufacturer or a qualified person shall provide specific data. These slings shall comply with all other requirements of this Chapter.

SECTION 9-2.3: FABRICATION AND CONFIGURATIONS

9-2.3.1 Fabrication

Methods of fabrication include hand splicing, turnback eye, return loop or flemish eye mechanical splicing, and poured or swaged socketing.

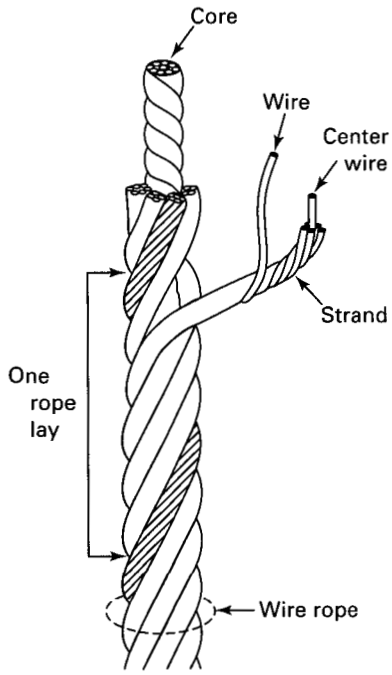


Fig. 3 Wire Rope

(a) Wire rope clips shall not be used to fabricate wire rope slings except where the application of slings prevents the use of prefabricated slings and where the specific application is designed by a qualified person.

(1) Wire rope clips, if used, shall be installed and maintained in accordance with the clip manufacturer's or a qualified person's recommendations.

(2) Malleable cast iron clips shall not be used to fabricate slings.

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

(c) The diameter and width of the bearing surface of the fitting can affect the strength of the sling. The sling manufacturer's recommendation should be followed when fittings are used with the sling.

(d) 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.

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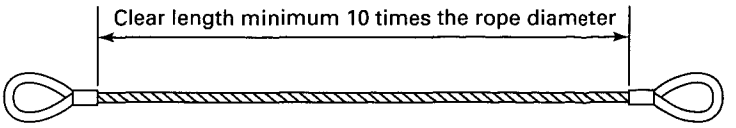


Fig. 4 Minimum Sling Length

9-2.3.2 Configurations

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

(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 Fig. 4), unless approved by 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 Fig. 9), unless approved by 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 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

The term *rated capacity* is commonly used to describe rated load.

9-2.5.1

These rated loads are based on the following factors:

(a) material strength(s)

(b) design factor

(c) type of hitch

(d) angle of loading (see Fig. 5)

(e) diameter of curvature over which the sling is used (D/d) (see Fig. 6)

(f) fabrication efficiency

9-2.5.2

Tables 5 through 13 show rated loads for single leg vertical, choker, basket hitches, and two-, three-, and four-leg bridle slings for specific grades of wire rope. For angles other than those shown in these tables, use the rated load for the next lower angle, or a qualified person shall calculate the rated load.

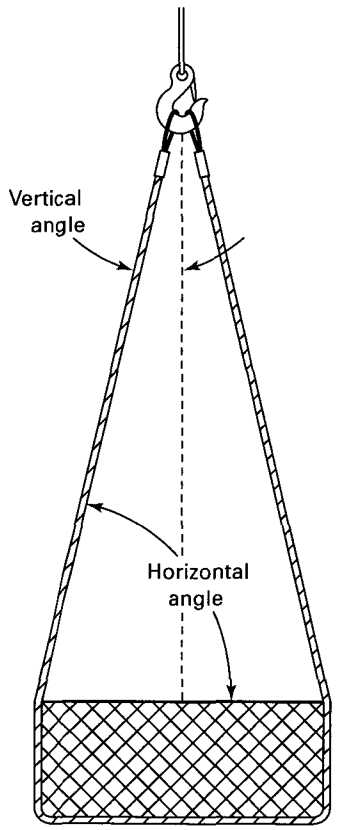
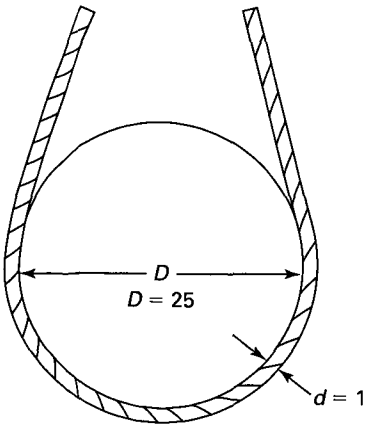


Fig. 5 Angle of Loading



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

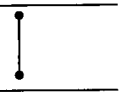
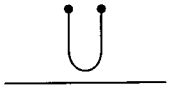
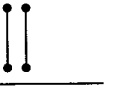
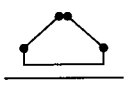
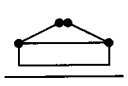
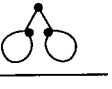
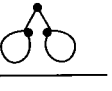
Fig. 6 *D/d* Ratio

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Table 5 Rated Load for Single- and Two-Leg Slings 6×19 or 6×36 Classification Extra Improved Plow Steel (EIPS) Grade Fiber Core (FC) Wire Rope

Based on Design Factor = 5 and Rated Loads Expressed in Tons (2,000 lb)

Hitch Type	Single-Leg							Two-Leg Bridle or Basket									Choker	
								Horizontal Angle									Horizontal Angle	
	Vertical			Choker	Vertical Basket			Vertical			60 deg		45 deg		30 deg		60 deg	30 deg
																		
Rope Diameter, in.	HT	MS	S	HT&MS	HT	MS	S	HT	MS	S	HT	MS	HT	MS	HT	MS	HT&MS	HT&MS
1/4	0.54	0.56	0.60	0.42	1.1	1.1	1.1	1.1	1.1	1.1	0.94	0.97	0.77	0.79	0.54	0.56	0.73	0.42
5/16	0.83	0.87	0.94	0.66	1.7	1.7	1.7	1.7	1.7	1.7	1.4	1.5	1.2	1.2	0.83	0.87	1.1	0.66
3/8	1.2	1.2	1.3	0.94	2.4	2.5	2.5	2.4	2.5	2.5	2.0	2.2	1.7	1.8	1.2	1.2	1.6	0.94
7/16	1.6	1.7	1.8	1.3	3.2	3.4	3.4	3.2	3.4	3.4	2.7	2.9	2.2	2.4	1.6	1.7	2.2	1.3
1/2	2.0	2.2	2.4	1.6	4.0	4.4	4.4	4.0	4.49	4.4	3.5	3.8	2.9	3.1	2.0	2.2	2.9	1.6
9/16	2.5	2.7	3.0	2.1	5.0	5.5	5.5	5.0	5.5	5.5	4.4	4.8	3.6	3.9	2.5	2.7	3.6	2.1
5/8	3.1	3.4	3.7	2.6	6.2	6.8	6.8	6.2	6.8	6.8	5.3	5.9	4.4	4.8	3.1	3.4	4.5	2.6
3/4	4.3	4.8	5.2	3.7	8.6	9.7	9.7	8.6	9.7	9.7	7.4	8.4	6.1	6.8	4.3	4.8	6.3	3.7
7/8	5.7	6.6	7.1	5.0	11	13	13	11	13	13	9.8	11	8.0	9.3	5.7	6.6	8.6	5.0
1	7.4	8.3	9.2	6.4	15	17	17	15	17	17	13	14	10	12	7.4	8.3	11	6.4
1 1/8	9.3	10	12	8.1	19	21	21	19	21	21	16	18	13	15	9.3	10	14	8.1
1 1/4	11	13	14	9.9	23	26	26	23	26	26	20	22	16	18	11	13	17	9.9

GENERAL NOTES:

(a) HT = hand-tucked splice.

(b) MS = mechanical splice.

(c) S = swaged or poured socket.

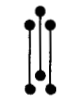
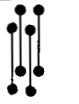
(d) Rated loads based on minimum D/d ratio of 25/1.

(e) Rated load based on pin diameter no larger than natural eye width or less than the nominal sling diameter.

(f) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-2.5.4).

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Table 6 Rated Load for Three- and Four-Leg Slings 6×19 or 6×36 Classification Extra Improved Plow Steel (EIPS) Grade Fiber Core (FC) Wire Rope
Based on Design Factor = 5 and Rated Loads Expressed in Tons (2,000 lb)

	Three-Leg								Four-Leg							
	Horizontal Angle								Horizontal Angle							
Hitch Type	Vertical		60 deg		45 deg		30 deg		Vertical		60 deg		45 deg		30 deg	
																
Rope Diameter, in.	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS
1/4	1.6	1.7	1.4	1.4	1.2	1.2	0.81	0.84	2.2	2.2	1.9	1.9	1.5	1.6	1.1	1.1
5/16	2.5	2.6	2.2	2.3	1.8	1.8	1.3	1.3	3.3	3.5	2.9	3.0	2.4	2.5	1.7	1.7
3/8	3.5	3.7	3.1	3.2	2.5	2.6	1.8	1.9	4.7	5.0	4.1	4.3	3.3	3.5	2.4	2.5
7/16	4.7	5.0	4.1	4.4	3.4	3.6	2.4	2.5	6.3	6.7	5.5	5.8	4.5	4.8	3.2	3.4
1/2	6.1	6.5	5.3	5.7	4.3	4.6	3.0	3.3	8.1	8.7	7.0	7.5	5.7	6.2	4.0	4.4
9/16	7.6	8.2	6.6	7.1	5.4	5.8	3.8	4.1	10	11	8.7	9.5	7.1	7.8	5.0	5.5
5/8	9.3	10	8.0	8.8	6.5	7.2	4.6	5.1	12	14	11	12	8.7	9.6	6.2	6.8
3/4	13	15	11	13	9.1	10	6.4	7.3	17	19	15	17	12	14	8.5	9.7
7/8	17	20	15	17	12	14	8.5	9.8	23	26	20	23	16	19	11	13
1	22	25	19	22	16	18	11	12	29	33	25	29	21	23	15	17
1 1/8	28	31	24	27	20	22	14	16	37	42	32	36	26	29	19	21
1 1/4	34	38	30	33	24	27	17	19	45	51	39	44	32	36	23	26

GENERAL NOTES:
(a) HT = hand-tucked splice.
(b) MS = mechanical splice.
(c) Rated loads based on minimum D/d ratio of 25/1.
(d) Rated load based on pin diameter no larger than natural eye width or less than the nominal sling diameter.

9-2.5.3

Horizontal sling angles less than 30 deg shall not be used except as recommended by the sling manufacturer or a qualified person (see Fig. 5).

NOTE: Rated loads for basket hitches and bridle slings are based on symmetrical loading. See para. 9-2.10.1(d) for nonsymmetrical loading.

9-2.5.4

Rated loads for slings used in a choker hitch shall conform to the values shown in Tables 5, 7, 9, 11, 12, and 13, provided that the angle of choke is 120 deg or greater (see Fig. 7).

9-2.5.5

Rated loads for angles of choke less than 120 deg shall be determined by using the values in Fig. 7, the sling manufacturer, or a qualified person.

9-2.5.6

Other materials and configurations 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.

9-2.5.7

When components of the sling have a lower rated load than the wire rope with which it is being used, the sling shall be identified with a rated load consistent with the lowest load rating of any of the components.

SECTION 9-2.6: PROOF TEST REQUIREMENTS

9-2.6.1

(a) Prior to initial use, all new swaged socket, poured socket, turnback eye, mechanical joint grommets, and 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

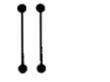
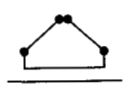
(a) For single- or multiple-leg slings and endless slings, each leg shall be proof loaded to the following

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Table 7 Rated Load for Single- and Two-Leg Slings 6×19 or 6×36 Classification Extra Improved Plow Steel (EIPS) Grade Independent Wire Rope Core (IWRC) Wire Rope

Based on Design Factor = 5 and Rated Loads Expressed in Tons (2,000 lb)

Hitch Type	Single-Leg								Two-Leg Bridle or Basket									Choker			
									Horizontal Angle									Horizontal Angle			
	Vertical			Choker		Vertical Basket			Vertical			60 deg		45 deg		30 deg		60 deg		30 deg	
																					
Rope Diameter, in.	HT	MS	S	HT	MS	HT	MS	S	HT	MS	S	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS
1/4	0.54	0.65	0.68	0.42	0.48	1.1	1.3	1.3	1.1	1.3	1.3	0.94	1.1	0.77	0.91	0.54	0.65	0.73	0.82	0.42	0.48
5/16	0.83	1.0	1.1	0.66	0.74	1.7	2.0	1.9	1.7	2.0	1.9	1.4	1.7	1.2	1.4	0.83	1.0	1.1	1.3	0.66	0.74
3/8	1.2	1.4	1.5	0.94	1.1	2.4	2.9	2.8	2.4	2.9	2.8	2.0	2.5	1.7	2.0	1.2	1.4	1.6	1.8	0.94	1.1
7/16	1.6	1.9	2.0	1.3	1.4	3.2	3.9	3.8	3.2	3.9	3.8	2.7	3.4	2.2	2.7	1.6	1.9	2.2	2.5	1.3	1.4
1/2	2.0	2.5	2.7	1.6	1.9	4.0	5.1	4.9	4.0	5.1	4.98	3.5	4.4	2.9	3.6	2.0	2.5	2.9	3.2	1.6	1.9
9/16	2.5	3.2	3.4	2.1	2.4	5.0	6.4	6.2	5.0	6.4	6.2	4.4	5.5	3.6	4.5	2.5	3.2	3.6	4.1	2.1	2.4
5/8	3.1	3.9	4.1	2.6	2.9	6.2	7.8	7.6	6.2	7.8	7.6	5.3	6.8	4.4	5.5	3.1	3.9	4.5	5.0	2.6	2.9
3/4	4.3	5.6	5.9	3.7	4.1	8.6	11	11	8.6	11	11	7.4	9.7	6.1	7.9	4.3	5.6	6.3	7.1	3.7	4.1
7/8	5.7	7.6	8.0	5.0	5.6	11	15	15	11	15	15	9.8	13	8.0	11	5.7	7.6	8.6	9.7	5.0	5.6
1	7.4	9.8	10	6.4	7.2	15	20	19	15	20	19	13	17	10	14	7.4	9.8	11	13	6.4	7.2
1 1/8	9.3	12	13	8.1	9.1	19	24	24	19	24	24	16	21	13	17	9.3	12	14	16	8.1	9.1
1 1/4	11	15	16	9.9	11	23	30	30	23	30	30	20	26	16	21	11	15	17	19	9.9	11
1 3/8	14	18	19	12	13	27	36	36	27	36	36	24	31	19	25	14	18	21	23	12	13
1 1/2	16	21	23	14	16	32	42	42	32	42	42	28	37	23	30	16	21	25	28	14	16
1 5/8	19	24	26	16	18	38	49	49	38	49	49	33	42	27	35	19	24	29	32	16	18
1 3/4	22	28	31	19	21	44	57	57	44	57	57	38	49	31	40	22	28	33	37	19	21
1 7/8	25	32	35	22	24	50	64	64	50	64	64	43	56	35	46	25	32	38	42	22	24
2	28	37	40	25	28	56	73	73	56	73	73	49	63	40	52	28	37	43	48	25	28

GENERAL NOTES:

(a) HT = hand-tucked splice.

(b) MS = mechanical splice.

(c) S = swaged or poured socket.

(d) Rated loads based on minimum D/d ratio of 25/1.

(e) Rated load based on pin diameter no larger than natural eye width or less than the nominal sling diameter.

(f) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-2.5.4).

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Table 8 Rated Load for Three- and Four-Leg Slings 6×19 or 6×36 Classification Extra Improved Plow Steel (EIPS) Grade Independent Wire Rope Core (IWRC) Wire Rope
Based on Design Factor = 5 and Rated Loads Expressed in Tons (2,000 lb)

	Three-Leg								Four-Leg							
	Horizontal Angle								Horizontal Angle							
Hitch Type	Vertical		60 deg		45 deg		30 deg		Vertical		60 deg		45 deg		30 deg	
Rope Diameter, in.	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS
1/4	1.6	1.9	1.4	1.7	1.2	1.4	0.81	0.97	2.2	2.6	1.9	2.2	1.5	1.8	1.1	1.3
5/16	2.5	3.0	2.2	2.6	1.8	2.1	1.3	1.5	3.3	4.0	2.9	3.5	2.4	2.8	1.7	2.0
3/8	3.5	4.3	3.1	3.7	2.5	3.0	1.8	2.2	4.7	5.7	4.1	5.0	3.3	4.1	2.4	2.9
7/16	4.7	5.8	4.1	5.0	3.4	4.1	2.4	2.9	6.3	7.8	5.5	6.7	4.5	5.5	3.2	3.9
1/2	6.1	7.6	5.3	6.6	4.3	5.4	3.0	3.8	8.1	10	7.0	8.8	5.7	7.1	4.0	5.1
9/16	7.6	9.6	6.6	8.3	5.4	6.8	3.8	4.8	10	13	8.7	11	7.1	9.0	5.0	6.4
5/8	9.3	12	8.0	10	6.5	8.3	4.6	5.9	12	16	11	14	8.7	11	6.2	7.8
3/4	13	17	11	15	9.1	12	6.4	8.4	17	22	15	19	12	16	8.6	11
7/8	17	23	15	20	12	16	8.5	11	23	30	20	26	16	21	11	15
1	22	29	19	26	16	21	11	15	29	39	25	34	21	28	15	20
1 1/8	28	36	24	31	20	26	14	18	37	48	32	42	26	34	19	24
1 1/4	34	44	30	38	24	31	17	22	45	59	39	51	32	42	23	30
1 3/8	41	53	36	46	29	38	21	27	55	71	47	62	39	50	27	36
1 1/2	49	63	42	55	34	45	24	32	65	84	56	73	46	60	32	42
1 5/8	56	73	49	63	40	52	28	37	75	98	65	85	53	69	38	49
1 3/4	65	85	57	74	46	60	33	42	87	113	76	98	62	80	44	57
1 7/8	74	97	64	84	53	68	37	48	99	129	86	112	70	91	50	64
2	84	110	73	95	60	78	42	55	113	147	98	127	80	104	56	73

GENERAL NOTES:
(a) HT = hand-tucked splice.
(b) MS = mechanical splice.
(c) Rated loads based on minimum D/d ratio of 25/1.
(d) Rated load based on pin diameter no larger than natural eye width or less than the nominal sling diameter.

load requirements based on fabrication method. In no case shall the proof load exceed 50% of the component ropes' or structural strands' minimum breaking strength.

(1) Mechanical Splice Slings. The proof load shall be a minimum of 2 times the single-leg vertical hitch rated load.

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

NOTE: The proof load should be that specified by the wire rope or fitting manufacturer's recommendation provided that it is within the above-specified proof load range.

(3) Hand-Tucked Slings. If proof tested, the proof load shall be a minimum of 1 and a maximum of 1.25 times the single-leg vertical 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 para. 9-2.6.2(a).

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

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

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

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

(b) rated loads for the type(s) of hitch(es) used and the angle upon which it is based

(c) diameter or size

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Table 9 Rated Load for Single- and Two-Leg Slings 6×19 or 6×36 Classification Extra Extra Improved Plow Steel (EEIPS) Grade Independent Wire Rope Core (IWRC) Wire Rope

Based on Design Factor = 5 and Rated Loads Expressed in Tons (2,000 lb)

Hitch Type	Single-Leg								Two-Leg Bridle or Basket								Choker			
											Horizontal Angle						Horizontal Angle			
	Vertical			Choker		Vertical Basket			Vertical		60 deg		45 deg		30 deg		60 deg		30 deg	
																				
Rope Diameter, in.	HT	MS	S	HT	MS	HT	MS	S	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS
1/4	0.60	0.71	0.74	0.46	0.52	1.2	1.4	1.4	1.2	1.4	1.0	1.2	0.84	1.0	0.60	0.71	0.80	0.90	0.46	0.52
5/16	0.92	1.1	1.2	0.72	0.81	1.8	2.2	2.1	1.8	2.2	1.6	1.9	1.3	1.6	0.92	1.1	1.2	1.4	0.72	0.81
3/8	1.3	1.6	1.7	1.0	1.2	2.6	3.2	3.1	2.6	3.2	2.3	2.7	1.8	2.2	1.3	1.6	1.8	2.0	1.0	1.2
7/16	1.7	2.1	2.2	1.4	1.6	3.5	4.3	4.1	3.5	4.3	3.0	3.7	2.5	3.0	1.7	2.1	2.4	2.7	1.4	1.6
1/2	2.2	2.8	2.9	1.8	2.0	4.5	5.5	5.4	4.5	5.5	3.9	4.8	3.1	3.9	2.2	2.8	3.1	3.5	1.8	2.0
9/16	2.8	3.5	3.7	2.3	2.6	5.6	7.0	6.8	5.6	7.0	4.8	6.1	3.9	5.0	2.8	3.5	4.0	4.5	2.3	2.6
5/8	3.4	4.3	4.5	2.8	3.2	6.8	8.6	8.4	6.8	8.6	5.9	7.5	4.8	6.1	3.4	4.3	4.9	5.5	2.8	3.2
3/4	4.7	6.2	6.5	4.0	4.5	9.4	12	12	9.4	12	8.2	11	6.7	8.7	4.7	6.2	7.0	7.9	4.0	4.5
7/8	6.2	8.3	8.8	5.5	6.1	12	17	16	12	17	11	14	8.8	12	6.2	8.3	9.4	11	5.5	6.1
1	8.1	11	11	7.1	8.0	16	22	21	16	22	14	19	11	15	8.1	11	12	14	7.1	8.0
1 1/8	10	...	14	8.9	...	20	...	26	20	...	18	...	14	...	10	...	15	...	8.9	...
1 1/4	13	...	18	11	...	25	...	33	25	...	22	...	18	...	13	...	19	...	11	...
1 3/8	15	...	21	13	...	30	...	39	30	...	26	...	21	...	15	...	23	...	13	...
1 1/2	18	...	25	16	...	36	...	46	36	...	31	...	25	...	18	...	27	...	16	...
1 5/8	21	...	29	18	...	41	...	54	41	...	36	...	29	...	21	...	31	...	18	...
1 3/4	24	...	34	21	...	48	...	63	48	...	42	...	34	...	24	...	36	...	21	...
1 7/8	27	...	38	24	...	55	...	71	55	...	47	...	39	...	27	...	41	...	24	...
2	31	...	43	27	...	62	...	80	62	...	54	...	44	...	31	...	47	...	27	...

GENERAL NOTES:

(a) HT = hand-tucked splice.

(b) MS = mechanical splice.

(c) S = swaged or poured socket.

(d) Rated loads based on minimum D/d ratio of 25/1.

(e) Rated load based on pin diameter no larger than natural eye width or less than the nominal sling diameter.

(f) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-2.5.4).

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Table 10 Rated Load for Three- and Four-Leg Slings 6×19 or 6×36 Classification Extra Extra Improved Plow Steel (EEIPS) Grade Independent Wire Rope Core (IWRC) Wire Rope
Based on Design Factor = 5 and Rated Loads Expressed in Tons (2,000 lb)

Hitch Type	Three-Leg								Four-Leg							
	Horizontal Angle								Horizontal Angle							
	Vertical		60 deg		45 deg		30 deg		Vertical		60 deg		45 deg		30 deg	
Rope Diameter, in.	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS
1/4	1.8	2.1	1.6	1.8	1.3	1.5	0.90	1.1	2.4	2.8	2.1	2.4	1.7	2.0	1.2	1.4
5/16	2.8	3.3	2.4	2.9	1.9	2.3	1.4	1.7	3.7	4.4	3.2	3.8	2.6	3.1	1.8	2.2
3/8	3.9	4.7	3.4	4.1	2.8	3.3	1.9	2.4	5.2	6.3	4.5	5.5	3.7	4.5	2.6	3.2
7/16	5.2	6.4	4.5	5.5	3.7	4.5	2.6	3.2	7.0	8.5	6.0	7.4	4.9	6.0	3.5	4.3
1/2	6.7	8.3	5.8	7.2	4.7	5.9	3.3	4.2	8.9	11	7.7	9.6	6.3	7.8	4.5	5.5
9/16	8.3	11	7.2	9.1	5.9	7.5	4.2	5.3	11	14	9.6	12	7.9	9.9	5.6	7.0
5/8	10	13	8.8	11	7.2	9.1	5.1	6.5	14	17	12	15	9.6	12	6.8	8.6
3/4	14	18	12	16	10	13	7.1	9.2	19	25	16	21	13	17	9.4	12
7/8	19	25	16	22	13	18	9.4	12	25	33	22	29	18	24	12	17
1	24	32	21	28	17	23	12	16	32	43	28	37	23	31	16	22
1 1/8	31	...	26	...	22	...	15	...	41	...	35	...	29	...	20	...
1 1/4	38	...	32	...	27	...	19	...	50	...	43	...	35	...	25	...
1 3/8	45	...	39	...	32	...	23	...	60	...	52	...	43	...	30	...
1 1/2	53	...	46	...	38	...	27	...	71	...	62	...	50	...	36	...
1 5/8	62	...	54	...	44	...	31	...	83	...	72	...	59	...	41	...
1 3/4	72	...	62	...	51	...	36	...	96	...	83	...	68	...	48	...
1 7/8	82	...	71	...	58	...	41	...	109	...	95	...	77	...	55	...
2	93	...	80	...	66	...	46	...	124	...	107	...	88	...	62	...

GENERAL NOTES:
(a) HT = hand-tucked splice.
(b) MS = mechanical splice.
(c) Rated loads based on minimum D/d ratio of 25/1.
(d) Rated load based on pin diameter no larger than natural eye width or less than the nominal sling diameter.

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. 9-2.9.5(a) and (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 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 can be affected by chemically active environments. Sling materials may be susceptible to damage from caustic or acid substances or fumes. Strongly oxidizing environments attack all common sling materials. The sling manufacturer should be consulted before slings are used in chemically active environments.

SECTION 9-2.9: INSPECTION, REMOVAL, AND REPAIR

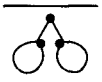
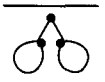
9-2.9.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired slings shall be inspected by a designated person to verify

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Table 11 Rated Load for Cable-Laid Wire Rope Single- and Two-Leg Slings Mechanical Splice Only

Based on Design Factor = 5 and Rated Loads Expressed in Tons (2,000 lb)

	Single-Leg			Two-Leg Bridle or Basket				Choker	
	Hitch Type			Horizontal Angle — Hitch Type				Horizontal Angle — Hitch Type	
	Vertical	Choker	Vertical Basket	Vertical	60 deg	45 deg	30 deg	60 deg	30 deg
Hitch Type									
Rope Diameter, in.									
7×7×7 Construction									
1/4	0.50	0.35	1.0	1.0	0.87	0.71	0.50	0.61	0.35
3/8	1.1	0.8	2.2	2.2	1.9	1.5	1.1	1.3	0.76
1/2	1.9	1.3	3.7	3.7	3.2	2.6	1.9	2.2	1.3
5/8	2.8	1.9	5.5	5.5	4.8	3.9	2.8	3.4	1.9
3/4	3.8	2.7	7.6	7.6	6.6	5.4	3.8	4.6	2.7
7/8	5.0	3.5	10	10	8.7	7.1	5.0	6.1	3.5
1	6.4	4.5	13	13	11	9.1	6.4	7.8	4.5
7×7×19 Construction									
1/2	1.9	1.3	3.8	3.8	3.3	2.7	1.9	2.3	1.3
5/8	2.9	2.0	5.8	5.8	5.0	4.1	2.9	3.5	2.0
3/4	4.1	2.8	8.1	8.1	7.0	5.8	4.1	4.9	2.8
7/8	5.4	3.8	11	11	9.3	7.6	5.4	6.5	3.8
1	6.9	4.8	14	14	12	9.7	6.9	8.3	4.8
1 1/8	8.3	5.8	17	17	14	12	8.3	10	5.8
1 1/4	9.9	6.9	20	20	17	14	9.9	12	6.9
7×6×19 or 7×6×36 IWRC Classification									
3/4	3.8	2.7	7.6	7.6	6.6	5.4	3.8	4.6	2.7
7/8	5.0	3.5	10	10	8.7	7.1	5.0	6.1	3.5
1	6.4	4.5	13	13	11	9.1	6.4	7.8	4.5
1 1/8	7.7	5.4	15	15	13	11	7.7	9.3	5.4
1 1/4	9.3	6.5	19	19	16	13	9.3	11	6.5
1 3/8	11	7.6	22	22	19	15	11	13	7.6
1 1/2	13	9.0	26	26	22	18	13	16	9.0
1 5/8	15	10	30	30	26	21	15	18	10

GENERAL NOTES:

(a) 7×7×7 = galvanized specialty cable.

(b) 7×7×19 = galvanized specialty cable.

(c) Rated loads based on minimum *D/d* ratio of 10/1.

(d) Rated load based on pin diameter no larger than natural eye width or less than the nominal sling diameter.

(e) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-2.5.4).

compliance with the applicable provisions of this Chapter.

9-2.9.2 Frequent Inspection

(a) A visual inspection for damage shall be performed by the user or other designated person each day or shift the sling is used.

(b) Conditions such as those listed in para. 9-2.9.4 or any other condition that may result in a hazard shall cause the sling to 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.

9-2.9.3 Periodic Inspection

(a) A complete inspection for damage to the sling shall be periodically performed by a designated person. Inspection shall be conducted on the entire length including splices, end attachments, and fittings. The sling shall be examined for conditions such as those listed in para. 9-2.9.4 and a determination made as to whether they constitute a hazard.

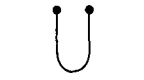
(b) Periodic Inspection Frequency. Periodic inspection intervals shall not exceed 1 year. The frequency of periodic inspections should be based on

(1) frequency of sling use

(2) severity of service conditions

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Table 12 Rated Load for Six-Part Braided Single- and Two-Leg Slings 6×19 or 6×36 Classification Extra Improved Plow Steel (EIPS) Independent Wire Rope Core (IWRC) Wire Rope
Based on Design Factor = 5 and Rated Loads Expressed in Tons (2,000 lb)

	Single-Leg			Two-Leg Bridle or Basket				Choker	
				Horizontal Angle				Horizontal Angle	
	Vertical	Choker	Vertical Basket	Vertical	60 deg	45 deg	30 deg	60 deg	30 deg
Hitch Type									
Rope Diameter, in.	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS
3/16	1.6	1.4	3.2	3.2	2.8	2.3	1.6	2.4	1.4
1/4	2.9	2.5	5.7	5.7	4.9	4.0	2.9	4.3	2.5
5/16	4.4	3.9	8.9	8.9	7.7	6.3	4.4	6.7	3.9
3/8	6.3	5.5	13	13	11	9.0	6.3	9.6	5.5
7/16	8.6	7.5	17	17	15	12	8.6	13	7.5
1/2	11	9.8	22	22	19	16	11	17	9.8
9/16	14	12	28	28	24	20	14	21	12
5/8	17	15	35	35	30	24	17	26	15
3/4	25	22	49	49	43	35	25	37	22
7/8	33	29	67	67	58	47	33	51	29
1	43	38	87	87	75	61	43	66	38
1 1/8	55	48	109	109	95	77	55	83	48
1 1/4	67	59	134	134	116	95	67	102	59
1 3/8	87	71	161	161	140	114	81	122	71
1 1/2	96	84	192	192	166	135	96	145	84
1 5/8	111	97	222	222	192	157	111	168	97
1 3/4	129	112	257	257	223	182	129	195	112
1 7/8	146	128	292	292	253	207	146	222	128
2	166	146	333	333	288	235	166	252	146

GENERAL NOTES:
(a) HT = hand-tucked splice.
(b) MS = mechanical splice.
(c) Rated loads based on minimum D/d ratio of 25 times the component rope diameter.
(d) Rated load based on pin diameter no larger than natural eye width or less than the nominal sling diameter.
(e) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-2.5.4).

(3) nature of lifts being made

(4) experience gained on the service life of slings used in similar circumstances

Guidelines for the time intervals are:

Normal service — yearly

Severe service — monthly to quarterly

Special service — as recommended by a qualified person

(c) Written records of the most recent periodic inspection shall be maintained and shall include the condition of the sling.

9-2.9.4 Removal Criteria

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

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

(b) broken wires

(1) for strand-laid and single-part slings, ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay (see Fig. 3)

(2) for cable-laid slings, 20 broken wires per lay (see Fig. 8)

(3) for six-part braided slings, 20 broken wires per braid (see Fig. 9)

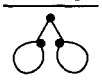
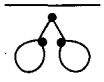
(4) for eight-part braided slings, 40 broken wires per braid (see Fig. 9)

(c) severe localized abrasion or scraping

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

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Table 13 Rated Load for Six-Part Braided Single- and Two-Leg Slings 6×19 or 6×36 Classification Extra Improved Plow Steel (EIPS) Independent Wire Rope Core (IWRC) Wire Rope
Based on Design Factor = 5 and Rated Loads Expressed in Tons (2,000 lb)

Hitch Type	Single-Leg			Two-Leg Bridle or Basket				Choker	
				Horizontal Angle				Horizontal Angle	
	Vertical	Choker	Vertical Basket	Vertical	60 deg	45 deg	30 deg	60 deg	30 deg
									
Rope Diameter, in.	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS	HT&MS
3/16	2.2	1.9	4.3	4.3	3.7	3.0	2.2	3.3	1.9
1/4	3.8	3.3	7.6	7.6	6.6	5.4	3.8	5.8	3.3
5/16	5.9	5.2	12	12	10	8.3	5.9	8.9	5.2
3/8	8.5	7.4	17	17	15	12	8.5	13	7.4
7/16	11	10	23	23	20	16	11	17	10
1/2	15	13	30	30	26	21	15	23	13
9/16	19	16	38	38	33	27	19	29	16
5/8	23	20	46	46	40	33	23	35	20
3/4	33	29	66	66	57	47	33	50	29
7/8	45	39	89	89	77	63	45	68	39
1	58	51	116	116	100	82	58	88	51
1 1/8	73	64	146	146	126	103	73	110	64
1 1/4	89	78	179	179	155	127	89	136	78
1 3/8	108	94	215	215	186	152	108	163	94
1 1/2	128	112	255	255	221	181	128	194	112
1 5/8	148	129	296	296	256	209	148	224	129
1 3/4	171	150	343	343	297	242	171	260	150
1 7/8	195	171	390	390	338	276	195	295	171
2	222	194	444	444	384	314	222	336	194

GENERAL NOTES:
(a) HT = hand-tucked splice.
(b) MS = mechanical splice.
(c) Rated loads based on minimum D/d ratio of 25 times the component rope diameter.
(d) Rated load based on pin diameter no larger than natural eye width or less than the nominal sling diameter.
(e) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-2.5.4).

(e) evidence of heat damage

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

(g) severe corrosion of the rope, end attachments, or fittings

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

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

9-2.9.5 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 agency per Section 9-2.7.

(c) End attachments and fittings used for sling repair shall comply with the provisions of this Chapter.

(d) Repair of hooks shall comply with ASME B30.10.

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

(f) Repairs to wire rope slings shall be restricted to end attachments and fittings.

(g) Modifications or alterations to end attachments or fittings shall be considered as repairs and shall conform to all other provisions of this Chapter.

(h) All repairs shall comply with the proof test requirements of Section 9-2.6.

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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.

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

(e) Multiple-leg slings shall be selected according to Tables 5 through 13 when used at the specific angles given in the table. Operation at other angles shall be limited to rated loads of the next lower angle given in the table or calculated by a qualified person.

(f) When using a multiple-leg sling, the rating shown for the single-leg sling shall not be exceeded in any leg of the multiple-leg sling.

(g) When D/d ratios (see Fig. 6) smaller than those cited in the tables are necessary, the rated load of the sling shall be decreased. Consult the sling manufacturer for specific data or refer to the WRTB Wire Rope Sling Users Manual.

(h) The fitting shall be of the proper shape and size to ensure that it seats properly in the hook or lifting device.

9-2.10.2 Cautions to Personnel

(a) All portions of the human body shall be kept from between the sling and the load, and from between the sling and the crane hook or hoist hook.

(b) Personnel should never 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) When used at or in contact with extreme temperatures the guidance provided in Section 9-2.8 shall be followed.

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

9-2.10.4 Rigging Practices

(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, twisting, or by wire rope clips.

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

(d) Sharp edges in contact with the sling should be padded with material of sufficient strength to protect 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 lifting, with or without load, personnel shall be alert for possible snagging.

(j) In a basket hitch, the load should be balanced to prevent slippage.

(k) When using 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) In a choker hitch, an angle of choke less than 120 deg should not be used without reducing the rated load (see para. 9-2.5.5).

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

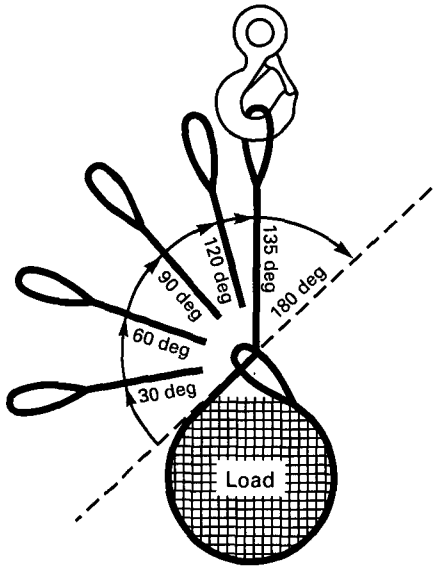
(p) The load applied to the hook should be centered in the base (bowl) of the hook to prevent point loading on the hook, unless the hook is designed for point loading.

(q) An object in the eye of a sling should not be wider than one half the length of the eye.

(r) Sling and load shall not be allowed to rotate when hand tucked slings are used in a single leg vertical lift application. Care shall be taken to minimize sling rotation.

(s) Slings made with wire rope clips shall not be used as a choker hitch.

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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.

Fig. 7 Angle of Choke

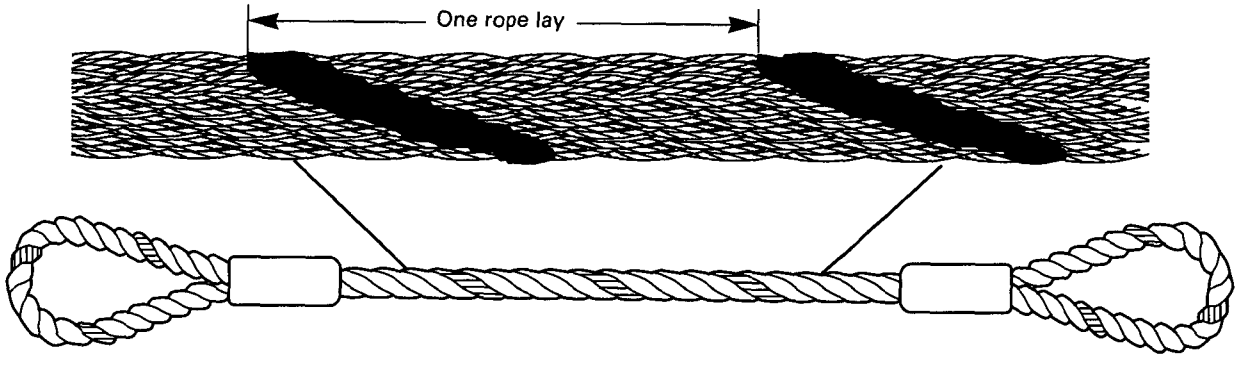


Fig. 8 Cable-Laid Wire Rope Sling

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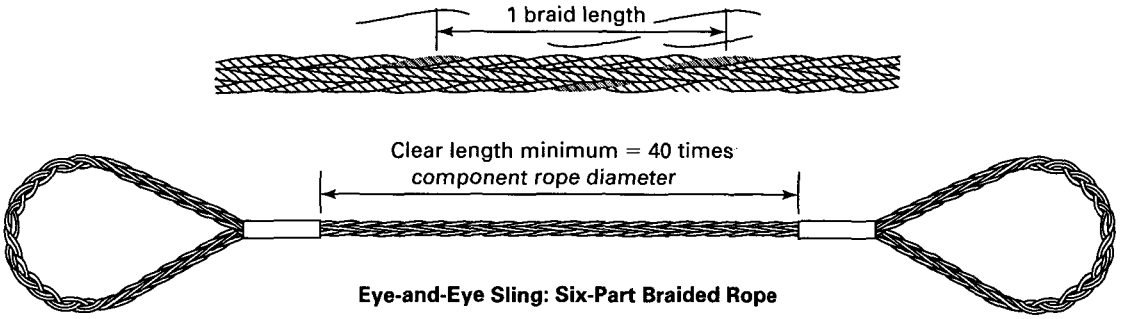


Fig. 9 Minimum Braided Sling Length

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Chapter 9-3
Metal Mesh Slings: Selection, Use, and Maintenance

SECTION 9-3.0: SCOPE

This Chapter applies to the selection, use, and maintenance of slings, for lifting purposes, fabricated from metal mesh (see Fig. 10).

SECTION 9-3.1: TRAINING

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

SECTION 9-3.2: MATERIALS AND COMPONENTS

9-3.2.1 Metal Mesh

The carbon steel metal mesh shall be manufactured in accordance with the specifications in Table 14.

9-3.2.2 Coatings

Finishes and coatings shall be compatible with the other components and not impair the performance of the sling.

9-3.2.3 Components

(a) End fittings shall be manufactured to ensure that the rated load shall be at least the same as the metal mesh sling.

(b) End fittings shall have sufficient strength to sustain twice the rated load of the sling without visible permanent deformation.

(c) All surfaces of end fittings shall be cleanly finished and sharp edges removed.

9-3.2.4 Other Materials

Other materials such as stainless steel, Monel, or alloy steels may be used. When such slings are used, the sling manufacturer or a qualified person shall provide specific data. These slings shall comply with all other requirements of this Chapter.

SECTION 9-3.3: FABRICATION AND CONFIGURATIONS

9-3.3.1 Fabrication

Methods of fabrication include welding or brazing.

9-3.3.2 Configurations

Single-leg slings, two-leg, three-leg, and four-leg bridle slings, used in vertical, choker, and basket hitches are covered by this Chapter.

SECTION 9-3.4: DESIGN FACTOR

The design factor for metal mesh slings shall be a minimum of 5.

SECTION 9-3.5: RATED LOAD

The term *rated capacity* is commonly used to describe rated load.

9-3.5.1

These rated loads are based on the following factors:
(a) material strength(s)
(b) design factor
(c) type of hitch
(d) angle of loading

9-3.5.2

Table 15 shows rated loads for single-leg vertical, choker, and basket hitches. For angles other than those shown in these tables, use the rated load for the next lower angle, or a qualified person shall calculate the rated load.

9-3.5.3

Horizontal sling angles less than 30 deg shall not be used except as recommended by the sling manufacturer or a qualified person (see Table 15).

9-3.5.4

Rated loads for slings used in a choker hitch shall conform to the values shown in Table 15, provided that the angle of choke is 120 deg or greater.

9-3.5.5

Rated loads for angles of choke less than 120 deg shall be determined by the sling manufacturer or a qualified person.

9-3.5.6

Other metal mesh materials and configurations not covered by this Chapter shall be rated in accordance

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Table 14 Fabric Construction (Metal Mesh Slings)

	Heavy Duty	Medium Duty	Light Duty
Nominal spiral turns per foot mesh width	35	43	59
Approx. spiral wire size	10 gage	12 gage	14 gage
Equivalent decimal size	0.135 in.	0.105 in.	0.080 in.
Nominal cross rods per foot of fabric length	21	30	38
Approx. size of cross rods	8 gage	10 gage	14 gage
Equivalent decimal size	0.162 in.	0.135 in.	0.080 in.
Nominal fabric thickness	1/2 in.	3/8 in.	5/16 in.

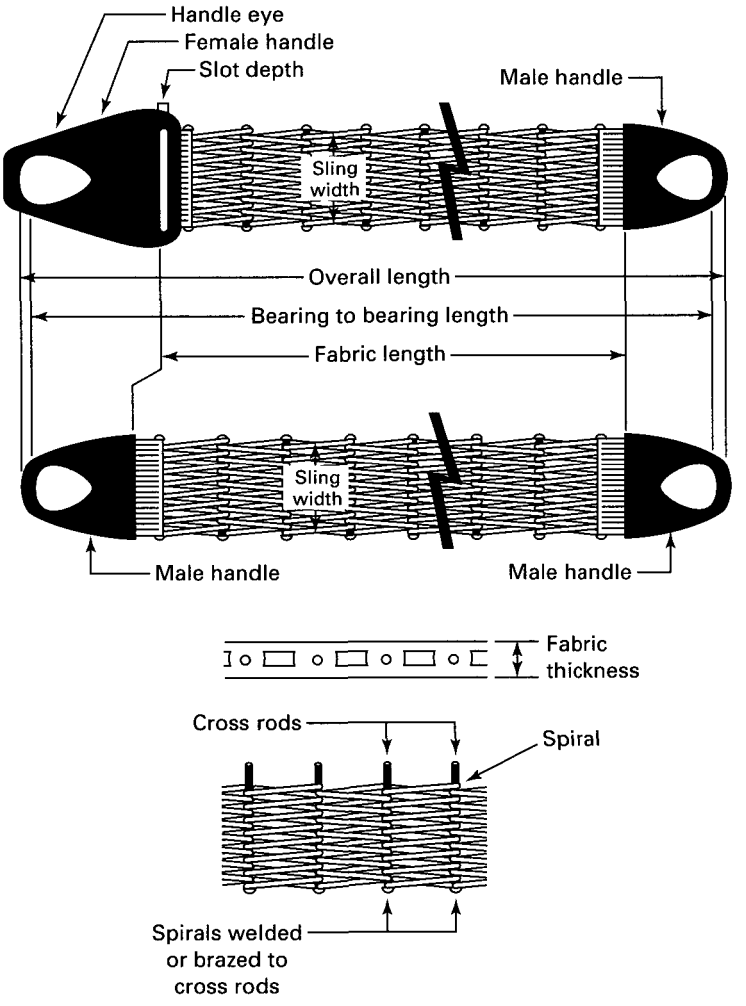


Fig. 10 Metal Mesh Sling

with the recommendation of the sling manufacturer or a qualified person, and shall conform to all other provisions of this Chapter.

9-3.5.7

When components of the sling have a lower rated load than the metal mesh with which it is being used, the sling shall be identified with a rated load consistent with the lowest load rating of any of the components.

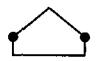
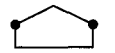
SECTION 9-3.6: PROOF TEST REQUIREMENTS

9-3.6.1

(a) Prior to initial use, all new and repaired metal

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Table 15 Rated Load for Metal Mesh Slings
Based on Design Factor = 5

Hitch Type	Vertical or Choker	Vertical Basket	Effect of Angle on Rated Capacities in Basket Hitch		
			60 deg	45 deg	30 deg
Width, in.					
Heavy Duty — 10 gage [Rated Loads in Pounds (lb)]					
2	1,600	3,200	2,770	2,260	1,600
3	3,000	6,000	5,200	4,240	3,000
4	4,400	8,800	7,620	6,220	4,400
6	6,600	13,200	11,430	9,330	6,600
8	8,800	17,600	15,240	12,440	8,800
10	11,000	22,000	19,050	15,550	11,000
12	13,200	26,400	22,860	18,660	13,200
14	15,400	30,800	26,670	21,770	15,400
16	17,600	35,200	30,480	24,880	17,600
18	19,800	39,600	34,290	28,000	19,800
20	22,000	44,000	38,100	31,100	22,000
Medium Duty — 12 gage [Rated Loads in Pounds (lb)]					
2	1,450	2,900	2,510	2,050	1,450
3	2,170	4,350	3,770	3,070	2,170
4	2,900	5,800	5,020	4,100	2,900
6	4,800	9,600	8,310	6,780	4,800
8	6,400	12,800	11,080	9,050	6,400
10	8,000	16,000	13,850	11,310	8,000
12	9,600	19,200	16,620	13,570	9,600
14	11,200	22,400	19,400	15,830	11,200
16	12,800	25,600	22,170	18,100	12,800
18	13,500	27,000	23,380	19,090	13,500
20	15,000	30,000	25,980	21,210	15,000
Light Duty — 14 gage [Rated Loads in Pounds (lb)]					
2	900	1,800	1,560	1,270	900
3	1,400	2,800	2,420	1,980	1,400
4	2,000	4,800	4,150	3,390	2,000
6	3,000	6,000	5,190	4,240	3,000
8	4,000	8,000	6,920	5,650	4,000
10	5,000	10,000	8,660	7,070	5,000
12	6,000	12,000	10,390	8,480	6,000
14	7,000	14,000	12,120	9,890	7,000
16	8,000	16,000	13,850	11,310	8,000
18	9,000	18,000	15,580	12,720	9,000
20	10,000	20,000	17,320	14,140	10,000

GENERAL NOTE: For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-3.5.4).

mesh slings shall be proof tested by the sling manufacturer or a qualified person.

(b) Coated slings shall be proof tested prior to coating.

9-3.6.2 Proof Load Requirements

The proof load shall be a minimum of 2 times the vertical hitch rated load.

SECTION 9-3.7: SLING IDENTIFICATION

9-3.7.1 Identification Requirements

Each sling shall be marked to show

(a) name or trademark of manufacturer

(b) rated loads for the type(s) of hitch(es) used and the angle upon which it is based

(c) width and gauge

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9-3.7.2 Initial Sling Identification

Sling identification shall be done by the sling manufacturer.

9-3.7.3 Maintenance of Sling Identification

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

9-3.7.4 Replacement of Sling Identification

Replacement of the sling identification shall be considered a repair as specified in paras. 9-3.9.5(a) and (b). Additional proof testing is not required.

SECTION 9-3.8: EFFECTS OF ENVIRONMENT

9-3.8.1 Temperature

(a) Metal mesh slings covered by this Chapter shall not be subjected to a reduction in rated load if used in temperatures below −20°F (−29°C) and above 550°F (288°C).

(b) All slings covered by this Chapter that are elastometer coated should be used only in a temperature range from 0°F (−18°C) to 200°F (93°C).

(c) For operation at temperatures outside these ranges or for other coatings, the sling manufacturer should be consulted for specific data.

9-3.8.2 Chemically Active Environments

The strength of metal mesh slings can be affected by chemically active environments. Sling materials may be susceptible to damage from caustic or acid substances or fumes. Strongly oxidizing environments attack all common sling materials. The sling manufacturer should be consulted before slings are used in chemically active environments.

SECTION 9-3.9: INSPECTION, REMOVAL, AND REPAIR

9-3.9.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired slings shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter.

9-3.9.2 Frequent Inspection

(a) A visual inspection for damage shall be performed by the user or other designated person each day or shift the sling is used.

(b) Conditions such as those listed in para. 9-3.9.4 or any other condition that may result in a hazard shall cause the sling to 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.

9-3.9.3 Periodic Inspection

(a) A complete inspection for damage to the sling shall be periodically performed by a designated person. Inspection shall be conducted on the entire length including splices, end attachments, and fittings. The sling shall be examined for conditions such as those listed in para. 9-3.9.4 and a determination made as to whether they constitute a hazard.

(b) Periodic Inspection Frequency. Periodic inspection intervals shall not exceed 1 year. The frequency of periodic inspections should be based on

(1) frequency of sling use

(2) severity of service conditions

(3) nature of lifts being made

(4) experience gained on the service life of slings used in similar circumstances

Guidelines for the time intervals are:

Normal service — yearly

Severe service — monthly to quarterly

Special service — as recommended by a qualified person

(c) Written records of the most recent periodic inspection shall be maintained and shall include the condition of the sling.

9-3.9.4 Removal Criteria

A metal mesh sling shall be removed from service if conditions such as the following are present:

(a) missing or illegible sling identification (see Section 9-3.7)

(b) broken weld or a broken brazed joint along the sling edge

(c) broken wire in any part of the mesh

(d) reduction in wire diameter of 25% due to abrasion or 15% due to corrosion

(e) lack of flexibility due to distortion of the mesh

(f) distortion of the choker fitting so the depth of the slot is increased by more than 10%

(g) distortion of either end fitting so the width of the eye opening is decreased by more than 10%

(h) a 15% reduction of the original cross-sectional area of any point around the hook opening of the end fitting

(i) visible distortion of either end fitting out of its plane

(j) cracked end fitting

(k) slings in which the spirals are locked or without free articulation shall not be used

(l) fittings that are pitted, corroded, cracked, bent, twisted, gouged, or broken

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

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9-3.9.5 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 agency per Section 9-3.7.

(c) Metal mesh and fittings used for sling repair shall comply with the provisions of this Chapter.

(d) Cracked, broken, bent, or damaged metal mesh or components shall not be repaired; they shall be replaced.

(e) All repairs shall comply with the proof test requirements of Section 9-3.6.

(f) Modifications or alterations to the sling or components shall be considered as repairs and shall conform to all other provisions of this Chapter.

SECTION 9-3.10: OPERATING PRACTICES

9-3.10.1 Sling Selection

(a) Slings that appear to be damaged shall not be used unless inspected and accepted as usable under Section 9-3.9.

(b) Slings having suitable characteristics for the type of load, hitch, and environment shall be selected in accordance with the requirements of Sections 9-3.5 and 9-3.8.

(c) The rated load of the sling shall not be exceeded.

(d) The fitting shall be of the proper shape and size to ensure that it is properly seated in the hook or lifting device.

9-3.10.2 Cautions to Personnel

(a) All portions of the human body shall be kept from between the sling and the load, and from between the sling and the crane hook or hoist hook.

(b) Personnel should never 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) Metal mesh slings shall not be used as bridles on suspended personnel platforms.

9-3.10.3 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 9-3.8).

(b) When used at or in contact with extreme temperatures the guidance provided in Section 9-3.8 shall be followed.

9-3.10.4 Rigging Practices

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

(b) The load should be evenly distributed across the width of the metal mesh.

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

(d) Sharp edges in contact with the sling should be padded with material of sufficient strength to protect 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 lifting, with or without load, personnel shall be alert for possible snagging.

(j) In a basket hitch, the load should be balanced to prevent slippage.

(k) When using 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) In a choker hitch, an angle of choke less than 120 deg should not be used without reducing the rated load (see para. 9-3.5.5).

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

(p) In a choker hitch, the load should be balanced to prevent edge overload.

(q) Straightening a spiral or cross rod or forcing a spiral into position shall not be done.

(r) Slings used in pairs should be attached to a spreader beam.

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Chapter 9-4
Synthetic Rope Slings: Selection, Use, and Maintenance

SECTION 9-4.0: SCOPE

This Chapter applies to the selection, use, and maintenance of slings, for lifting purposes, fabricated from synthetic fiber rope as specified herein (see Fig. 11).

SECTION 9-4.1: TRAINING

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

SECTION 9-4.2: MATERIALS AND COMPONENTS

9-4.2.1 Synthetic Ropes

Synthetic fiber materials covered for use in synthetic ropes are nylon, polyester, and polypropylene. Rope constructions covered are three-strand laid, eight-strand plaited, and hollow braided. The rope constructions shall be manufactured and tested in accordance with one of the following applicable Cordage Institute specifications:

Rope Type	Designation
Nylon three-strand laid	CI 1303
Nylon eight-strand plaited	CI 1303
Nylon double braid	CI 1306
Polyester three-strand laid	CI 1304
Polyester eight-strand plaited	CI 1304
Polyester double braid	CI 1307
Polyester single braid	CI 1305
Polypropylene three-strand laid	CI 1301
Polypropylene eight-strand plaited	CI 1301

9-4.2.2 Coatings

Finishes and coatings shall be compatible with the other components and not impair the performance of the sling.

9-4.2.3 Components

Mechanical components used as part of a synthetic rope sling should be selected to meet the following requirements:

(a) Suitability of mechanical or socketed fittings shall be verified by a qualified person.

(b) The material shall be compatible with the mechanical and environmental requirements imposed on the sling.

(c) Components shall have sufficient strength to sustain twice the rated load of the sling without visible permanent deformation.

(d) All surfaces shall be cleanly finished and sharp edges removed so as not to cause damage to the rope.

(e) Slings incorporating reused, repaired, or welded fittings shall undergo proof load in accordance with Section 9-4.6.

(f) Slings incorporating aluminum fittings shall not be used where fumes, vapors, sprays, mists, or liquids of alkalis or acids are present.

(g) Thimbles should be used in the sling whenever possible. Thimbles should have closed ears that will prevent the thimble from falling out of the eye or rotating inside it. Thimbles shall have a minimum diameter at the bearing surface at least equal to two times the rope diameter.

(h) Hook characteristics shall meet the requirements of ASME B30.10.

9-4.2.4 Other Materials

Other synthetic ropes may be used in slings. When such materials are used, the sling manufacturer or a qualified person shall provide specific data. These slings shall comply with all other requirements of this Chapter.

SECTION 9-4.3: FABRICATION AND CONFIGURATIONS

9-4.3.1 Fabrication

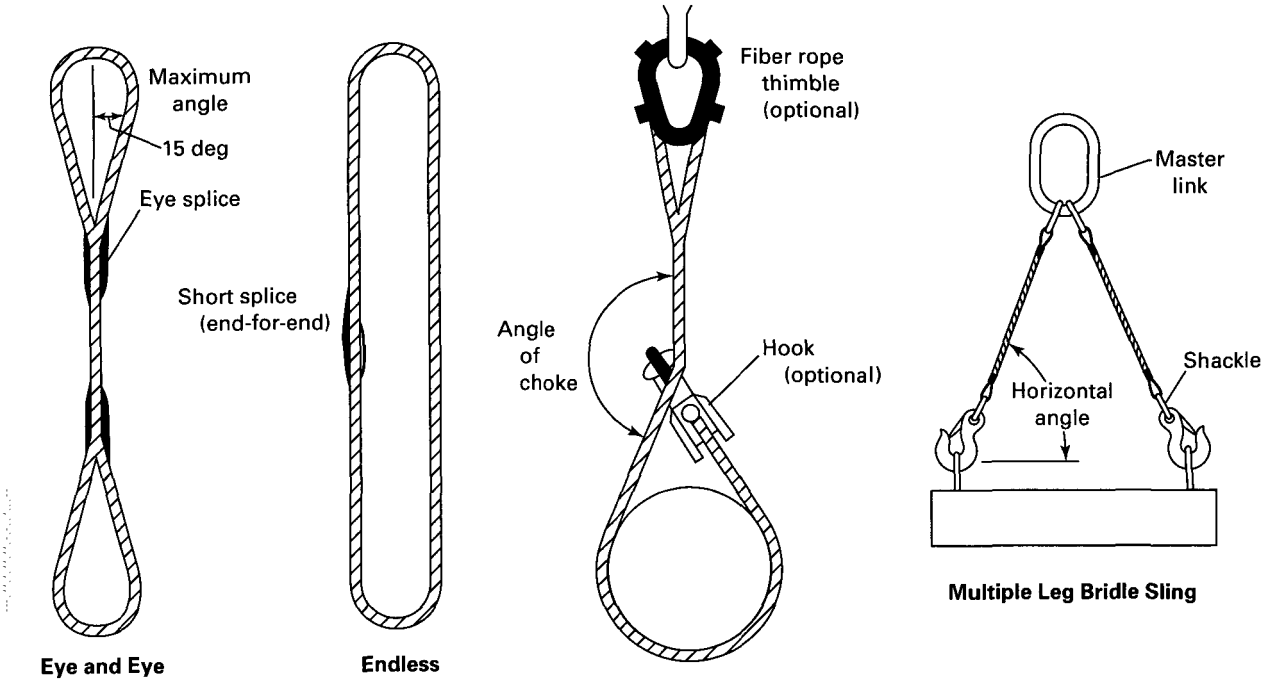
Splicing is the preferred method of fabricating eye-and-eye or endless rope components for slings. All splices shall be made in accordance with splicing instructions provided by the rope manufacturer or a qualified person. In addition, the following shall be observed:

(a) With tuck splices in three-strand and eight-strand synthetic ropes, no less than four full tucks shall be used. Short splices shall contain at least six full tucks, three on each side of the center of the splice.

(b) Strand end tails in all tuck splices shall not be trimmed short (cut flush with the body of the rope). In cases where the projecting tails may be objectionable, the tails shall be tapered and buried into the body of the rope using two additional tucks.

(c) Synthetic rope slings shall have a minimum undisturbed length of rope of 10 times the rope diameter between the last tuck of tuck splices or between the ends of the buried tails or strands of other types of splices.

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GENERAL NOTE: Fittings designed for synthetic slings should be used.

Fig. 11 Synthetic Fiber Rope Slings

(d) The diameter and width of the bearing surface of the fitting can affect the strength of the sling. The sling manufacturer's recommendation should be followed when fittings are used with the sling.

(e) Knots, clips, or clamps shall not be used to fabricate slings.

(f) If thimbles do not have ears to prevent rotation, they should be lashed to the rope.

9-4.3.2 Configurations

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

(b) Synthetic rope leg(s) shall be either eye-and-eye or endless.

SECTION 9-4.4: DESIGN FACTOR

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

SECTION 9-4.5: RATED LOAD

The term *rated capacity* is commonly used to describe rated load.

9-4.5.1

These rated loads are based on the following factors:

(a) material strength(s)

(b) design factor

(c) type of hitch (see Fig. 12)

(d) angle of loading (see Fig. 13)

(e) diameter of curvature over which the sling is used (D/d) (see Fig. 14)

9-4.5.2

Tables 16 through 18 show rated loads for vertical, choker, and basket hitches. For angles other than those shown in these tables, use the rated load for the next lower angle, or a qualified person shall calculate the rated load.

9-4.5.3

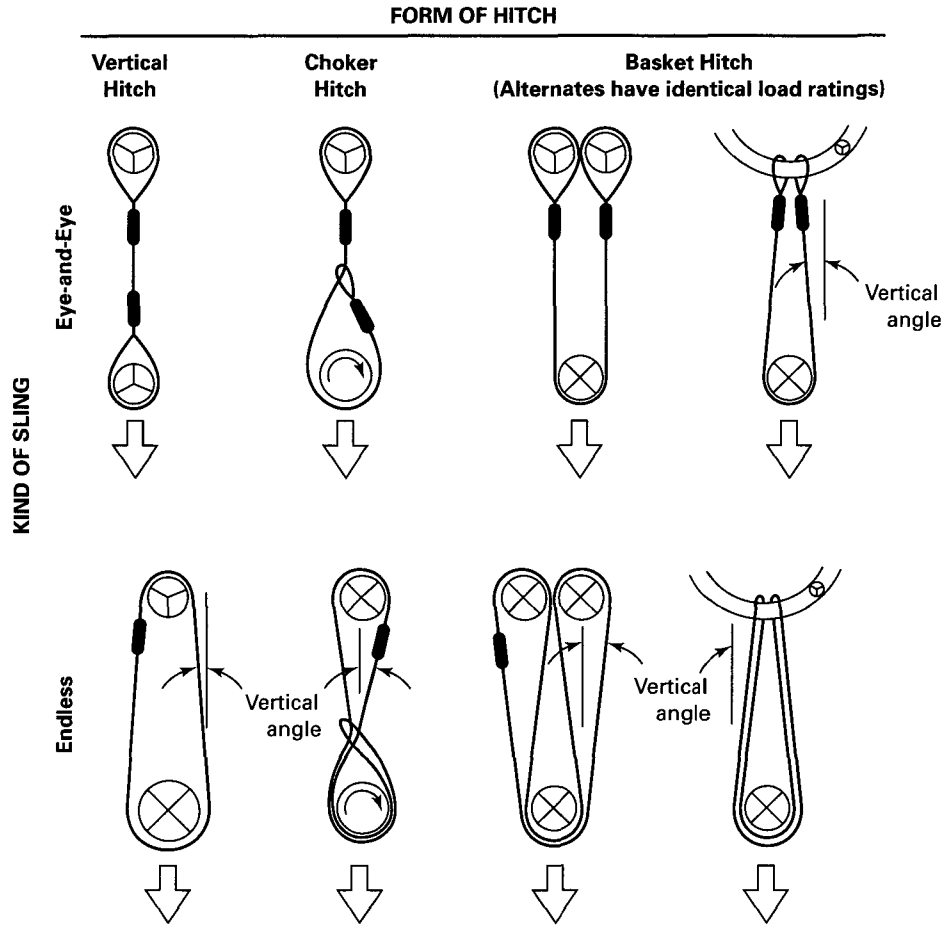
Horizontal sling angles less than 30 deg shall not be used except as recommended by the sling manufacturer or a qualified person (see Fig. 13).

NOTE: Rated loads for basket hitches and bridle slings are based on symmetrical loading. See para. 9-4.10.1(d) for nonsymmetrical loading.

9-4.5.4

Rated loads for slings used in a choker hitch shall conform to the values shown in Tables 16 through 18, provided that the angle of choke is 120 deg or greater (see Fig. 15).

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The symbols below represent load or support surfaces in contact with the rope sling. The contact surface diameter divided by the rope diameter is designated *D/d* ratio as described in Fig. 14. Tables 16, 17, and 18 are based on the *D/d* ratios indicated below.

Represents a contact surface which shall have a diameter of curvature at least double the diameter of the rope from which the sling is made.

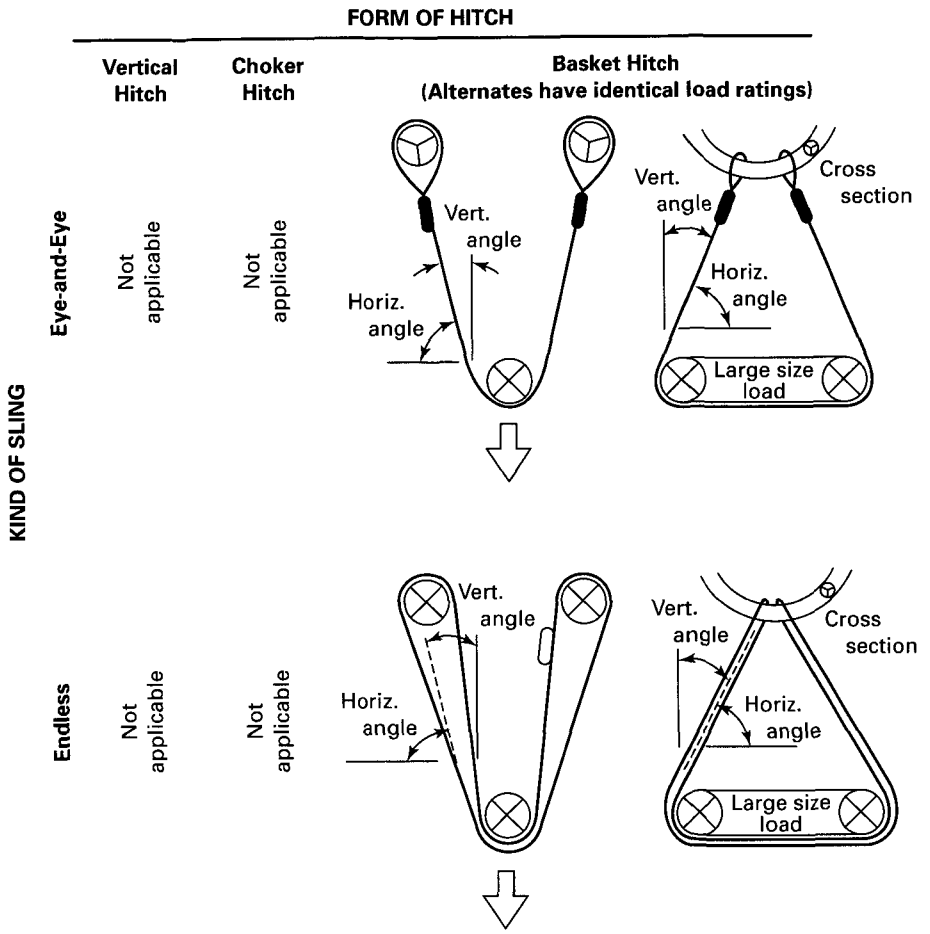
Represents a contact surface which shall have a diameter of curvature at least 8 times the diameter of the rope.

Represents a load in choker hitch and illustrates the rotary force on the load and/or the slippage of the rope in contact with the load. Diameter of curvature of load surface shall be at least double the diameter of the rope.

GENERAL NOTE: Legs 5 deg or less from vertical may be considered vertical. For slings more than 5 deg vertical, the actual angle shall be used. See para. 9-4.5.2.

Fig. 12 Hitch Types for Synthetic Rope Slings

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GENERAL NOTE: Legs 5 deg or less from vertical may be considered vertical. Slings with horizontal angles less than 30 deg should not be used. See paras. 9-4.5.2 and 9-4.5.3.

Fig. 12 Hitch Types for Synthetic Rope Slings (Cont'd)

9-4.5.5

Rated loads for angles of choke less than 120 deg shall be determined by using the values in Fig. 15, the sling manufacturer, or a qualified person.

9-4.5.6

Other synthetic rope materials and configurations 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.

9-4.5.7

When components of the sling have a lower rated load than the synthetic rope with which it is being used, the sling shall be identified with a rated load consistent with the lowest load rating of any of the components.

SECTION 9-4.6: PROOF TEST REQUIREMENTS

9-4.6.1

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

(b) All other new synthetic fiber rope slings and fittings are not required to be proof tested unless specified by the purchaser.

9-4.6.2 Proof Load Requirements

(a) For single- or multiple-leg slings and endless slings, each leg shall be proof loaded to a minimum of 2 times the single-leg vertical hitch rated load.

(b) The proof load for fittings attached to single legs shall be a minimum of 2 times the single-leg vertical hitch rated load.

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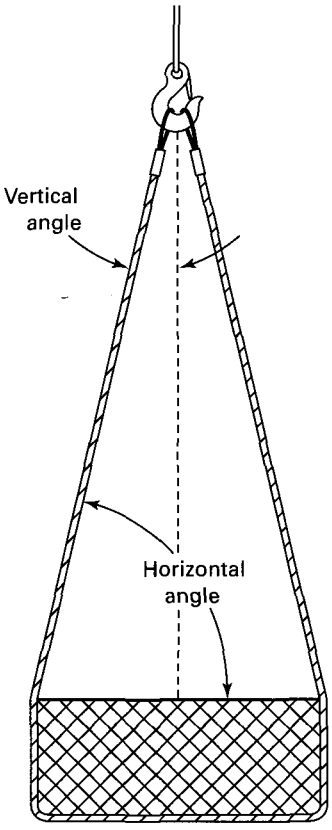
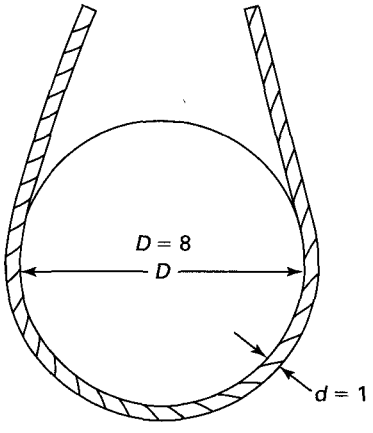


Fig. 13 Angle of Loading



GENERAL NOTE: When *D* is 8 times the component rope diameter (*d*) the *D*/*d* is expressed as 8/1.

Fig. 14 *D*/*d* Ratio

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

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

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

SECTION 9-4.7: SLING IDENTIFICATION

9-4.7.1 Identification Requirements

Each sling shall be marked to show

(a) name or trademark of manufacturer

(b) manufacturer's code or stock number

(c) rated loads for the type(s) of hitch(es) used and the angle upon which it is based

(d) type of fiber material

9-4.7.2 Initial Sling Identification

Sling identification shall be done by the sling manufacturer.

9-4.7.3 Maintenance of Sling Identification

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

9-4.7.4 Replacement of Sling Identification

Replacement of the sling identification shall be considered a repair as specified in paras. 9-4.9.5(a) and (b). Additional proof testing is not required.

SECTION 9-4.8: EFFECTS OF ENVIRONMENT

9-4.8.1 Temperature

(a) Polyester and nylon rope slings shall not be used in contact with objects or at temperatures in excess of 194°F (90°C) or at temperatures below −40°F (−40°C).

(b) Polypropylene slings shall not be used in contact with objects or at temperatures in excess of 140°F (60°C) or below −40°F (−40°C).

(c) Some synthetic yarns do not retain their published breaking strength during long-term exposure above 140°F (60°C). The rope sling manufacturer should be consulted for the effects of long-term heat exposure.

9-4.8.2 Chemically Active Environments

Certain chemically active environments may weaken or destroy synthetic rope slings. In general, acids may affect nylon and strong alkalis may affect polyester, both aggravated by elevated temperatures. In general, polypropylene may be affected by volatile petroleum and other solvents and most hydrocarbons at elevated temperatures. The presence of rust in wet nylon ropes has

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Table 16 Nylon Rope Slings

Based on Design Factor = 5 and Rated Loads Expressed in Pounds (lb)

Hitch Type	Eye-and-Eye Sling						Endless Sling					
			Two-Leg Bridle or Basket						Basket			
			Horizontal Angle, deg						Horizontal Angle, deg			
	Vertical	Choker	90	60	45	30	Vertical	Choker	90	60	45	30
Rope Diameter, in.												
1/2	1,100	830	2,200	1,900	1,600	1,100	2,000	1,500	4,000	3,500	2,800	2,000
9/16	1,400	1,100	2,800	2,400	2,000	1,400	2,600	2,000	5,200	4,500	3,700	2,600
5/8	1,800	1,400	3,600	3,100	2,500	1,800	3,200	2,400	6,400	5,500	4,500	3,200
3/4	2,600	2,000	5,200	4,500	3,700	2,600	4,600	3,500	9,200	8,000	6,500	4,600
7/8	3,500	2,600	7,000	6,100	4,900	3,500	6,200	4,700	12,400	10,700	8,800	6,200
1	4,400	3,300	8,800	7,600	6,200	4,400	7,900	5,900	15,800	13,700	11,200	7,900
1 1/8	5,700	4,300	11,400	9,900	8,100	5,700	10,100	7,600	20,200	17,500	14,300	10,100
1 1/4	7,000	5,300	14,000	12,100	9,900	7,000	12,400	9,300	24,800	21,500	17,500	12,400
1 5/16	7,700	5,800	15,400	13,300	10,900	7,700	13,700	10,300	27,400	23,700	19,400	13,700
1 1/2	9,700	7,300	19,400	16,800	13,700	9,700	17,400	13,100	34,800	30,100	24,600	17,400
1 5/8	11,500	8,600	23,000	19,900	16,300	11,500	20,500	15,400	41,000	35,500	29,000	20,500
1 3/4	13,200	9,900	26,400	22,900	18,700	13,200	23,600	17,700	47,200	40,900	33,400	23,600
2	16,900	12,700	33,800	29,300	23,900	16,900	30,200	22,700	60,400	52,300	42,700	30,200
2 1/8	19,100	14,300	38,200	33,100	27,000	19,100	34,100	25,600	68,200	59,100	48,200	34,100
2 1/4	21,400	16,100	42,800	37,100	30,300	21,400	38,300	28,700	76,600	66,300	54,200	38,300
2 1/2	26,300	19,700	52,600	45,600	37,200	26,300	46,900	35,200	93,800	81,200	66,300	46,900
2 5/8	28,800	21,600	57,600	49,900	40,700	28,800	51,400	38,600	102,800	89,000	72,700	51,400
3	37,100	27,800	74,200	64,300	52,500	37,100	66,200	49,700	132,400	114,700	93,600	66,200

GENERAL NOTES:

(a) See Fig. 11 for sling types, Fig. 12 for hitch types, and Fig. 13 for sling angle descriptions. For D/d considerations, see note in Fig. 12 and para. 9-4.10.1(f).

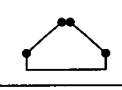
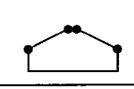
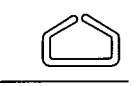
(b) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-4.5.4).

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Table 17 Polyester Rope Slings

Based on Design Factor = 5 and Rated Loads Expressed in Pounds (lb)

Hitch Type	Eye-and-Eye Sling						Endless Sling					
			Basket						Basket			
			Horizontal Angle, deg						Horizontal Angle, deg			
	Vertical	Choker	90	60	45	30	Vertical	Choker	90	60	45	30
Rope Diameter, in.												
1/2	1,000	750	2,000	1,700	1,400	1,000	1,800	1,400	3,600	3,100	2,500	1,800
9/16	1,300	980	2,600	2,300	1,800	1,300	2,300	1,700	4,600	4,000	3,300	2,300
5/8	1,600	1,200	3,200	2,800	2,300	1,600	2,800	2,100	5,600	4,800	4,000	2,800
3/4	2,200	1,700	4,400	3,800	3,100	2,200	4,000	3,000	8,000	6,900	5,700	4,000
7/8	3,000	2,300	6,000	5,200	4,200	3,000	5,400	4,100	10,800	9,400	7,600	5,400
1	4,000	3,000	8,000	6,900	5,700	4,000	7,100	5,300	14,200	12,300	10,000	7,100
1 1/8	5,000	3,800	10,000	8,700	7,100	5,000	8,900	6,700	17,800	15,400	12,600	8,900
1 1/4	6,000	4,500	12,000	10,400	8,500	6,000	10,600	8,000	21,200	18,400	15,000	10,600
1 5/16	6,500	4,900	13,000	11,300	9,200	6,500	11,600	8,700	23,200	20,100	16,400	11,600
1 1/2	8,400	6,300	16,800	14,500	11,900	8,400	15,100	11,300	30,200	26,200	21,400	15,100
1 5/8	9,900	7,400	19,800	17,100	14,000	9,900	17,600	13,200	35,200	30,500	24,900	17,600
1 3/4	11,400	8,600	22,800	19,700	16,100	11,400	20,400	15,300	40,800	35,300	28,800	20,400
2	14,400	10,800	28,800	24,900	20,400	14,400	25,700	19,300	51,400	44,500	36,300	25,700
2 1/8	16,200	12,200	32,400	28,100	22,900	16,200	28,900	21,700	57,800	50,100	40,900	28,900
2 1/4	18,100	13,600	36,200	31,300	25,600	18,100	32,300	24,200	64,600	55,900	45,700	32,300
2 1/2	22,000	16,500	44,000	38,100	31,100	22,000	39,300	29,500	78,600	68,100	55,600	39,300
2 5/8	24,200	18,200	48,400	41,900	34,200	24,200	43,200	32,400	86,400	74,800	61,100	43,200
3	31,200	23,400	62,400	54,000	44,100	31,200	55,700	41,800	111,400	96,500	78,800	55,700

GENERAL NOTES:

(a) See Fig. 11 for sling types, Fig. 12 for hitch types, and Fig. 13 for sling angle descriptions. For D/d considerations, see note in Fig. 12 and para. 9-4.10.1(f).

(b) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-4.5.4).

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Table 18 Polypropylene Rope Slings

Based on Design Factor = 5 and Rated Loads Expressed in Pounds (lb)

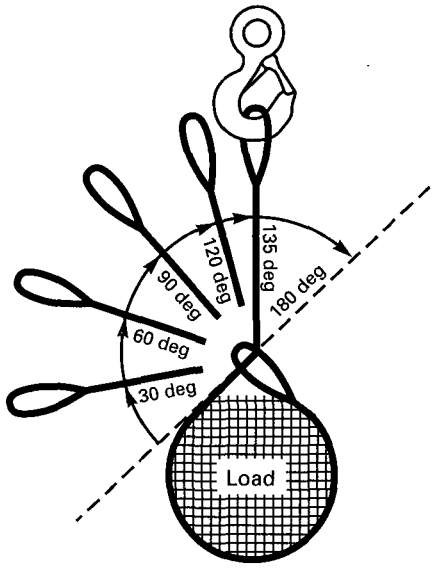
Hitch Type	Eye-and-Eye Sling						Endless Sling					
			Basket						Basket			
			Horizontal Angle, deg						Horizontal Angle, deg			
Rope Diameter, in.	Vertical	Choker	90	60	45	30	Vertical	Choker	90	60	45	30
1/2	760	570	1,500	1,300	1,100	750	1,400	1,100	2,800	2,400	2,000	1,400
9/16	920	690	1,800	1,600	1,300	900	1,600	1,200	3,200	2,800	2,300	1,600
5/8	1,100	830	2,200	1,900	1,600	1,100	2,000	1,500	4,000	3,500	2,800	2,000
3/4	1,500	1,100	3,000	2,600	2,100	1,500	2,700	2,000	5,400	4,700	3,800	2,700
7/8	2,100	1,600	4,200	3,600	3,000	2,100	3,700	2,800	7,400	6,400	5,200	3,700
1	2,600	2,000	5,200	4,500	3,700	2,600	4,600	3,500	9,200	8,000	6,500	4,600
1 1/8	3,200	2,400	6,400	5,500	4,500	3,200	5,700	4,300	11,400	9,900	8,100	5,700
1 1/4	3,900	2,900	7,800	6,800	5,500	3,900	6,900	5,200	13,800	12,000	9,800	6,900
1 5/16	4,200	3,200	8,400	7,300	5,900	4,200	7,600	5,700	15,200	13,200	10,700	7,600
1 1/2	5,500	4,100	11,000	9,500	7,800	5,500	9,800	7,400	19,600	17,000	13,900	9,800
1 5/8	6,400	4,800	12,800	11,100	9,000	6,400	11,400	8,600	22,800	19,700	16,100	11,400
1 3/4	7,400	5,600	14,800	12,800	10,500	7,400	13,200	9,900	26,400	22,900	18,700	13,200
2	9,400	7,100	18,800	16,300	13,300	9,400	16,700	12,500	33,400	28,900	23,600	16,700
2 1/8	10,500	7,900	21,000	18,200	14,800	10,500	18,800	14,100	37,600	32,600	26,600	18,800
2 1/4	11,900	8,900	23,800	20,600	16,800	11,900	21,200	15,900	42,400	36,700	30,000	21,200
2 1/2	14,400	10,800	28,800	24,900	20,400	14,400	25,700	19,300	51,400	44,500	36,300	25,700
2 5/8	16,100	12,100	32,200	27,900	22,800	16,100	28,800	21,600	57,600	49,900	40,700	28,800
3	20,500	15,400	41,000	35,500	29,000	20,500	36,600	27,500	73,200	63,400	51,800	36,600

GENERAL NOTES:

(a) See Fig. 11 for sling types, Fig. 12 for hitch types, and Fig. 13 for sling angle descriptions. For D/d considerations, see note in Fig. 12 and para. 9-4.10.1(f).

(b) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-4.5.4).

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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.

Fig. 15 Angle of Choke

been found to be potentially harmful. Consult the sling manufacturer before using slings in a chemically active environment.

9-4.8.3 Sunlight and Ultraviolet

Ropes made of polypropylene shall be made of fibers that have been produced with an appropriate ultraviolet inhibitor. Slings made of nylon rope should be made of fibers that have been produced with an appropriate ultraviolet inhibitor. Nylon and particularly polypropylene ropes subjected to long-term exposure to sunlight should be subjected to an appropriate retirement criteria; consult the sling manufacturer or a qualified person.

SECTION 9-4.9: INSPECTION, REMOVAL, AND REPAIR

9-4.9.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired slings shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter.

9-4.9.2 Frequent Inspection

(a) A visual inspection for damage shall be performed by the user or other designated person each day or shift the sling is used.

(b) Conditions such as those listed in para. 9-4.9.4 or any other condition that may result in a hazard shall cause the sling to 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.

9-4.9.3 Periodic Inspection

(a) A complete inspection for damage to the sling shall be periodically performed by a designated person. Each sling and component shall be examined individually, taking care to expose and examine all surfaces. Inspection shall be conducted on the entire length including splices, end attachments, and fittings. The sling shall be examined for conditions such as those listed in para. 9-4.9.4 and a determination made as to whether they constitute a hazard.

(b) Periodic Inspection Frequency. Periodic inspection intervals shall not exceed 1 year. The frequency of periodic inspections should be based on

(1) frequency of sling use

(2) severity of service conditions

(3) nature of lifts being made

(4) experience gained on the service life of slings used in similar circumstances

Guidelines for the time intervals are:

Normal service — yearly

Severe service — monthly to quarterly

Special service — as recommended by a qualified person

(c) Written records of the most recent periodic inspection shall be maintained and shall include the condition of the sling.

9-4.9.4 Removal Criteria

A synthetic rope sling shall be removed from service if conditions such as the following are present:

(a) missing or illegible sling identification (see Section 9-4.7)

(b) cuts, gouges, areas of extensive fiber breakage along the length, and abraded areas on the rope

(c) damage that is estimated to have reduced the effective diameter of the rope by more than 10%

(d) uniform fiber breakage along the major part of the length of the rope in the sling such that the entire rope appears covered with fuzz or whiskers

(e) inside the rope, fiber breakage, fused or melted fiber (observed by prying or twisting to open the strands) involving damage estimated at 10% of the fiber in any strand or the rope as a whole

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(f) discoloration, brittle fibers, and hard or stiff areas that may indicate chemical damage, ultraviolet damage, or heat damage

(g) dirt and grit in the interior of the rope structure that is deemed excessive

(h) foreign matter that has permeated the rope and makes it difficult to handle and may attract and hold grit

(i) kinks or distortion in the rope structure, particularly if caused by forcibly pulling on loops (known as hockles)

(j) melted, hard, or charred areas that affect more than 10% of the diameter of the rope or affect several adjacent strands along the length that affect more than 10% of strand diameters

(k) poor condition of thimbles or other components manifested by corrosion, cracks, distortion, sharp edges, or localized wear

(l) other visible damage that causes doubt as to the strength of the sling

9-4.9.5 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 agency per Section 9-4.7.

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

(d) The ropes that make up the sling shall not be respliced or knotted to effect repairs.

(e) All repairs shall comply with the proof test requirements of Section 9-4.6.

(f) Modifications or alterations to the sling components shall be considered as repairs and shall conform to all other provisions of this Chapter.

SECTION 9-4.10: OPERATING PRACTICES

9-4.10.1 Sling Selection

(a) Slings that appear to be damaged shall not be used unless inspected and accepted as usable under Section 9-4.9.

(b) Slings having suitable characteristics for the type of load, hitch, and environment shall be selected in accordance with the requirements of Sections 9-4.5 and 9-4.8.

(c) The rated load of the sling shall not be exceeded.

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

(e) Multiple-leg slings shall be selected according to Tables 16 through 18 when used at the specific angles given in the table. Operation at other angles shall be limited to rated loads of the next lower angle given in the table or calculated by a qualified person.

(f) When D/d ratios (see Fig. 14) smaller than those cited in Fig. 12 are necessary, the rated load of the sling shall be decreased. Consult the sling manufacturer or a qualified person.

(g) The component shall be of the proper shape and size to ensure that it is properly seated in the hook or lifting device.

9-4.10.2 Cautions to Personnel

(a) All portions of the human body shall be kept from between the sling and the load, and from between the sling and the crane hook or hoist hook.

(b) Personnel should never 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) Synthetic rope slings shall not be used as bridles on suspended personnel platforms.

9-4.10.3 Effects of Environment

(a) Slings should be stored in an area where they will not be subjected to mechanical, chemical, or ultraviolet damage, or extreme temperatures (see Section 9-4.8).

(b) When used at or in contact with extreme temperatures, the guidance provided in Section 9-4.8 shall be followed.

(c) Do not store nylon ropes in areas where they may become impregnated with rust.

(d) Slings exposed to salt water should be thoroughly rinsed with fresh water to prevent mechanical damage from salt crystals when the rope dries.

9-4.10.4 Rigging Practices

(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.

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

(d) Sharp edges in contact with the sling should be padded with material of sufficient strength to protect 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 lifting, with or without load, personnel shall be alert for possible snagging.

(j) In a basket hitch, the load should be balanced to prevent slippage.

(k) When using 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.

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(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) In a choker hitch, an angle of choke less than 120 deg should not be used without reducing the rated load (see para. 9-4.5.5).

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

(p) 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.

(q) An object in the eye of a sling should not be wider than one-third the length of the eye.

(r) Sling and load shall not be allowed to rotate when hand-tucked slings are used in a single-leg vertical lift application. Care shall be taken to minimize sling rotation.

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Chapter 9-5
Synthetic Webbing Slings: Selection, Use, and Maintenance

SECTION 9-5.0: SCOPE

This Chapter applies to the selection, use, and maintenance of slings, for lifting purposes, fabricated from woven synthetic webbing of nylon- or polyester-type yarns (see Fig. 16).

SECTION 9-5.1: TRAINING

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

SECTION 9-5.2: MATERIALS AND COMPONENTS

9-5.2.1 Webbing

The synthetic webbing shall be manufactured and tested in accordance with WSTDA-WB-1.

9-5.2.2 Thread

The thread and coatings shall be compatible with the other components and not impair the performance of the sling.

9-5.2.3 Coatings

Finishes and coatings shall be compatible with the other components and not impair the performance of the sling.

9-5.2.4 Components

(a) Fittings shall be manufactured to ensure that the rated load shall be at least the same as the synthetic webbing sling.

(b) Fittings shall have sufficient strength to sustain twice the rated load of the sling without visible permanent deformation.

(c) All surfaces of fittings shall be cleanly finished and sharp edges removed.

(d) Hook characteristics shall meet the requirements of ASME B30.10.

9-5.2.5 Other Materials

Other synthetic webbings may be used in slings. When such materials are used, the sling manufacturer or a qualified person shall provide specific data. These slings shall comply with all other requirements of this Chapter.

SECTION 9-5.3: FABRICATION AND CONFIGURATIONS

9-5.3.1 Fabrication

(a) Stitching shall be the method for fabricating synthetic webbing slings.

(b) The thread shall be the same yarn type as the sling webbing.

(c) The diameter and width of the bearing surface of the fitting can affect the strength of the sling. The sling manufacturer's recommendation should be followed when fittings are used with the sling.

9-5.3.2 Configurations

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

(b) One-, two-, and four-ply slings are covered by this Chapter.

(c) 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 9-5.4: DESIGN FACTOR

The design factor for synthetic webbing slings shall be a minimum of 5.

SECTION 9-5.5: RATED LOAD

The term *rated capacity* is commonly used to describe rated load.

9-5.5.1

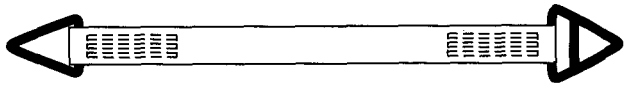
These rated loads are based on the following factors:

(a) material strength(s)
(b) design factor
(c) type of hitch
(d) angle of loading (see Fig. 19)
(e) diameter of curvature over which the sling is used
(f) fabrication efficiency

9-5.5.2

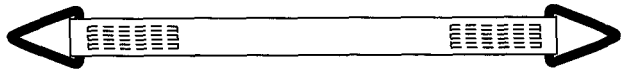
Tables 19 through 23 show rated loads for single-leg vertical, choker, basket hitches, and two-leg bridle slings. For angles other than those shown in these tables,

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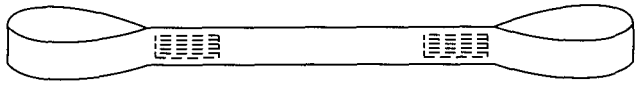
Sling made with a triangle fitting on one end and a slotted triangle choker fitting on the other end. It can be used in a vertical, basket, or choker hitch.

Type I



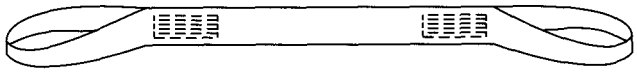
Sling made with a triangle fitting on both ends. It can be used in a vertical or basket hitch only.

Type II



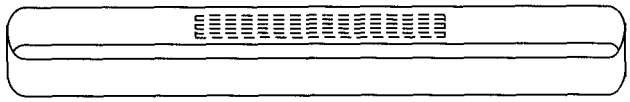
Sling made with a flat loop eye on each end with loop eye opening on same plane as sling body. This type of sling is sometimes called a flat eye-and-eye, eye-and-eye, or double-eye sling.

Type III



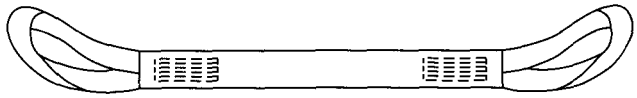
Sling made with both loop eyes formed as in Type III, except that the loop eyes are turned to form a loop eye which is at a right angle to the plane of the sling body. This type of sling is commonly referred to as a twisted-eye sling.

Type IV



Endless sling, sometimes referred to as a grommet. It is a continuous loop formed by joining the ends of the webbing together.

Type V



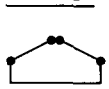
Return-eye (reversed-eye) sling is formed by using multiple widths of webbing held edge-to-edge. A wear pad is attatched on one or both sides of the sling body and on one or both sides of the loop eyes to form a loop eye at each end which is at a right angle to the plane of the sling body.

Type VI

Fig. 16 Synthetic Webbing Slings

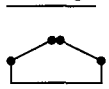
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Table 19 Rated Load for One-Ply, Class 5 Synthetic Webbing Slings

	Types I, II, III, and IV			Two-Leg or Single Basket				Type V
	Single-Leg			Horizontal Angle				
Hitch Type	Vertical	Choker	Vertical Basket	Vertical	60 deg	45 deg	30 deg	Endless Vertical
Width, in.								
1	1,100	880	2,200	2,200	1,900	1,600	1,100	2,200
1½	1,600	1,280	3,200	3,200	2,800	2,300	1,600	3,200
1¾	1,900	1,520	3,800	3,800	3,300	2,700	1,900	3,800
2	2,200	1,760	4,400	4,400	3,800	3,100	2,200	4,400
3	3,300	2,640	6,600	6,600	5,700	4,700	3,300	6,600
4	4,400	3,520	8,800	8,800	7,600	6,200	4,400	8,800
5	5,500	4,400	11,000	11,000	9,500	7,800	5,500	11,000
6	6,600	5,280	13,200	13,200	11,400	9,300	6,600	13,200

GENERAL NOTES:
(a) The rated loads are based on stuffer weave construction webbing with a minimum certified tensile strength of 6,800 pounds per inch of width of the webbing.
(b) Rated loads for Types III and IV slings apply to both tapered and nontapered eye constructions. Rated loads for Type V slings are based on nontapered webbing.
(c) For Type VI slings, consult the manufacturer for rated loads.
(d) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-5.5.4).

Table 20 Rated Load for Two-Ply, Class 5 Synthetic Webbing Slings

	Types I, II, III, and IV			Two-Leg or Single Basket				Type V
	Single-Leg			Horizontal Angle				
Hitch Type	Vertical	Choker	Vertical Basket	Vertical	60 deg	45 deg	30 deg	Endless Vertical
Width, in.								
1	2,200	1,760	4,400	4,400	3,800	3,100	2,200	4,400
1½	3,300	2,640	6,600	6,600	5,700	4,700	3,300	6,600
1¾	3,800	3,040	7,600	7,600	6,600	5,400	3,800	7,600
2	4,400	3,520	8,800	8,800	7,600	6,200	4,400	8,800
3	6,600	5,280	13,200	13,200	11,400	9,300	6,600	13,200
4	8,200	6,560	16,400	16,400	14,200	11,600	8,200	16,400
5	10,200	8,160	20,400	20,400	17,700	14,400	10,200	20,400
6	12,300	9,840	24,600	24,600	21,300	17,400	12,300	24,600

GENERAL NOTES:
(a) The rated loads are based on stuffer weave construction webbing with a minimum certified tensile strength of 6,800 pounds per inch of width of the webbing.
(b) Rated loads for Types III and IV slings apply to both tapered and nontapered eye constructions. Rated loads for Type V slings are based on nontapered webbing.
(c) For Type VI slings, consult the manufacturer for rated loads.
(d) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-5.5.4).

use the rated load for the next lower angle, or a qualified person shall calculate the rated load.

9-5.5.3

Horizontal sling angles less than 30 deg shall not be used except as recommended by the sling manufacturer or a qualified person (see Fig. 19).

NOTE: Rated loads for basket hitches and bridle slings are based on symmetrical loading. See para. 9-5.10.1(d) for nonsymmetrical loading.

9-5.5.4

Rated loads for slings used in a choker hitch shall conform to the values shown in Tables 19 through 23,

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Table 21 Rated Load for One-Ply, Class 7 Synthetic Webbing Slings

	Types I, II, III, and IV			Two-Leg or Single Basket				Type V
	Single-Leg			Horizontal Angle				
Hitch Type	Vertical	Choker	Vertical Basket	Vertical	60 deg	45 deg	30 deg	Endless Vertical
Width, in.								
1	1,600	1,280	3,200	3,200	2,800	2,300	1,600	3,200
1½	2,300	1,840	4,600	4,600	4,000	3,300	2,300	4,600
1¾	2,700	2,160	5,400	5,400	4,700	3,800	2,700	5,400
2	3,100	2,480	6,200	6,200	5,400	4,400	3,100	6,200
3	4,700	3,760	9,400	9,400	8,100	6,600	4,700	9,400
4	6,200	4,960	12,400	12,400	10,700	8,800	6,200	12,400
5	7,800	6,240	15,600	15,600	13,500	11,000	7,800	15,600
6	9,300	7,440	18,600	18,600	16,100	13,200	9,300	18,600
8	11,750	9,400	21,150	21,150	18,300	15,000	11,750	21,150
10	14,700	11,760	26,450	26,450	22,900	18,700	14,700	26,450
12	17,650	14,120	31,750	31,750	27,500	22,400	17,650	31,750

GENERAL NOTES:

(a) The rated loads are based on stuffer weave construction webbing with a minimum certified tensile strength of 6,800 pounds per inch of width of the webbing.

(b) Rated loads for Types III and IV slings apply to both tapered and nontapered eye constructions. Rated loads for Type V slings are based on nontapered webbing.

(c) For Type VI slings, consult the manufacturer for rated loads.

(d) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-5.5.4).

Table 22 Rated Load for Two-Ply, Class 7 Synthetic Webbing Slings

	Types I, II, III, and IV			Two-Leg or Single Basket				Type V
	Single-Leg			Horizontal Angle				
Hitch Type	Vertical	Choker	Vertical Basket	Vertical	60 deg	45 deg	30 deg	Endless Vertical
Width, in.								
1	3,100	2,480	6,200	6,200	5,400	4,400	3,100	6,200
1½	4,700	3,760	9,400	9,400	8,100	6,600	4,700	9,400
1¾	5,400	4,320	10,800	10,800	9,400	7,600	5,400	10,800
2	6,200	4,960	12,400	12,400	10,700	8,800	6,200	12,400
3	8,800	7,040	17,600	17,600	15,200	12,400	8,800	17,600
4	11,000	8,800	22,000	22,000	19,100	15,600	11,000	22,000
5	13,700	10,960	27,400	27,400	23,700	19,400	13,700	27,400
6	16,500	13,200	33,000	33,000	28,600	23,000	16,500	33,000
8	22,750	18,200	42,350	42,350	36,700	29,900	22,750	42,350
10	28,400	22,720	52,900	52,900	45,800	37,400	28,400	52,900
12	34,100	27,280	63,500	63,500	55,000	44,900	34,100	63,500

GENERAL NOTES:

(a) The rated loads are based on stuffer weave construction webbing with a minimum certified tensile strength of 6,800 pounds per inch of width of the webbing.

(b) Rated loads for Types III and IV slings apply to both tapered and nontapered eye constructions. Rated loads for Type V slings are based on nontapered webbing.

(c) For Type VI slings, consult the manufacturer for rated loads.

(d) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-5.5.4).

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Table 23 Rated Load for Four-Ply, Class 7 Synthetic Webbing Slings

Hitch Type / Width, in.	Single-Leg Vertical	Single-Leg Choker	Single-Leg Vertical Basket	Types I, II, III, and IV Two-Leg or Single Basket Horizontal Angle Vertical	60 deg	45 deg	30 deg
1	5,500	4,400	11,000	11,000	9,500	7,800	5,500
2	11,000	8,800	22,000	22,000	19,000	15,600	11,000
3	16,450	13,160	32,900	32,900	28,500	23,300	16,450
4	20,400	16,320	40,800	40,800	35,300	28,800	20,400
5	25,500	20,400	51,000	51,000	44,200	36,100	25,500
6	30,600	24,480	61,200	61,200	53,000	43,300	30,600

GENERAL NOTES:
(a) The rated loads are based on stuffer weave construction webbing with a minimum certified tensile strength of 9,800 pounds per inch of width of the webbing.
(b) Rated loads for Types III and IV slings apply to both tapered and nontapered eye constructions. Rated loads for Type V slings are based on nontapered webbing.
(c) For Types VI and V slings, consult the manufacturer for rated loads.
(d) For choker hitch, the angle of choke shall be 120 deg greater (see para. 9-5.5.4).

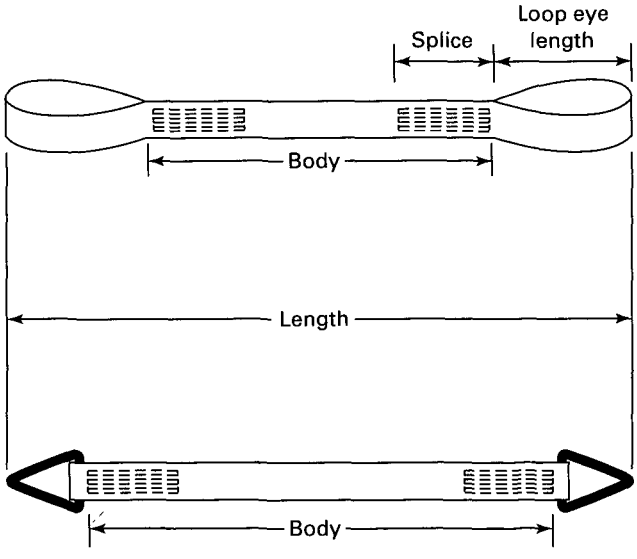


Fig. 17 Synthetic Webbing Sling Nomenclature

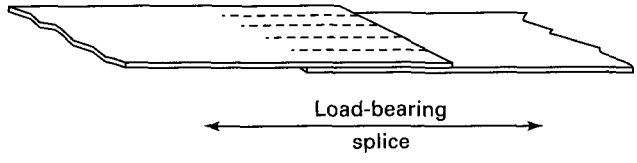


Fig. 18 Load-Bearing Splice

provided that the angle of choke is 120 deg or greater (see Fig. 20).

9-5.5.5

Rated loads for angles of choke less than 120 deg shall be determined by using the values in Fig. 20, the sling manufacturer, or a qualified person.

9-5.5.6

Other synthetic webbing materials and configurations 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.

9-5.5.7

When components of the sling have a lower rated load than the synthetic webbing with which it is being used, the sling shall be identified with a rated load consistent with the lowest load rating of any of the components.

SECTION 9-5.6: PROOF TEST REQUIREMENTS

9-5.6.1

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

(b) All other new synthetic webbing slings and fittings are not required to be proof tested unless specified by the purchaser.

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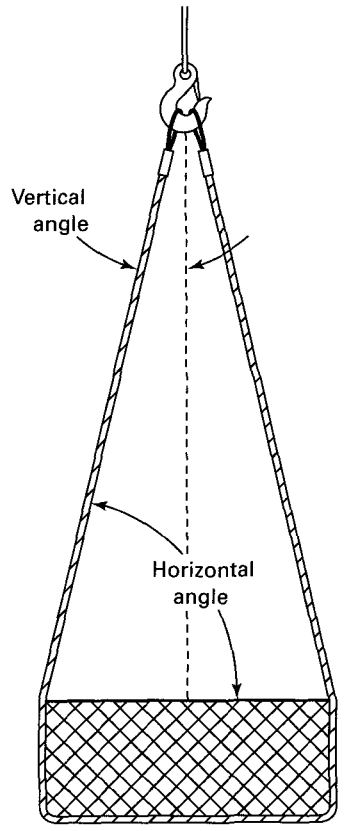
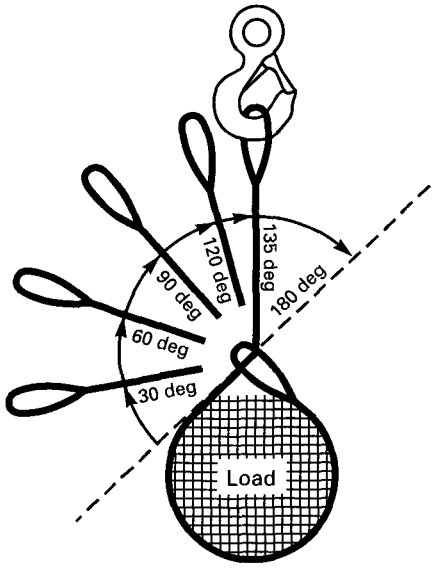


Fig. 19 Angle of Loading



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.

Fig. 20 Angle of Choke

9-5.6.2 Proof Load Requirements

(a) For single- or multiple-leg slings and endless slings, each leg shall be proof loaded to 2 times the single-leg vertical hitch rated load.

(b) The proof load for fittings attached to single legs shall be a minimum of 2 times the single-leg vertical hitch rated load.

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

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

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

SECTION 9-5.7: SLING IDENTIFICATION

9-5.7.1 Identification Requirements

Each sling shall be marked to show

(a) name or trademark of manufacturer

(b) manufacturer's code or stock number

(c) rated loads for the type(s) of hitch(es) used and the angle upon which it is based

(d) type of synthetic web material

9-5.7.2 Initial Sling Identification

Sling identification shall be done by the sling manufacturer.

9-5.7.3 Maintenance of Sling Identification

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

9-5.7.4 Replacement of Sling Identification

Replacement of the sling identification shall be considered a repair as specified in paras. 9-5.9.5(a) and (b). Additional proof testing is not required.

SECTION 9-5.8: EFFECTS OF ENVIRONMENT

9-5.8.1 Temperature

Polyester and nylon webbing slings shall not be used in contact with an object or at temperatures in excess of 194°F (90°C) or below −40°F (−40°C).

9-5.8.2 Chemically Active Environments

The strength of synthetic webbing slings can be affected by chemically active environments. Sling materials may be susceptible to damage from caustic or acid

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substances, vapors, or fumes. Strongly oxidizing environments attack all common sling materials. The sling manufacturer should be consulted before slings are used in chemically active environments.

SECTION 9-5.9: INSPECTION, REMOVAL, AND REPAIR

9-5.9.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired slings shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter.

9-5.9.2 Frequent Inspection

(a) A visual inspection for damage shall be performed by the user or other designated person each day or shift the sling is used.

(b) Conditions such as those listed in para. 9-5.9.4 or any other condition that may result in a hazard shall cause the sling to 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.

9-5.9.3 Periodic Inspection

(a) A complete inspection for damage to the sling shall be periodically performed by a designated person. Each sling and component shall be examined individually, taking care to expose and examine all surfaces. The sling shall be examined for conditions such as those listed in para. 9-5.9.4 and a determination made as to whether they constitute a hazard.

(b) Periodic Inspection Frequency. Periodic inspection intervals shall not exceed 1 year. The frequency of periodic inspections should be based on

(1) frequency of sling use

(2) severity of service conditions

(3) nature of lifts being made

(4) experience gained on the service life of slings used in similar circumstances

Guidelines for the time intervals are:

Normal service — yearly

Severe service — monthly to quarterly

Special service — as recommended by a qualified person

(c) Written records of the most recent periodic inspection shall be maintained and shall include the condition of the sling.

9-5.9.4 Removal Criteria

A synthetic webbing sling shall be removed from service if conditions such as the following are present:

(a) missing or illegible sling identification (see Section 9-5.7)

(b) acid or caustic burns

(c) melting or charring of any part of the sling

(d) holes, tears, cuts, or snags

(e) broken or worn stitching in load bearing splices

(f) excessive abrasive wear

(g) knots in any part of the sling

(h) discoloration and brittle or stiff areas on any part of the sling, which may mean chemical or ultraviolet/sunlight damage

(i) fittings that are pitted, corroded, cracked, bent, twisted, gouged, or broken

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

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

9-5.9.5 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 agency per Section 9-5.7.

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

(d) Cracked, broken, melted, or damaged webbing material or fittings other than hooks shall not be repaired.

(e) Repair of hooks shall comply with ASME B30.10.

(f) All repairs shall comply with the proof test requirements of Section 9-5.6.

(g) Modifications or alterations to the sling components shall be considered as repairs and shall conform to all other provisions of this Chapter.

(h) There shall be no repairs of a load-bearing splice.

(i) Temporary repairs of either synthetic webbing slings or fittings shall not be permitted.

SECTION 9-5.10: OPERATING PRACTICES

9-5.10.1 Sling Selection

(a) Slings that appear to be damaged shall not be used unless inspected and accepted as usable under Section 9-5.9.

(b) Slings having suitable characteristics for the type of load, hitch, and environment shall be selected in accordance with the requirements of Sections 9-5.5 and 9-5.8.

(c) The rated load of the sling shall not be exceeded.

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

(e) Multiple-leg slings shall be selected according to Tables 19 through 23 when used at the specific angles given in the table. Operation at other angles shall be limited to rated loads of the next lower angle given in the table or calculated by a qualified person.

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(f) Rated loads cited in this chapter are based on pin diameters shown in WSTDA-WS-1. Pin diameters smaller than these may reduce the rated load of the sling.

(g) The fitting shall be of the proper shape and size to ensure that it is seated properly in the hook or lifting device.

9-5.10.2 Cautions to Personnel

(a) All portions of the human body shall be kept from between the sling and the load, and from between the sling and the crane hook or hoist hook.

(b) Personnel should never 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) Synthetic webbing slings shall not be used as bridles on suspended personnel platforms.

9-5.10.3 Effects of Environment

(a) Slings should be stored in an area where they will not be subjected to mechanical, chemical, or ultraviolet damage or extreme temperatures (see Section 9-5.8).

(b) When used at or in contact with extreme temperatures the guidance provided in Section 9-5.8 shall be followed.

(c) When extensive exposure to sunlight or ultraviolet light is experienced by nylon or polyester webbing slings, the sling manufacturer should be consulted for recommended inspection procedure.

9-5.10.4 Rigging Practices

(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.

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

(d) Sharp edges in contact with the sling should be padded with material of sufficient strength to protect 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 shall be avoided.

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

(j) In a basket hitch, the load should be balanced to prevent slippage.

(k) When using 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) In a choker hitch, an angle of choke less than 120 deg should not be used without reducing the rated load (see para. 9-5.5.5).

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

(p) 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.

(q) An object in the eye of a sling should not be wider than one-half the length of the eye.

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Chapter 9-6
Synthetic Roundslings: Selection, Use, and Maintenance

SECTION 9-6.0: SCOPE

This Chapter applies to the selection, use, and maintenance of synthetic endless roundslings, for lifting purposes, fabricated from load bearing core(s) of synthetic yarn(s), enclosed in protective cover(s) (see Fig. 21).

SECTION 9-6.1: TRAINING

Synthetic roundsling users shall be trained in the selection, inspection, cautions to personnel, effects of environment, and rigging practices as covered by this Chapter.

SECTION 9-6.2: MATERIALS AND COMPONENTS

9-6.2.1 Core and Cover

(a) Core yarn(s) shall be of a synthetic fiber.
(b) Covers shall be woven from synthetic yarns.

9-6.2.2 Thread

The thread used in the fabrication of synthetic roundslings shall be manufactured and tested in accordance with WSTDA-TH-1.

9-6.2.3 Coatings

Finishes and coatings shall be compatible with the other components and not impair the performance of the sling.

9-6.2.4 Components

(a) Fittings shall be manufactured to ensure that the rated load shall be at least the same as the synthetic roundsling.
(b) Fittings shall have sufficient strength to sustain twice the rated load of the sling without visible permanent deformation.
(c) All surfaces of fittings shall be cleanly finished and sharp edges removed.
(d) Hook characteristics shall meet the requirements of ASME B30.10.

9-6.2.5 Other Materials

When materials other than polyester are used, the sling manufacturer or a qualified person shall provide specific data. These slings shall comply with all other requirements of this Chapter.

SECTION 9-6.3: FABRICATION AND CONFIGURATIONS

9-6.3.1 Fabrication

Synthetic roundslings shall be fabricated from core yarns wound together with multiple turns and enclosed in protective cover(s).
(a) The cover and core should be the same type of material.
(b) When the core and cover are the same yarn type, the thread should be of the same yarn type.
(c) When the core and cover are of a different yarn type, the thread should be of the same yarn type as the core.
(d) Stitching, if used, should be of the type to prevent unraveling.
(e) The diameter and width of the bearing surface of the fitting can affect the strength of the sling. The sling manufacturer's recommendation should be followed when fittings are used with the sling.

9-6.3.2 Configurations

(a) Single-leg slings, two-leg, three-leg, and four-leg bridle slings, used in vertical, choker, and basket hitches are covered by this Chapter.
(b) 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 9-6.4: DESIGN FACTOR

The design factor for roundslings shall be a minimum of 5.

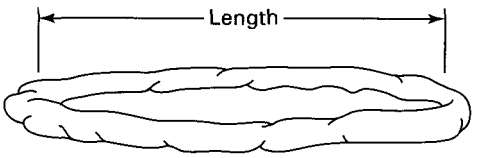
SECTION 9-6.5: RATED LOAD

The term *rated capacity* is commonly used to describe rated load.

9-6.5.1

These rated loads are based on the following factors:
(a) material strength(s)
(b) design factor
(c) type of hitch
(d) angle of loading (see Fig. 22)
(e) diameter of curvature over which the sling is used

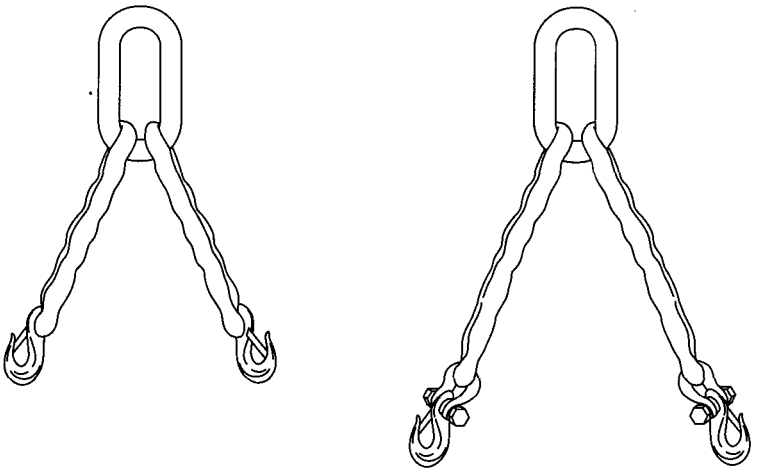
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Endless Roundsling



Endless Roundsling With Center Cover (Eye-and-Eye)



Endless Roundsling With Fittings

Fig. 21 Synthetic Roundslings

9-6.5.2

Table 24 shows rated loads for single-leg vertical, choker, basket hitches, and two-leg bridle slings. For angles other than those shown in this table, use the rated load for the next lower angle, or a qualified person shall calculate the rated load.

9-6.5.3

Horizontal sling angles less than 30 deg shall not be used except as recommended by the sling manufacturer or a qualified person.

NOTE: Rated loads for basket hitches and bridle slings are based on symmetrical loading. See para. 9-6.10.1(d) for nonsymmetrical loading.

9-6.5.4

Rated loads for slings used in a choker hitch shall conform to the values shown in Table 24, provided that the angle of choke is 120 deg or greater (see Fig. 23).

9-6.5.5

Rated loads for angles of choke less than 120 deg shall be determined by using the values in Fig. 23, the sling manufacturer, or a qualified person.

9-6.5.6

Other synthetic roundsling materials and configurations 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.

9-6.5.7

When fittings of the sling have a lower rated load than the synthetic roundsling with which it is being used, the sling shall be identified with a rated load consistent with the lowest load rating of any of the components.

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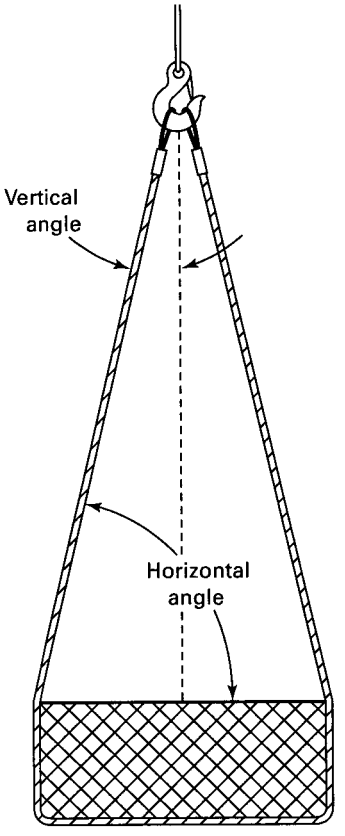


Fig. 22 Angle of Loading

SECTION 9-6.6: PROOF TEST REQUIREMENTS

9-6.6.1

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

(b) All other synthetic roundslings and fittings are not required to be proof tested unless specified by the purchaser.

9-6.6.2 Proof Load Requirements

(a) For single- or multiple-leg slings and endless slings, each leg shall be proof loaded to a minimum of 2 times the single-leg vertical hitch rated load.

(b) The proof load for fittings attached to single legs shall be a minimum of 2 times the single-leg vertical hitch rated load.

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

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

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

SECTION 9-6.7: SLING IDENTIFICATION

9-6.7.1 Identification Requirements

Each sling shall be marked to show:

(a) name or trademark of manufacturer

(b) manufacturer's code or stock number

(c) rated loads for the type(s) of hitch(es) used and the angle upon which it is based

(d) core material

(e) cover material, if different from core material

9-6.7.2 Initial Sling Identification

Sling identification shall be done by the sling manufacturer.

9-6.7.3 Maintenance of Sling Identification

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

9-6.7.4 Replacement of Sling Identification

Replacement of the sling identification shall be considered a repair as specified in paras. 9-6.9.5(a) and (b). Additional proof testing is not required.

SECTION 9-6.8: EFFECTS OF ENVIRONMENT

9-6.8.1 Temperature

(a) Polyester roundslings shall not be used in contact with objects or at temperatures in excess of 194°F (90°C) or at temperatures below −40°F (−40°C).

(b) Some synthetic yarns do not retain their published breaking strength above 140°F (60°C). The roundsling manufacturer should be consulted for the temperature range of roundslings made from other synthetic yarns.

9-6.8.2 Chemically Active Environments

(a) The strength of roundslings can be affected by chemically active environments. Sling materials may be susceptible to damage from caustic or acid substances, vapors, or fumes. Strongly oxidizing environments attack all common sling materials. The sling manufacturer should be consulted before slings are used in chemically active environments.

(b) In chemically active environments, the cover shall be the same type yarn as the load-bearing core.

9-6.8.3

Fittings selected shall be compatible with the mechanical and environmental requirements imposed on the sling.

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Table 24 Rated Load for Single-Leg Polyester Roundslings: Endless and Eye-and-Eye Type

	Hitch Type			Horizontal Angle, deg		
	Vertical	Choker	Vertical Basket	60	45	30
						
Size	lb	lb	lb	lb	lb	lb
1	2,600	2,100	5,200	4,500	3,700	2,600
2	5,300	4,200	10,600	9,200	7,500	5,300
3	8,400	6,700	16,800	14,500	11,900	8,400
4	10,600	8,500	21,200	18,400	15,000	10,600
5	13,200	10,600	26,400	22,900	18,700	13,200
6	16,800	13,400	33,600	29,100	23,800	16,800
7	21,200	17,000	42,400	36,700	30,000	21,200
8	25,000	20,000	50,000	43,300	35,400	25,000
9	31,000	24,800	62,000	53,700	43,800	31,000
10	40,000	32,000	80,000	69,300	56,600	40,000
11	53,000	42,400	106,000	91,800	74,900	53,000
12	66,000	52,800	132,000	114,300	93,300	66,000
13	90,000	72,000	180,000	155,900	127,300	90,000

GENERAL NOTES:

(a) See para. 9-6.3.1.

(b) Roundslings are identified by the vertical rated load shown on the sling identification. The size numbers in the first column have been adopted by the Web Sling & Tie Down Association to describe certain polyester roundslings. They are included for reference only. Other polyester roundslings may have different vertical rated loads.

(c) Color guidelines for polyester roundsling covers are widely used to indicate the vertical rated load of roundslings; however, this is not followed by some manufacturers. Always select and use roundslings by the rated load as shown on the sling identification; never by color.

(d) For choker hitch, the angle of choke shall be 120 deg or greater (see para. 9-6.5.4).

SECTION 9-6.9: INSPECTION, REMOVAL, AND REPAIR

9-6.9.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired slings shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter.

9-6.9.2 Frequent Inspection

(a) A visual inspection for damage shall be performed by the user or other designated person each day or shift the sling is used.

(b) Conditions such as those listed in para. 9-6.9.4 or any other condition that may result in a hazard shall cause the sling to 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.

9-6.9.3 Periodic Inspection

(a) A complete inspection for damage to the sling shall be periodically performed by a designated person. Each sling and component shall be examined individually, taking care to expose and examine all surfaces. The sling shall be examined for conditions such as those listed in para. 9-6.9.4 and a determination made as to whether they constitute a hazard.

(b) Periodic Inspection Frequency. Periodic inspection intervals shall not exceed 1 year. The frequency of periodic inspections should be based on

(1) frequency of sling use

(2) severity of service conditions

(3) nature of lifts being made

(4) experience gained on the service life of slings used in similar circumstances

Guidelines for the time intervals are:

Normal service — yearly

Severe service — monthly to quarterly

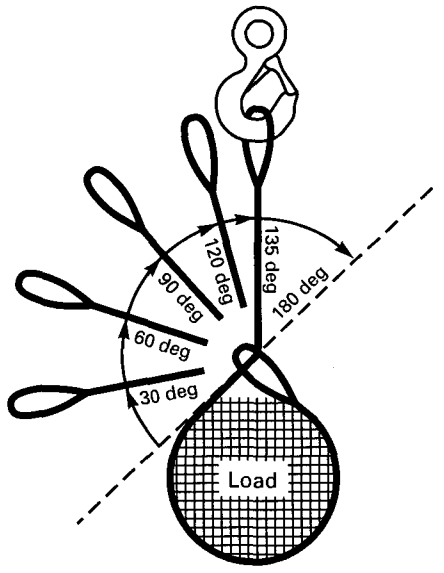
Special service — as recommended by a qualified person

(c) Written records of the most recent periodic inspection shall be maintained and shall include the condition of the sling.

9-6.9.4 Removal Criteria

A synthetic roundsling shall be removed from service if conditions such as the following are present:

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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.

Fig. 23 Angle of Choke

(a) missing or illegible sling identification (see Section 9-6.7)

(b) acid or caustic burns

(c) evidence of heat damage

(d) holes, tears, cuts, abrasive wear, or snags that expose the core yarns

(e) broken or damaged core yarns

(f) weld splatter that exposes core yarns

(g) roundslings that are knotted

(h) discoloration and brittle or stiff areas on any part of the slings, which may mean chemical or ultraviolet/sunlight damage

(i) fittings that are pitted, corroded, cracked, bent, twisted, gouged, or broken

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

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

9-6.9.5 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 agency per Section 9-6.7.

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

(d) Cracked, broken, or bent fittings other than hooks shall not be repaired; they shall be replaced.

(e) Repair of hooks shall comply with ASME B30.10.

(f) All repairs shall comply with the proof test requirements of Section 9-6.6.

(g) Modifications or alterations to the sling or components shall be considered as repairs and shall conform to all other provisions of this Chapter.

(h) There shall be no repairs of load-bearing yarns.

(i) Temporary repairs of either roundslings or fittings shall not be permitted.

SECTION 9-6.10: OPERATING PRACTICES

9-6.10.1 Sling Selection

(a) Slings that appear to be damaged shall not be used unless inspected and accepted as usable under Section 9-6.9.

(b) Slings having suitable characteristics for the type of load, hitch, and environment shall be selected in accordance with the requirements of Sections 9-6.5 and 9-6.8.

(c) The rated load of the sling shall not be exceeded.

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

(e) Multiple-leg slings shall be selected according to Table 24 when used at the specific angles given in the table. Operation at other angles shall be limited to rated loads of the next lower angle given in the table or calculated by a qualified person.

(f) Rated loads cited in this chapter are based on pin diameters shown in WSTDA-RS-1.

(g) The fitting shall be of the proper shape and size to ensure that it is properly seated in the hook or lifting device.

9-6.10.2 Cautions to Personnel

(a) All portions of the human body shall be kept from between the sling and the load, and from between the sling and the crane hook or hoist hook.

(b) Personnel should never 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) Synthetic roundslings shall not be used as bridles on suspended personnel platforms.

9-6.10.3 Effects of Environment

(a) Slings should be stored in an area where they will not be subjected to mechanical, chemical, or ultraviolet damage or extreme temperatures (see Section 9-6.8).

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(b) When used at or in contact with extreme temperatures, the guidance provided in Section 9-6.8 shall be followed.

9-6.10.4 Rigging Practices

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

(b) Slings shall be hitched in a manner providing control of the load.

(c) Sharp edges in contact with the sling should be padded with material of sufficient strength to protect the sling.

(d) Shock loading should be avoided.

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

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

(g) Twisting shall be avoided.

(h) During lifting, with or without load, personnel shall be alert for possible snagging.

(i) In a basket hitch, the load should be balanced to prevent slippage.

(j) When using 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.

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

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

(m) In a choker hitch, an angle of choke less than 120 deg should not be used without reducing the rated load (see para. 9-6.5.5).

(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) Slings shall not be shortened or lengthened by knotting or twisting.

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ASME B30.9-2003 INTERPRETATIONS

Replies to Technical Inquiries
June 1999 through June 2002

FOREWORD

This publication includes all of the written replies issued between the indicated dates by the Secretary, speaking for the ASME B30 Standards Committee, Safety Standards for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings, to inquiries concerning interpretations of technical aspects of ASME B30.9, Slings.

These replies are taken verbatim from the original letters except for a few typographical corrections and some minor editorial corrections made for the purpose of improved clarity. In some few instances, a review of the interpretation revealed a need for corrections of a technical nature; in these cases, a corrected interpretation follows immediately after the original reply.

These interpretations were prepared in accordance with the accredited ASME procedures. ASME procedures provide for reconsideration of these interpretations when or if additional information is available that the inquirer believes might affect the interpretation. Further, persons aggrieved by this interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

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Interpretation: 9-23

Subject: ASME B30.9a-1991, Slings

Date Issued: June 11, 1999

Question (1): Paragraph 9-5.6.2, Inspection Records, states: "Written inspection records, utilizing the identification for each sling as established by the user, should be kept for all slings. These records should show a description of the new sling and its condition on each periodic inspection."

Does this mean a serial number or other identifier unique to each sling? (An example is a power plant having many slings of the same type, rating, and manufacturer.)

Reply (1): The provisions of para. 9-5.6.2 indicate that a method of distinguishing individual slings, one from another, should be developed by the user. Individual serial numbers or another unique identification method could fulfill this recommended practice.

Question (2): Paragraph 9-5.1.6 requires permanent markings but does not mention a unique identifier for each sling. Is a unique identifier required for each sling?

Reply (2): The items listed in paras. 9-5.1.6(a) through (d) list the mandatory identification requirements of the sling manufacturer. Any additional specific or unique identifier is not specified or required of the sling manufacturer by this volume of the B30 Standard.

Interpretation: 9-24

Subject: ASME B30.9-1996, Slings

Date Issued: January 19, 2001

Question: Paragraph 9-2.4.4 specifically requires individually testing multileg bridle slings to a specific number of times the vertical rated load of a single-leg sling of the same size, grade, or construction of rope. What is the reason for this method in lieu of applying a proof load of 2 times the force of the combined legs as described for the master link to which the legs are connected?

Reply: The requirements of para. 9-2.4.4 are that each individual component of the sling be subjected to the specified proof load for that component. The B30 Committee did not and does not intend to specify the actual method used to achieve this requirement.

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Interpretation: 9-25

Subject: ASME B30.9-1996, Slings

Date Issued: June 3, 2002

Question (1): Does a written documentation of a visual inspection meet the requirements of Section 9-2.8 for periodic inspection?

Reply (1): Yes.

Question (2): How does a visual inspection verify the integrity of the splice or the inner core of a sling?

Reply (2): Proper visual inspection by a trained and qualified person will provide indications of both the splice and the inner core (we assume this to refer to either the fiber core or the independent wire rope core) condition. If these indications warrant, further inspection and evaluation can be made. If indications of a potential problem are detected, additional evaluation by a qualified person may be required. A proof test may or may not provide additional relevant information regarding either the splice or the inner core's condition.

Question (3): Is proof testing a sling on an annual basis detrimental to the sling?

Reply (3): No.

Question (4): Is proof testing a sling an appropriate way of performing a periodic inspection?

Reply (4): Proof testing of slings may be an appropriate part of, but not a substitute for, the required Periodic Inspection.

Question (5): Are quadruple-sling ratings to be the same as triple-sling ratings for wire rope slings?

Reply (5): No.

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