ASME B30.26-2004

Rigging Hardware

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

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Three Park Avenue • New York, NY 10016

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The next edition of this Standard is scheduled for publication in 2007. 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 will also be published within the next edition of the Standard.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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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 standards (each complete as to construction and installation; inspection, testing, and maintenance; and operation) will 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 the 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 Committee and by ASME, was approved by ANSI and designated as an American National Standard on December 2, 2004.

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.

ASME B30 STANDARDS COMMITTEE
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 STANDARD 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
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, B30.27, and B30.28 are in the developmental stage.

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 STANDARD

This Standard applies to the construction, installation, operation, inspection, maintenance, and safe use of lifting equipment used in construction and industrial settings. This includes, but is not limited to: articulating-boom, container, gantry, mobile, pedestal, portal, tower and stacker cranes; balance-lifting units; below-the-hook lifting devices; cableways; derricks; jacks; hoists; hooks; loads suspended from rotorcraft; material placement systems; monorails; rigging hardware; and scrap and material handlers.

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.

SECTION V: MANDATORY AND ADVISORY RULES

Mandatory rules of this Standard 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

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

RIGGING HARDWARE

Chapter 26-0
Scope, Definitions, and References

SECTION 26-0.1: SCOPE

Volume B30.26 includes provisions that apply to the construction, installation, operation, inspection, and maintenance of detachable rigging hardware used for lifting purposes in conjunction with equipment described in other volumes of the B30 Standard. This hardware includes shackles, links, rings, swivels, turnbuckles, eyebolts, hoist rings, wire rope clips, wedge sockets, and rigging blocks. Use of the same hardware for purposes other than lifting is excluded from the provisions of this Volume.

SECTION 26-0.2: DEFINITIONS

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

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

bow, shackle: the curved portion of the shackle body opposite the pin, often referred to as the bail, the body, the dee, or the bowl (see Fig. 3).

dead end: the section of wire rope that is not tensioned under load (see Figs. 10 and 11).

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

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

ears, shackle: portion of the shackle body which supports the shackle pin (see Fig. 3).

hardware service:

normal: service that involves use of loads at or below the rated load.

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

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

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.

in-line loading: condition where the load is applied through the centerline of the rigging hardware at the intended bearing points.

jaw: a U-shaped load bearing connection, designed for use with a removable pin (see Fig. 5).

line pull: the tension load in a rope entering a rigging block (see Fig. 17).

live end: the section of wire rope that is tensioned under load. (see Figs. 10 and 11).

manufacturer: The entity responsible for the physical production of an item.

pin, shackle: a steel bolt made to span the two shackle ears (see Fig. 3).

primary load fitting: the fitting on a rigging block that carries the highest applied load during use (see Fig. 17).

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 rigging hardware.

qualified person: a person who, by possession of a recognized degree in an applicable field or certificate of professional standing, 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 capacity: refer to rated load.

rated load: the maximum allowable working load established by the rigging hardware manufacturer. The terms "rated capacity" and "working load limit" are commonly used to describe rated load.

saddle: the base of a wire rope clip (see Fig. 10).

shackle: a U-shaped load-bearing connector designed to be used with a removable pin (see Fig. 1).

shock load: any condition which causes a momentary increase in the forces in a load-supporting component beyond the weight of the actual load being lifted.

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

swivel hoist ring: a load-supporting device capable of pivoting and rotating, consisting of four components: a bolt, a swivel bearing, a bushing flange, and a load connection fitting such as a bail or eye (see Fig. 8).

turnbuckle: an adjustable device consisting of three primary components: a body, a right-hand threaded end fitting, and a left-hand threaded end fitting (see Fig. 5).

wedge socket: an end fitting that terminates a wire rope by compressing the wire rope between a wedge and socket body (see Fig. 11).

wire rope clip: a fitting for clamping two parts of wire rope of the same diameter to each other by compressing the wire ropes between a saddle and a U-bolt or between two saddles (see Fig. 10).

u-bolt type: wire rope clip using one saddle and a U-bolt.

double saddle type: wire rope clip using two saddles.

working load limit (WLL): see *rated load*.

CHAPTER 26-1
Shackles—Selection, Use, and Maintenance

SECTION 26-1.0: SCOPE

This Chapter applies to shackles.

SECTION 26-1.1: TYPES AND MATERIALS

26-1.1.1 Types

(*a*) Body types covered are anchor, chain, and synthetic sling (see Fig. 1).

(*b*) Pin types covered are screw pin and bolt-type (see Fig. 1).

(*c*) Shackles other than those detailed in this chapter shall be used only in accordance with recommendations of the shackle manufacturer or a qualified person.

NOTE: Round pin shackles are not covered by the scope of this volume, because they have limited application in lifting. They are only restrained by a cotter pin and may present a hazard in odd angle loading conditions.

26-1.1.2 Materials

The shackle shall have sufficient ductility to permanently deform before losing the ability to support the load at the temperatures at which the manufacturer has specified for use.

SECTION 26-1.2: DESIGN FACTOR

(*a*) The design factor for shackles up to and including a 150 ton rated load shall be a minimum of 5.

(*b*) The design factor for shackles over 150 ton rated load shall be a minimum of 4.

SECTION 26-1.3: RATED LOADS

Rated load shall be in accordance with the recommendation of the shackle manufacturer. The terms "rated capacity" and "working load limit" are commonly used to describe rated load.

SECTION 26-1.4: PROOF TEST

26-1.4.1 Proof Test Requirements

(*a*) Shackles are not required to be proof tested unless specified by the purchaser.

(*b*) If proof tested, a shackle shall be inspected after the test for the conditions stated in para. 26-1.8.4.

26-1.4.2 Proof Load Requirements

(*a*) The proof load for a shackle up to and including a 150 ton rated load shall be a minimum of 2 and a max-

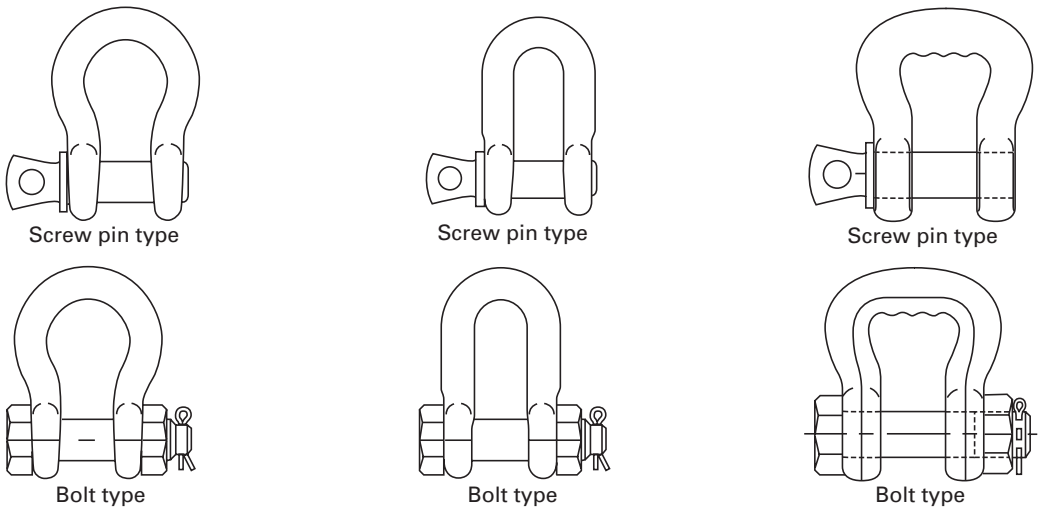


Fig. 1 Shackle Types

imum of 2.2 times the rated load unless approved by the manufacturer.

(*b*) The proof load for a shackle over a 150 ton rated load shall be a minimum of 1.33 and a maximum of 2 times the rated load unless approved by the manufacturer.

SECTION 26-1.5: IDENTIFICATION

26-1.5.1 Shackle Body Identification

Each new shackle body shall have forged, cast, or die stamped markings by the manufacturer to show

(*a*) name or trademark of manufacturer

(*b*) rated load

(*c*) size

26-1.5.2 Shackle Pin Identification

Each new shackle pin shall have forged, cast, or die-stamped markings by the manufacturer to show

(*a*) name or trademark of manufacturer

(*b*) grade, material type, or load rating

26-1.5.3 Maintenance of Identification

Shackle identification should be maintained by the user so as to be legible throughout the life of the shackle.

SECTION 26-1.6: EFFECTS OF ENVIRONMENT

26-1.6.1 Temperature

When shackles are to be used at temperatures above 400°F (204°C) or below −40°F (−40°C), the shackle manufacturer or a qualified person should be consulted.

26-1.6.2 Chemically Active Environments

The strength of shackles can be affected by chemically active environments such as caustic or acid substances or fumes. The shackle manufacturer or a qualified person should be consulted before shackles are used in chemically active environments.

SECTION 26-1.7: TRAINING

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

SECTION 26-1.8: INSPECTION, REPAIR, AND REMOVAL

26-1.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired shackles shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter. Written records are not required.

26-1.8.2 Frequent Inspection

(*a*) A visual inspection shall be performed by the user or other designated person each day before the shackle is used. Semi-permanent and inaccessible locations where frequent inspections are not feasible shall have periodic inspections performed.

(*b*) Conditions such as those listed in para. 26-1.8.4 or any other condition that may result in a hazard shall cause the shackle to be removed from service. Shackles shall not be returned to service until approved by a qualified person.

(*c*) Written records are not required.

26-1.8.3 Periodic Inspection

(*a*) A complete inspection of the shackle shall be performed by a designated person. The shackle shall be examined for conditions such as those listed in Section 26-1.8.4 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 shackle use

(*2*) severity of service conditions

(*3*) nature of lifts being made

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

(*5*) Guidelines for the time intervals are

(*a*) normal service – yearly

(*b*) severe service – monthly to quarterly

(*c*) special service – as recommended by a qualified person

(*c*) Written records are not required.

26-1.8.4 Removal Criteria

Shackles shall be removed from service if damage such as the following is visible and shall only be returned to service when approved by a qualified person:

(*a*) missing or illegible manufacturer's name or trademark and/or rated load identification

(*b*) indications of heat damage including weld spatter or arc strikes

(*c*) excessive pitting or corrosion

(*d*) bent, twisted, distorted, stretched, elongated, cracked, or broken load-bearing components

(*e*) excessive nicks or gouges

(*f*) a 10% reduction of the original or catalog dimension at any point around the body or pin

(*g*) incomplete pin engagement

(*h*) excessive thread damage

(*i*) evidence of unauthorized welding

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

26-1.8.5 Repairs and Modifications

(*a*) Repairs, alterations, or modifications shall be as specified by the shackle manufacturer or a qualified person.

(*b*) Replacement parts, such as pins, shall meet or exceed the original equipment manufacturer's specifications.

SECTION 26-1.9: OPERATING PRACTICES

26-1.9.1 Shackle Selection

(*a*) Shackles having suitable characteristics for the type of sling, load, hitch, and environment shall be selected in accordance with the shackle manufacturer's data.

NOTE: The angle of loading affects the stress in the shackle. As the horizontal angle decreases, the stress increases in the shackle (see Fig. 2).

(*b*) The rated load of the shackle shall not be exceeded.

(*c*) Shackles that appear to be damaged shall not be used until inspected and accepted as usable under Section 26-1.8.

26-1.9.2 Cautions to Personnel

(*a*) All portions of the human body shall be kept from between the shackle, the load, and any other rigging during the lift.

(*b*) Personnel should stand clear of the suspended load.

(*c*) Personnel shall not ride the shackle.

26-1.9.3 Storage & Work Environments

(*a*) Shackles should be stored in an area where they will not be subjected to damage, corrosive action, or extreme heat.

(*b*) If extreme temperatures or chemically active environments are involved, the guidance provided in paras. 26-1.6.1 or 26-1.6.2 shall be followed.

26-1.9.4 Rigging Practices

(*a*) The screw pin shall be fully engaged, with the shoulder in contact with the shackle body (see Fig. 3).

(*b*) If a shackle is designed for a cotter pin, it shall be used and maintained in good working condition. Alterations or modifications shall comply with para. 26-1.8.5(a).

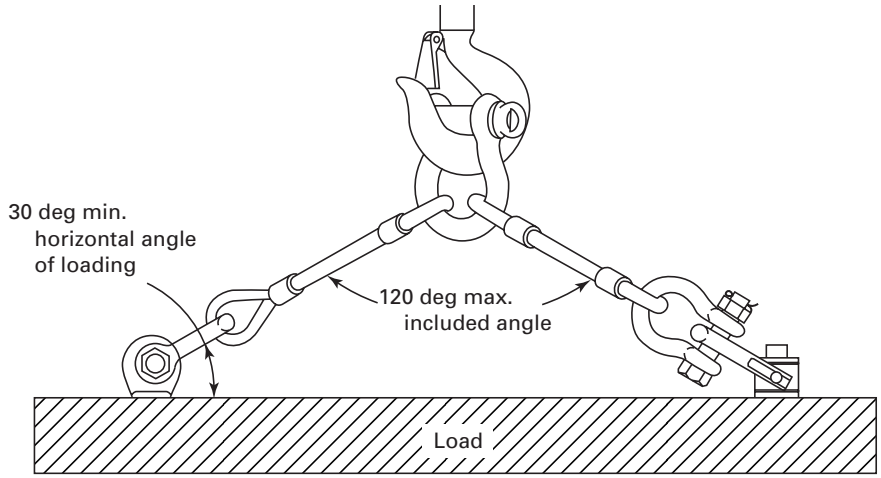
(*c*) Contact with sharp edges that could damage the shackle should be avoided.

(*d*) Shock loading should be avoided.

(*e*) The load applied to the shackle should be centered in the bow of the shackle to prevent side loading of the shackle.

(*f*) Multiple sling legs should not be applied to the shackle pin.

(*g*) If the shackle is to be side loaded, the rated load shall be reduced according to the recommendations of the manufacturer or a qualified person (see Fig. 4).



Horizontal Angle, deg	Stress Multiplier
90	1.000
60	1.155
45	1.414
30	2.000

Fig. 2 Angle of Loading (Shackles)

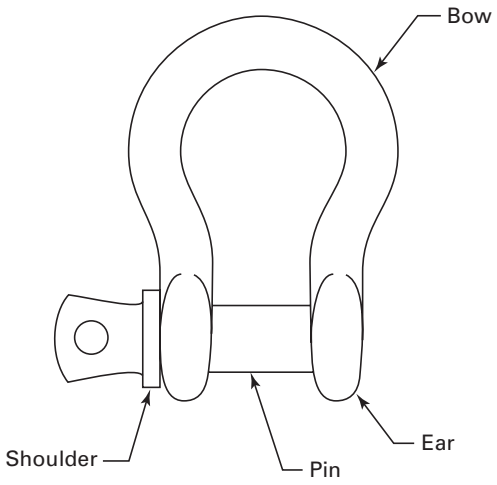


Fig. 3 Typical Shackle Components

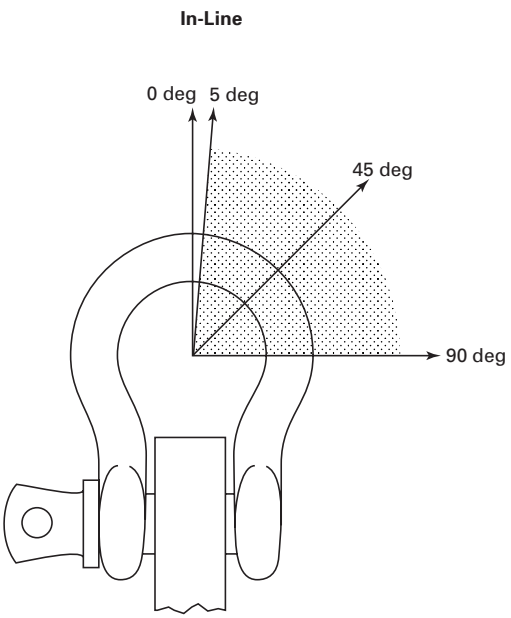
(*h*) The screw pin shackle shall not be rigged in a manner that would cause the pin to unscrew.

(*i*) For long-term installations, bolt type shackles should be used; if screw pin type shackles are used, the pin shall be secured from rotation or loosening.

(*j*) Shackles should not be dragged on an abrasive surface.

(*k*) Multiple slings in the body of a shackle shall not exceed 120 deg included angle.

(*l*) When a shackle is used in a choker hitch, the pin shall be connected to the choking eye of the sling.



Side Loading Angle, deg	% Rate Load Reduction
In-line (0) to 5	None
6 to 45	30%
46 to 90	50%
Over 90	Not recommended to load in this condition. Consult manufacturer or qualified person.

Fig. 4 Side Loading

Chapter 26-2
Adjustable Hardware — Selection, Use, and Maintenance

SECTION 26-2.0: SCOPE

This Chapter applies to adjustable hardware including turnbuckles, eyebolts, eye nuts, and swivel hoist rings.

SECTION 26-2.1: TYPES AND MATERIALS

26-2.1.1 Types

(*a*) Turnbuckles, including open and pipe body types with hook, eye, or jaw end fittings (see Fig. 5).

(*b*) Eyebolts including shoulder nut, nonshoulder nut, nonshoulder machinery, and shoulder machinery types (see Fig. 6).

(*c*) Eye nuts (see Fig. 7).

(*d*) Swivel hoist rings (see Fig. 8).

(*e*) Adjustable hardware other than those detailed in this chapter shall be used only in accordance with recommendations of the manufacturer or a qualified person.

26-2.1.2 Materials

The hardware, excluding bushings and bearings, shall have sufficient ductility to permanently deform before losing the ability to support the load at the temperatures at which the manufacturer has specified for use.

SECTION 26-2.2: DESIGN FACTOR

The design factor for adjustable hardware shall be a minimum of 5.

SECTION 26-2.3: RATED LOADS

Rated load shall be in accordance with the recommendation of the hardware manufacturer. The terms "rated capacity" and "working load limit" are commonly used to describe rated load.

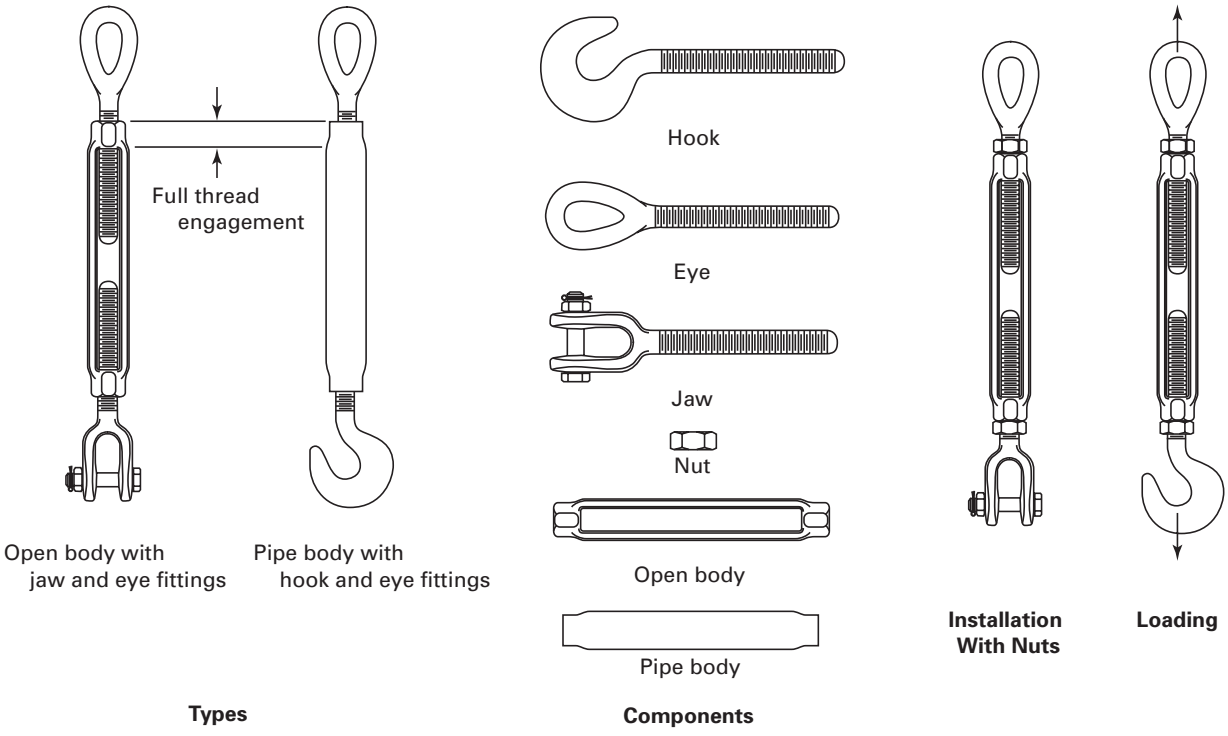


Fig. 5 Turnbuckles

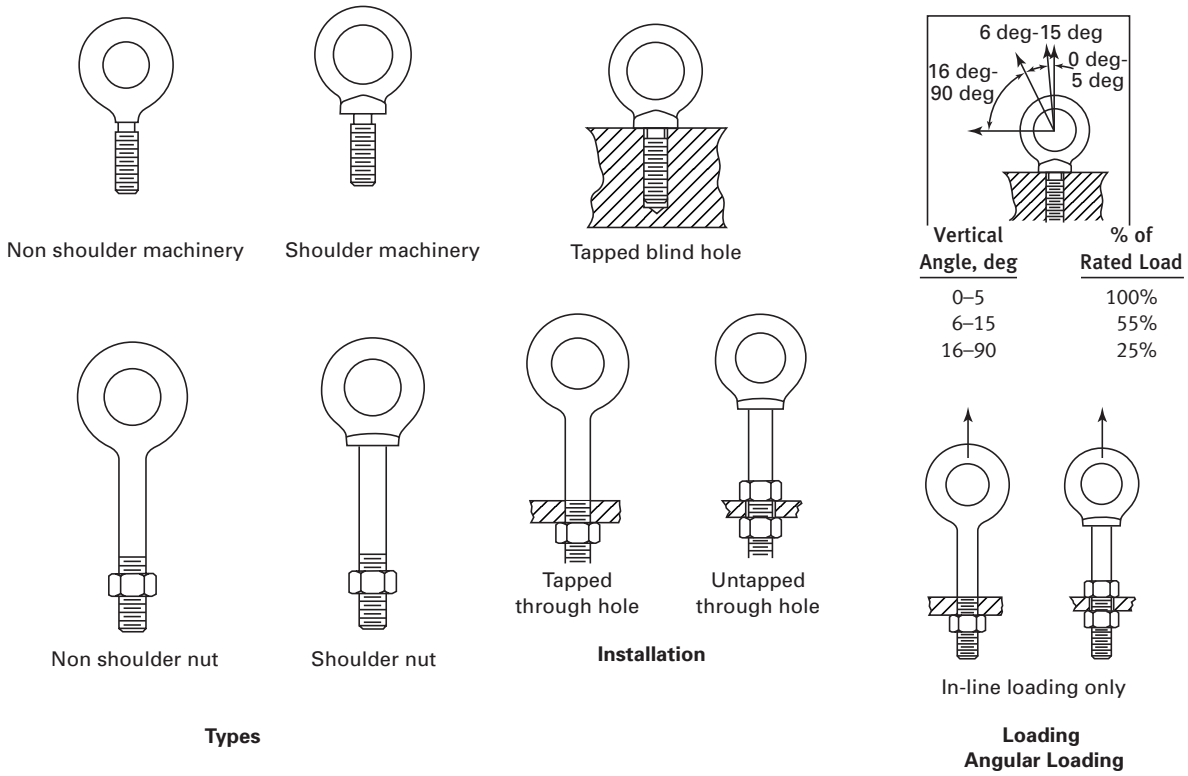


Fig. 6 Eyebolts

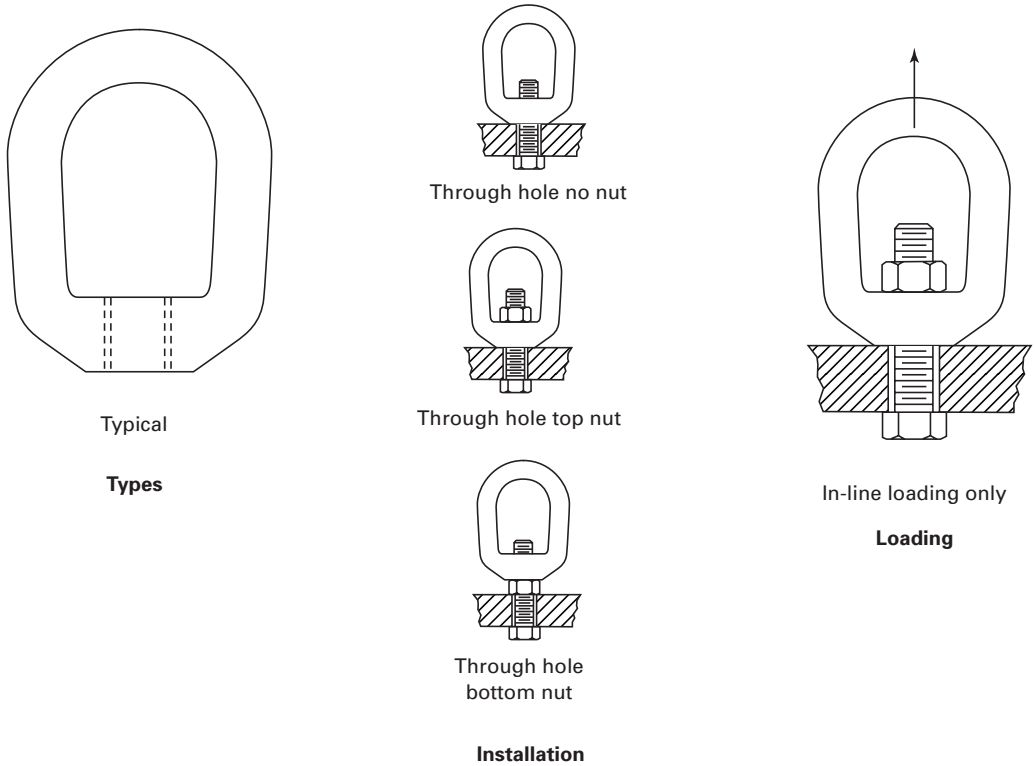


Fig. 7 Eye Nuts

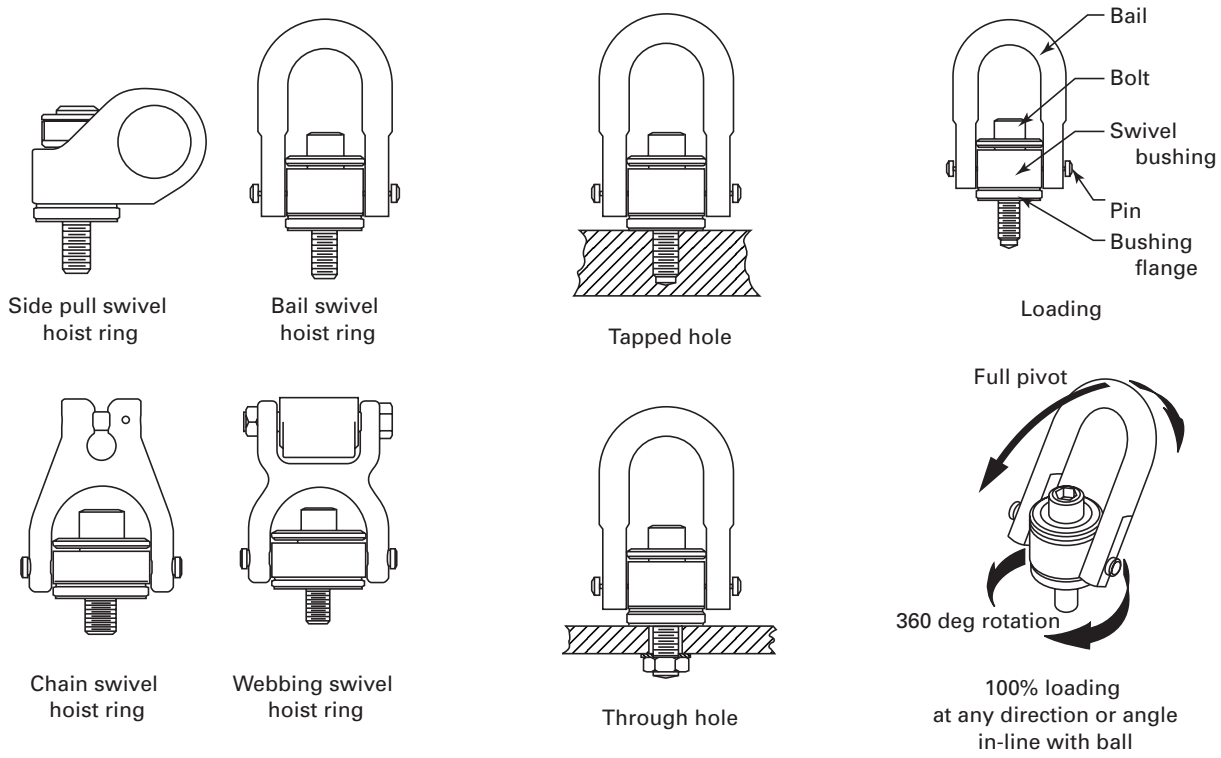


Fig. 8 Swivel Hoist Rings

SECTION 26-2.4: PROOF TEST

26-2.4.1 Proof Test Requirements

(*a*) New adjustable hardware is not required to be proof tested unless specified by the purchaser.

(*b*) All repairs to swivel hoist rings with bushings or bearings should be proof tested.

(*c*) If proof tested, adjustable hardware shall be inspected after the test for the conditions stated in para. 26-2.8.4.

26-2.4.2 Proof Load Requirements

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

SECTION 26-2.5: IDENTIFICATION

26-2.5.1 Turnbuckle, Eyebolt, and Eye Nut Identification

Each turnbuckle, eyebolt, and eye nut shall be marked to show

(*a*) name or trademark of manufacturer
(*b*) size or rated load
(*c*) grade for alloy eyebolts

26-2.5.2 Swivel Hoist Ring Identification

Each swivel hoist ring shall be marked to show

(*a*) name or trademark of manufacturer
(*b*) rated load
(*c*) torque value

26-2.5.3 Adjustable Hardware Identification

Adjustable hardware identification shall be provided by the manufacturer.

26-2.5.4 Maintenance of Identification

Turnbuckle, eyebolt, eye nut, and swivel hoist ring identification should be maintained by the user so as to be legible during the life of the hardware.

SECTION 26-2.6: EFFECTS OF ENVIRONMENT

26-2.6.1 Temperature

(*a*) When adjustable hardware, excluding swivel hoist rings and carbon steel eyebolts, is to be used at temperatures above 400°F (204°C) or below −40°F (−40°C), the hardware manufacturer or a qualified person should be consulted.

(*b*) When swivel hoist rings are to be used at temperatures above 400°F (204°C) or below −20°F (−29°C), the hardware manufacturer or a qualified person should be consulted.

(*c*) When carbon steel eyebolts are to be used at temperatures above 275°F (135°C) or below 30°F (−1°C), the hardware manufacturer or a qualified person should be consulted.

26-2.6.2 Chemically Active Environments

The strength of adjustable hardware can be affected by chemically active environments such as caustic or acid substances or fumes. The adjustable hardware manufacturer or a qualified person should be consulted before use in chemically active environments.

SECTION 26-2.7: TRAINING

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

SECTION 26-2.8: INSPECTION, REPAIR, AND REMOVAL

26-2.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired adjustable hardware shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter. Written records are not required.

26-2.8.2 Frequent Inspection

(*a*) A visual inspection shall be performed by the user or other designated person each shift before the adjustable hardware is used. Semi-permanent and inaccessible locations where frequent inspections are not feasible shall have periodic inspections performed.

(*b*) Conditions such as those listed in para. 26-2.8.4 or any other condition that may result in a hazard shall cause the adjustable hardware to be removed from service. Adjustable hardware shall not be returned to service until approved by a qualified person.

(*c*) Written records are not required.

26-2.8.3 Periodic Inspection

(*a*) A complete inspection of the adjustable hardware shall be performed by a designated person. The adjustable hardware shall be examined for conditions such as those listed in para. 26-2.8.4 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 use

(*2*) severity of service conditions

(*3*) nature of lifts being made

(*4*) experience gained on the service life of adjustable hardware used in similar circumstances

(*5*) Guidelines for the time intervals are

(*a*) normal service – yearly

(*b*) severe service – monthly to quarterly

(*c*) special service – as recommended by a qualified person

(*c*) Written records are not required.

26-2.8.4 Removal Criteria

Adjustable hardware shall be removed from service if damage such as the following is present and shall only be returned to service when approved by a qualified person:

(*a*) missing or illegible identification

(*b*) indications of heat damage including weld spatter or arc strikes

(*c*) excessive pitting or corrosion

(*d*) bent, twisted, distorted, stretched, elongated, cracked, or broken load-bearing components

(*e*) excessive nicks or gouges

(*f*) a 10% reduction of the original or catalog dimension at any point

(*g*) excessive thread damage or wear

(*h*) evidence of unauthorized welding or modification

(*i*) for swivel hoist rings, lack of the ability to freely rotate or pivot

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

26-2.8.5 Repairs and Modifications

(*a*) Repairs, alterations, or modifications shall be as specified by the adjustable hardware manufacturer or a qualified person.

(*b*) Replacement parts, including nuts, pins, and bolts, shall meet or exceed the original equipment manufacturer's specifications.

SECTION 26-2.9: OPERATING PRACTICES

26-2.9.1 Adjustable Hardware Selection

(*a*) Adjustable hardware having suitable characteristics for the type of load, hitch, angle of loading, and environment shall be selected in accordance with the adjustable hardware manufacturer's data.

NOTE 1: The angle of loading affects the stress in the hardware. As the horizontal angle decreases, the stress increases (see Fig. 9).

NOTE 2: The integrity of the load where the adjustable hardware attaches is the responsibility of the end user.

(*b*) The rated load of the adjustable hardware shall not be exceeded.

(*c*) Adjustable hardware that appears to be damaged shall not be used until inspected and accepted as usable per Section 26-2.8.

26-2.9.2 Cautions to Personnel

(*a*) All portions of the human body shall be kept from between the rigging hardware, the load, and any other rigging during the lift.

(*b*) Personnel should stand clear of the suspended load.

(*c*) Personnel shall not ride rigging hardware.

26-2.9.3 Storage & Work Environments

(*a*) Adjustable hardware should be stored in an area where it will not be subjected to damage, corrosive action, or extreme heat.

(*b*) If extreme temperatures or chemically active environments are involved, the guidance provided in paras. 26-2.6.1 or 26-2.6.2 shall be followed.

26-2.9.4 Rigging Practices

26-2.9.4.1 Turnbuckles

(*a*) Turnbuckle end fitting threads shall be fully engaged in the body threads.

NOTE: Pipe bodies conceal the length of thread engagement. Verify full engagement before loading (see Fig. 5).

(*b*) Components, including pins, bolts, nuts, or cotter pins used with jaw ends, shall be in good working condition prior to use. Alterations or modifications shall comply with para. 26-2.8.5(a).

(*c*) If locking nuts (see Fig. 5) are used they shall be compatible with the threads of the turnbuckle end.

(*d*) Contact with obstructions that could damage or bend the turnbuckle should be avoided.

(*e*) Shock loading should be avoided.

(*f*) The load applied to the turnbuckle should be in line and in tension.

(*g*) Turnbuckles should not be side loaded.

(*h*) Turnbuckles should be rigged or secured to prevent unscrewing during the lift.

(*i*) For long-term installations, turnbuckles shall be secured to prevent unscrewing.

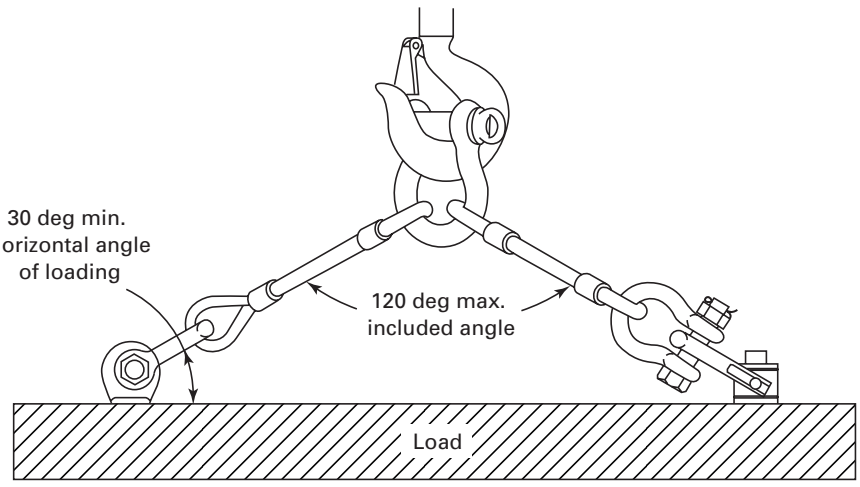
(*j*) Turnbuckles should not be dragged on an abrasive surface.

(*k*) Turnbuckles should be adjusted with a properly sized wrench, used on the wrench flats of the turnbuckle body.

26-2.9.4.2 Eyebolts

(*a*) Eyebolts should be tightened or otherwise secured against rotation during the lift.

(*b*) When used in a tapped blind hole, the effective thread length shall be at least $1\frac{1}{2}$ times the diameter of the bolt for engagement in steel (see Fig. 6). For other thread engagements or engagement in other materials, contact the eyebolt manufacturer or a qualified person.



Horizontal Angle, deg	Stress Multiplier
90	1.000
60	1.155
45	1.414
30	2.000

Fig. 9 Angle of Loading (Adjustable Hardware)

(*c*) When used in a tapped through-hole of less than one diameter thickness, a nut shall be used under the load and shall be fully engaged and tightened securely against the load (see Fig. 6).

(*d*) When used in an untapped through-hole the nut under the load shall be fully engaged. If the eyebolt is not shouldered to the load, a second nut on top of the load should be used where possible (see Fig. 6).

(*e*) Eyebolts not shouldered to the load shall only be used for in-line loads (see Fig. 6).

(*f*) Only shoulder eyebolts shall be used for angular lifting. When used for angular lifting, the shoulder shall be flush and securely tightened against the load. The working load limit (WLL) must be reduced as shown in Fig. 6.

(*g*) When using shoulder eyebolts for angular lifts, the plane of the eye shall be aligned with the direction of loading. Flat washers may be used under the shoulder to position the plane of the eye (see Fig. 6).

(*h*) Eyebolts shall be in good working condition prior to use. Alterations or modifications shall comply with para. 26-2.8.5(a).

(*i*) Shock loading should be avoided.

26-2.9.4.3 Eye Nuts

(*a*) Eye nuts should be secured against rotation during the lift.

(*b*) The threads of the eye nut shall be fully engaged (see Fig. 7).

(*c*) Eye nuts shall only be used for in-line loads (see Fig. 7).

(*d*) The plane of the eye may be positioned with a flat washer(s) or lock nut.

(*e*) Components shall be in good working condition prior to use. Alterations or modifications shall comply with para. 26-2.8.5(a).

(*f*) Shock loading should be avoided.

26-2.9.4.4 Swivel Hoist Rings

(*a*) When used in a threaded-hole, the effective thread length shall be $1^1/_2$ times the diameter of the bolt for steel (see Fig. 8). For other thread engagements or engagement in other materials, contact the swivel hoist ring manufacturer or a qualified person.

(*b*) When used in a through-hole application, a nut and washer shall be used. The washer and nut shall be in accordance with the swivel hoist ring manufacturer's recommendations. The nut shall be fully engaged (see Fig. 8).

(*c*) The bushing flange (see Fig. 8) shall fully contact the load surface.

(*d*) Spacers or washers shall not be used between the bushing flange and the mounting surface of the load being lifted.

(*e*) The swivel hoist ring shall be tightened to the torque specifications of the manufacturer.

(*f*) The swivel hoist ring shall be free to rotate and pivot without interference during lifting (see Fig. 8).

(*g*) The load applied to the swivel hoist ring shall be centered in the bail to prevent side loading.

(*h*) Any attached lifting component shall be narrower than the inside width of the bail to avoid spreading (see Fig. 8).

(*i*) Components shall be in good working condition prior to use. Alterations or modifications shall comply with para. 26-2.8.5(a).

(*j*) Ensure that the swivel hoist ring WLL meets or exceeds the anticipated angular rigging tension (see Fig. 9).

(*k*) Shock loading should be avoided.

Chapter 26-3
Compression Hardware – Selection, Use, and Maintenance

SECTION 26-3.0: SCOPE

This Chapter applies to compression hardware including forged wire rope clips and wedge sockets.

SECTION 26-3.1: TYPES, MATERIALS, AND ASSEMBLY

26-3.1.1 Types

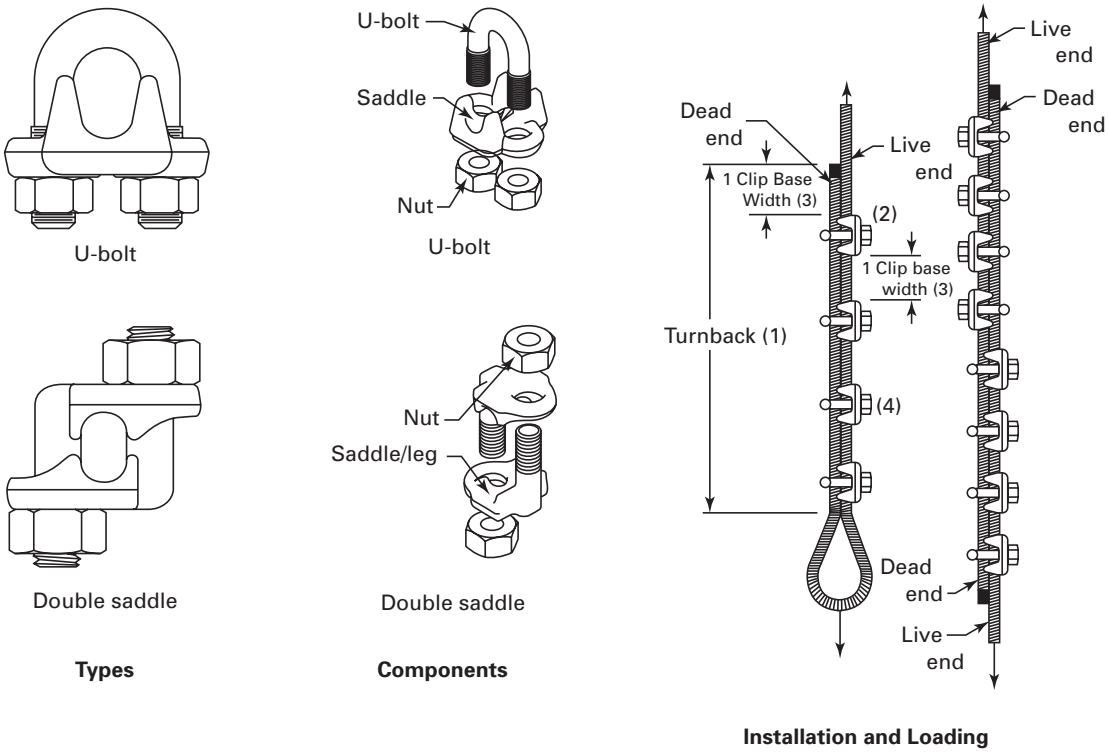
(*a*) Wire rope clip types covered are U-bolt and double saddle (see Fig. 10).

(*b*) Wedge sockets (see Fig. 11).

(*c*) Compression hardware other than those detailed in this chapter shall be used only in accordance with recommendations of the manufacturer or a qualified person.

26-3.1.2 Materials

(*a*) Wire rope clip materials shall be of sufficient strength such that failure of the wire rope will occur before failure of the wire rope clip at the temperatures



GENERAL NOTE: Correct number of clips for wire rope size shall be used.
NOTES:
(1) correct turnback length should be used
(2) correct orientation of saddle on live end shall be observed
(3) correct spacing of clips should be used
(4) correct torque on nuts shall be applied

Fig. 10 Wire Rope Clips

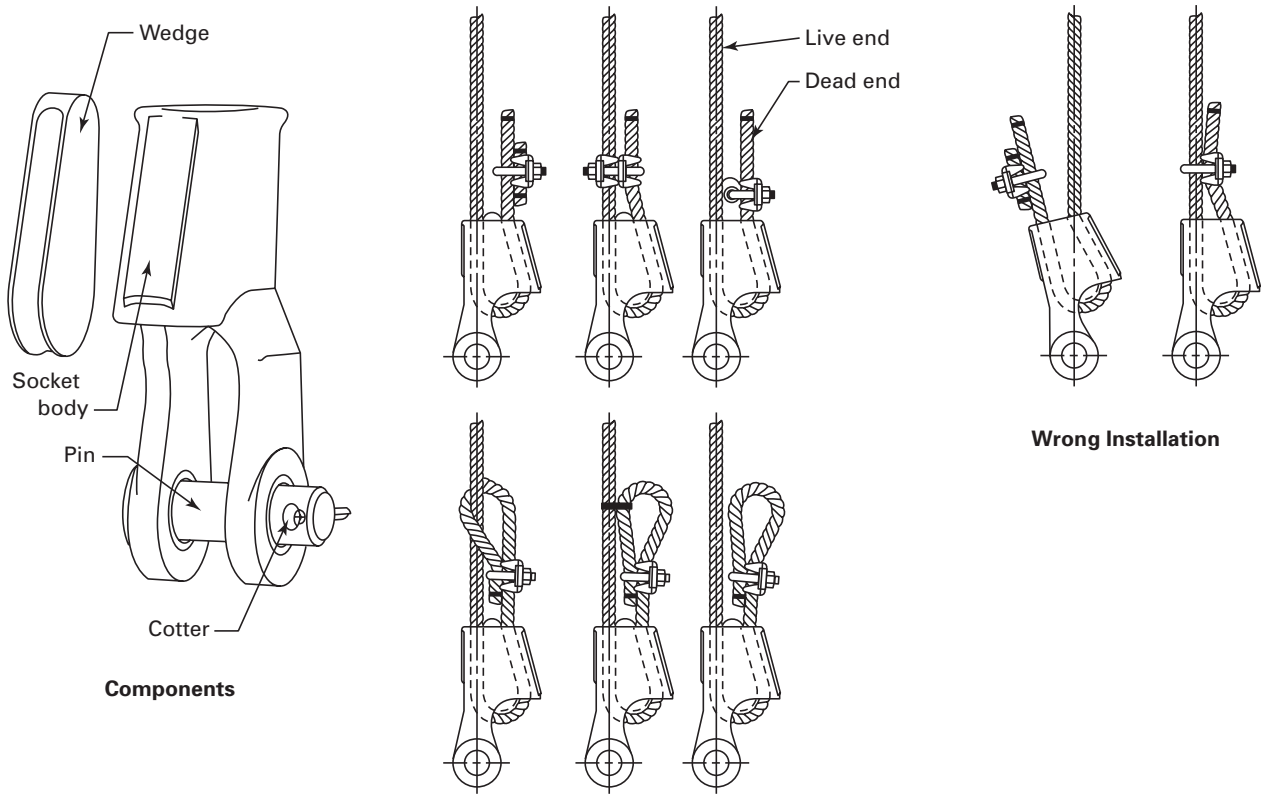


Fig. 11 Wedge Sockets

that the manufacturer has specified for use. Saddles shall be forged steel.

(*b*) Wedge socket materials shall be of sufficient strength such that failure of the wire rope will occur before failure of the wedge socket at the temperatures, that the manufacturer has specified for use.

26-3.1.3 Assembly – Wire Rope Clips

(*a*) Before installing a wire rope clip on plastic coated or plastic impregnated wire rope, consult the wire rope clip manufacturer, wire rope manufacturer, or a qualified person.

(*b*) For U-bolt clips used to create end terminations, the saddle shall be placed on the live end of the wire rope, with the U-bolt on the dead end side (see Fig. 10).

(*c*) At least the minimum number of clips as recommended by the manufacturer or a qualified person shall be used.

(*d*) The spacing and turn-back should be as recommended by the manufacturer or a qualified person.

(*e*) The wire rope clip shall be tightened to the torque recommended by the manufacturer or a qualified person.

(*f*) After assembly, the connection shall be loaded to at least the expected working load. After unloading, wire rope clips shall then be re-tightened to the torque recommended by the manufacturer or a qualified person.

26-3.1.4 Assembly – Wedge Sockets

(*a*) The wedge socket shall be assembled as recommended by the manufacturer or a qualified person.

(*b*) Before installing a wedge socket on plastic coated or plastic impregnated wire rope, consult the wedge socket manufacturer, wire rope manufacturer, or a qualified person.

(*c*) The live end of the wire rope in the wedge socket cavity shall be in alignment with the socket's pin (see Fig. 11).

(*d*) The assembler shall match the proper wedge with the socket for the wire rope to be installed.

NOTE: Wedges shall not be interchanged between different manufacturers' sockets or models.

(*e*) The length of the dead end tail of the wire rope shall be as required by the manufacturer or a qualified person.

(*f*) The dead end tail of the wire rope extending beyond the wedge socket shall be secured in a manner rec-

ommended by the wedge socket manufacturer or a qualified person (see Fig. 11).

(*g*) The dead end of the wire rope shall not be secured to the live end of the wire rope such that it restricts the movement of the live end (see Fig. 11).

(*h*) After assembly, the connection shall be loaded to fully seat the wedge before use.

SECTION 26-3.2: DESIGN FACTOR

Due to the nature of the design and use, wire rope clips and wedge sockets do not have a conventional design factor. Wire rope clips and wedge sockets shall be designed to have an 80% minimum connection efficiency based on the wire rope published minimum breaking force with which they are used.

SECTION 26-3.3: RATED LOADS

The rated load for wire rope assemblies using compression hardware is based on the following factors:

(*a*) wire rope minimum breaking force

(*b*) 80% minimum connection efficiency

(*c*) design factor of the wire rope application

SECTION 26-3.4: PROOF TEST

26-3.4.1 Proof Test Requirements

(*a*) Compression hardware is not required to be proof tested unless specified by the purchaser.

(*b*) If required, the proof test shall be applied to the wedge socket or the connection made by the wire rope clips after the assembly is complete.

(*c*) After proof testing, wire rope clips on a finished assembly shall be re-tightened to the torque recommended by the wire rope clip manufacturer or a qualified person.

(*d*) If proof tested, compression hardware shall be inspected after the test for the conditions stated in para. 26-3.8.4.

26-3.4.2 Proof Load Requirements

The proof load shall be a minimum of 40%, but not exceed 50%, of the wire rope minimum breaking force unless approved by the compression hardware manufacturer or a qualified person.

SECTION 26-3.5: IDENTIFICATION

26-3.5.1 Wire Rope Clip Saddle Identification

Each new wire rope clip saddle shall have forged or die stamped markings by the manufacturer to show

(*a*) name or trademark of manufacturer

(*b*) size

26-3.5.2 Wedge Socket Identification

Each new wedge socket body and wedge shall have forged, cast, or die stamped marking by the manufacturer to show

(*a*) name or trademark of manufacturer

(*b*) size

(*c*) model, if required to match wedge to body

26-3.5.3 Maintenance of Identification

Compression hardware identification should be maintained by the user so as to be legible throughout the life of the hardware.

SECTION 26-3.6: EFFECTS OF ENVIRONMENT

26-3.6.1 Temperature

(*a*) When wire rope clips are to be used at temperatures above 400°F (204°C) or below −40°F (−40°C), the wire rope clip manufacturer or a qualified person should be consulted.

(*b*) When wedge sockets are to be used at temperatures above 400°F (204°C) or below −4°F (−20°C), the wedge socket manufacturer or a qualified person should be consulted.

26-3.6.2 Chemically Active Environments

The strength of compression hardware can be affected by chemically active environments such as caustic or acid substances or fumes. The compression hardware manufacturer or a qualified person should be consulted before compression hardware is used in chemically active environments.

SECTION 26-3.7: TRAINING

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

SECTION 26-3.8: INSPECTION, REPAIR, AND REMOVAL

26-3.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired compression hardware shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter. Written records are not required.

26-3.8.2 Frequent Inspection

(*a*) A visual inspection shall be performed by the user or other designated person each day before the compression hardware is used. Semi-permanent and inaccessible locations where frequent inspections are not feasible shall have periodic inspections performed.

(*b*) Conditions such as those listed in para. 26-3.8.4, or any other condition that may result in a hazard, shall cause the compression hardware to be removed from service. Compression hardware shall not be returned to service until approved by a qualified person.

(*c*) Written records are not required.

26-3.8.3 Periodic Inspection

(*a*) A complete inspection of the compression hardware shall be performed by a designated person. The compression hardware shall be examined for conditions such as those listed in para. 26-3.8.4 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 compression hardware use

(*2*) severity of service conditions

(*3*) nature of lifts being made

(*4*) experience gained on the service life of compression hardware used in similar circumstances

(*5*) Guidelines for the time intervals are

(*a*) normal service – yearly

(*b*) severe service – monthly to quarterly

(*c*) special service – as recommended by a qualified person

(*c*) Written records are not required.

26-3.8.4 Removal Criteria

Compression hardware shall be removed from service if conditions such as the following are visible and shall only be returned to service when approved by a qualified person:

(*a*) missing or illegible identification

(*b*) indications of heat damage including weld spatter or arc strikes

(*c*) excessive pitting or corrosion

(*d*) bent, twisted, distorted, stretched, elongated, cracked, or broken components

(*e*) excessive nicks or gouges

(*f*) a 10% reduction of the original or catalog dimension at any point

(*g*) evidence of unauthorized welding

(*h*) unauthorized replacement components

(*i*) insufficient number of wire rope clips

(*j*) improperly tightened wire rope clips

(*k*) indications of damaged wire rope

(*l*) indications of wire rope slippage

(*m*) improper assembly or other conditions, including visible damage, that cause doubt as to continued use

26-3.8.5 Repairs and Modifications

(*a*) Repairs, alterations, or modifications shall be as specified by the compression hardware manufacturer or a qualified person.

(*b*) Replacement parts shall meet or exceed the original compression hardware manufacturer's specifications.

SECTION 26-3.9: OPERATING PRACTICES

26-3.9.1 Compression Hardware Selection

(*a*) Compression hardware having suitable characteristics for the type of application and environment shall be selected in accordance with the recommendations of the compression hardware manufacturer or a qualified person.

(*b*) The rated load shall not be exceeded (see Section 26-3.3).

(*c*) Compression hardware that appears to be damaged shall not be used until inspected and accepted as usable under Section 26-3.8.

26-3.9.2 Cautions to Personnel

(*a*) All portions of the human body shall be kept from between the load and any other rigging during the lift.

(*b*) Personnel should stand clear of the suspended load.

(*c*) Personnel shall not ride rigging hardware.

26-3.9.3 Storage & Work Environments

(*a*) Compression hardware should be stored in an area where it will not be subjected to damage, corrosive action, or extreme heat.

(*b*) If extreme temperatures or chemically active environments are involved, the guidance provided in paras. 26-3.6.1 or 26-3.6.2 shall be followed.

26-3.9.4 Rigging Practices

26-3.9.4.1 Wire Rope Clips

(*a*) Assemble wire rope clips in accordance with para. 26-3.1.3.

(*b*) Wire rope clips should not be in contact with the load or any obstruction during the lift.

(*c*) Shock loading should be avoided.

(*d*) Rigging using wire rope clips should not be dragged on an abrasive surface.

(*e*) When wire rope clips are applied to join two lengths of wire rope in an in-line splice, the requirements of para. 26-3.1.3 shall be followed (see Fig. 10).

(*f*) The use of wire rope clips to fabricate slings is generally prohibited. See ASME B30.9 for specific exceptions.

26-3.9.4.2 Wedge Sockets

(*a*) Assemble wedge sockets in accordance with para. 26-3.1.4.

(*b*) The wedge sockets should not be side loaded.

(*c*) Contact with sharp edges that could damage the wedge socket should be avoided.

(*d*) Shock loading should be avoided.

(*e*) Impacts can dislodge the wedge from the body and should be avoided.

(*f*) Rigging using wedge sockets should not be dragged on an abrasive surface.

Chapter 26-4
Links, Rings, and Swivels – Selection, Use, and Maintenance

SECTION 26-4.0: SCOPE

This Chapter applies to links, rings, and swivels.

SECTION 26-4.1: TYPES AND MATERIALS

26-4.1.1 Types

(*a*) Links and rings, including oblong, round and pear shapes (see Fig. 12).

(*b*) Swivels, including eye & eye and eye & jaw types used for positioning (see Fig. 13).

(*c*) Links, rings, and swivels other than those detailed in this Chapter shall be used only in accordance with recommendations of the manufacturer or a qualified person.

26-4.1.2 Materials

Links, rings, and swivels shall have sufficient ductility to permanently deform before losing the ability to support the load at the temperatures that the manufacturer has specified for use.

SECTION 26-4.2: DESIGN FACTOR

The design factor for links, rings, and swivels shall be a minimum of 5.

SECTION 26-4.3: RATED LOADS

Rated load shall be in accordance with the recommendation of the link, ring, or swivel manufacturer. The terms "rated capacity" and "working load limit" are commonly used to describe rated load.

SECTION 26-4.4: PROOF TEST

26-4.4.1 Proof Test Requirements

(*a*) Prior to initial use, welded links and rings shall be proof tested by the manufacturer or a qualified person.

(*b*) All other links, rings, and swivels are not required to be proof tested unless specified by the purchaser.

(*c*) If proof tested, links, rings, and swivels shall be inspected after the test for the conditions stated in para. 26-4.8.4.

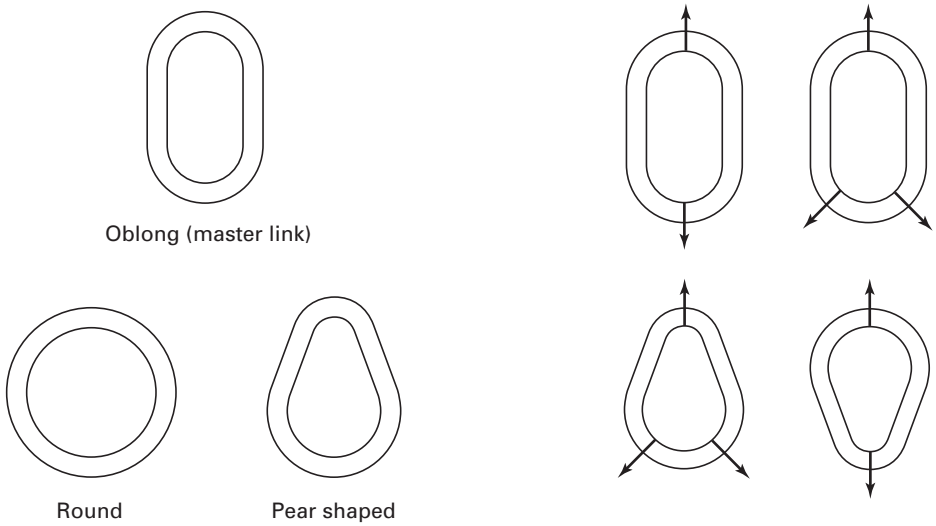


Fig. 12 Links and Rings

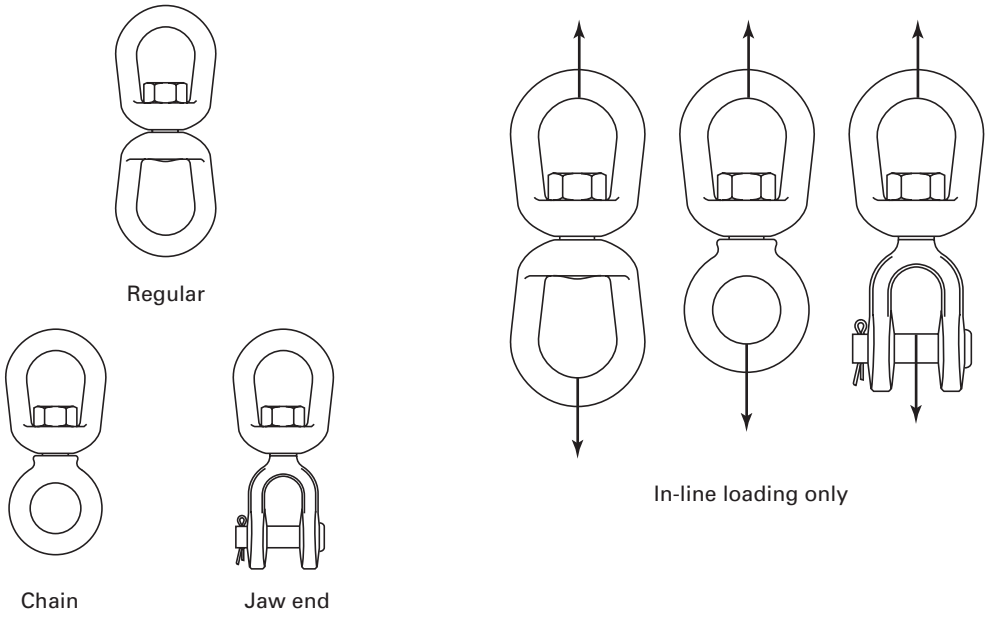


Fig. 13 Swivels

26-4.4.2 Proof Load Requirements

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

SECTION 26-4.5: IDENTIFICATION

26-4.5.1 Links, Rings, and Swivels Identification

Each new link, ring, and swivel shall be marked by the manufacturer to show

(*a*) name or trademark of manufacturer
(*b*) size or rated load
(*c*) grade, if required to identify rated load

26-4.5.2 Maintenance of Identification

Link, ring, and swivel identification should be maintained by the user so as to be legible during the life of the hardware.

SECTION 26-4.6: EFFECTS OF ENVIRONMENT

26-4.6.1 Temperature

(*a*) When steel links, rings, or swivels are to be used at temperatures above 400°F (204°C) or below −40°F (−40°C), the link, ring, and swivel manufacturer or a qualified person should be consulted.

(*b*) For links, rings, or swivels made from other materials, consult the manufacturer or a qualified person.

26-4.6.2 Chemically Active Environments

The strength of links, rings, and swivels can be affected by chemically active environments such as caustic or acid substances or fumes. The link, ring, or swivel manufacturer or a qualified person shall be consulted before use in chemically active environments.

SECTION 26-4.7: TRAINING

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

SECTION 26-4.8: INSPECTION, REPAIR, AND REMOVAL

26-4.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired links, rings, and swivels shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter. Written records are not required.

26-4.8.2 Frequent Inspection

(*a*) A visual inspection shall be performed by the user or other designated person each shift before the links, rings, and swivels are used. Semi-permanent and inaccessible locations where frequent inspections are not feasible shall have periodic inspections performed.

(*b*) Conditions such as those listed in para. 26-4.8.4, or any other condition that may result in a hazard, shall cause the hardware to be removed from service. Links, rings, and swivels shall not be returned to service until approved by a qualified person.

(*c*) Written records are not required.

26-4.8.3 Periodic Inspection

(*a*) A complete inspection of the links, rings, and swivels shall be performed by a designated person. The hardware shall be examined for conditions such as those listed in para. 26-4.8.4 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 use

(*2*) severity of service conditions

(*3*) nature of lifts being made

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

(*5*) Guidelines for the time intervals are

(*a*) normal service – yearly

(*b*) severe service – monthly to quarterly

(*c*) special service – as recommended by a qualified person

(*c*) Written records are not required.

26-4.8.4 Removal Criteria

Links, rings, and swivels shall be removed from service if conditions such as the following are present and shall only be returned to service when approved by a qualified person:

(*a*) missing or illegible identification

(*b*) indications of heat damage, including weld spatter or arc strikes

(*c*) excessive pitting or corrosion

(*d*) bent, twisted, distorted, stretched, elongated, cracked, or broken load bearing components

(*e*) excessive nicks or gouges

(*f*) a 10% reduction of the original or catalog dimension at any point

(*g*) evidence of unauthorized welding or modification

(*h*) for swivels, lack of the ability to freely rotate when not loaded

(*i*) for swivels, loose or missing nuts, bolts, cotter pins, snap rings, or other fasteners and retaining devices

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

26-4.8.5 Repairs and Modifications

(*a*) Repairs, alterations, or modifications shall be as specified by the link, ring, or swivel manufacturer or a qualified person.

(*b*) Replacement parts shall meet or exceed the original equipment manufacturer's specifications.

SECTION 26-4.9: OPERATING PRACTICES

26-4.9.1 Links, Rings, and Swivels Selection

(*a*) Links, rings, and swivels having suitable characteristics for the type of load, hitch, angle of loading, and environment shall be selected in accordance with the recommendations of the hardware manufacturer or a qualified person.

NOTE: The angle of loading affects the load on the links, rings, and swivels. As the horizontal angle decreases, the effective load increases (see Fig. 14).

(*b*) The rated load of the links, rings, and swivels shall not be exceeded.

(*c*) Links, rings, and swivels that appear to be damaged shall not be used until inspected and accepted as usable under para. 26-4.8.4.

26-4.9.2 Cautions to Personnel

(*a*) All portions of the human body shall be kept from between the links, rings, and swivels, the load, and any other rigging during the lift.

(*b*) Personnel should stand clear of the suspended load.

(*c*) Personnel shall not ride links, rings, and swivels.

26-4.9.3 Storage & Work Environments

(*a*) Links, rings, and swivels should be stored in an area where they will not be subjected to damage, corrosive action, or extreme temperatures.

(*b*) If extreme temperatures or chemically active environments are involved, the guidance provided in paras. 26-4.6.1 or 26-4.6.2 shall be followed.

26-4.9.4 Rigging Practices

26-4.9.4.1 Links and Rings

(*a*) Alterations or modifications shall comply with para. 26-4.8.5(a).

(*b*) Contact with obstructions that could damage the link or ring should be avoided.

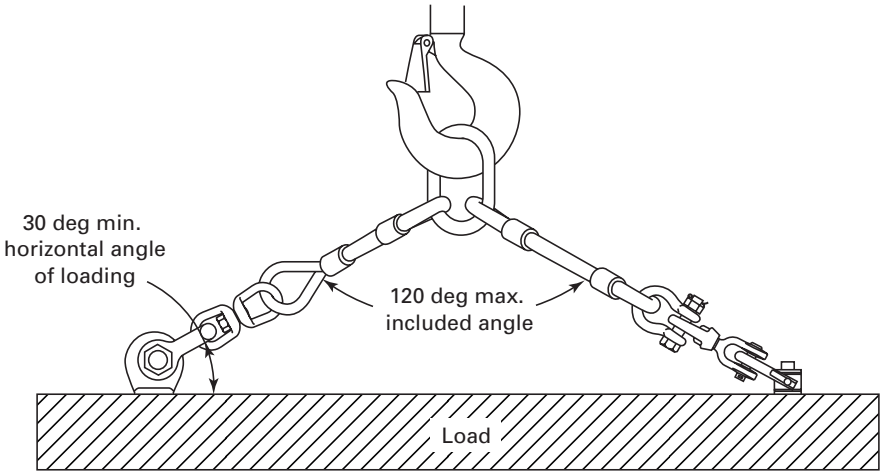
(*c*) Shock loading should be avoided.

(*d*) Links and rings should not be dragged on an abrasive surface.

(*e*) The link or ring shall be of the proper shape and size to ensure that it seats properly in the hook or lifting device.

(*f*) Multiple slings or rigging hardware gathered in a link or ring shall not exceed a 120 deg included angle (see Fig. 14).

(*g*) The horizontal angle of loading should not be less than 30 deg unless approved by a qualified person (see Fig. 14).



Horizontal Angle, deg	Stress Multiplier
90	1.000
60	1.155
45	1.414
30	2.000

Fig. 14 Angle of Loading (Links, Rings, and Swivels)

26-4.9.4.2 Swivels

(*a*) Swivels are positioning hardware and are not intended to be rotated under load.

(*b*) Swivels shall only be used for in-line loads (see Fig. 13).

(*c*) Components shall be maintained in good working condition.

(*d*) Alterations or modifications shall comply with para. 26-4.8.5(a).

(*e*) Shock loading should be avoided.

(*f*) Swivels shall be of the proper shape and size to ensure that they seat properly in the hook or lifting device.

(*g*) Contact with obstructions that could damage the swivel should be avoided.

Chapter 26-5
Rigging Blocks – Selection, Use, and Maintenance

SECTION 26-5.0: SCOPE

This Chapter applies to rigging blocks. Crane blocks are covered by crane type under other ASME B30 volumes.

SECTION 26-5.1: TYPES AND MATERIALS

26-5.1.1 Types

(*a*) Types include tackle, utility, rolling, and snatch blocks (see Fig. 15).

(*b*) Load fittings on rigging blocks may include hooks, eyes, swivels, yokes, bails, shackles, and pins (see Fig. 16).

(*c*) Rigging blocks other than those detailed in this Chapter shall be used in accordance with recommendations of the manufacturer or a qualified person.

26-5.1.2 Materials

(*a*) The rigging block shall have sufficient ductility to permanently deform before losing the ability to support the load at the temperatures that the manufacturer has specified for use.

(*b*) The shell or side plates shall be metal, wood, or synthetic.

(*c*) The sheave(s) shall be metal or synthetic.

(*d*) The load bearing straps and fitting(s) shall be made of metal.

SECTION 26-5.2: DESIGN FACTOR

The design factor for rigging blocks shall be a minimum of 4.

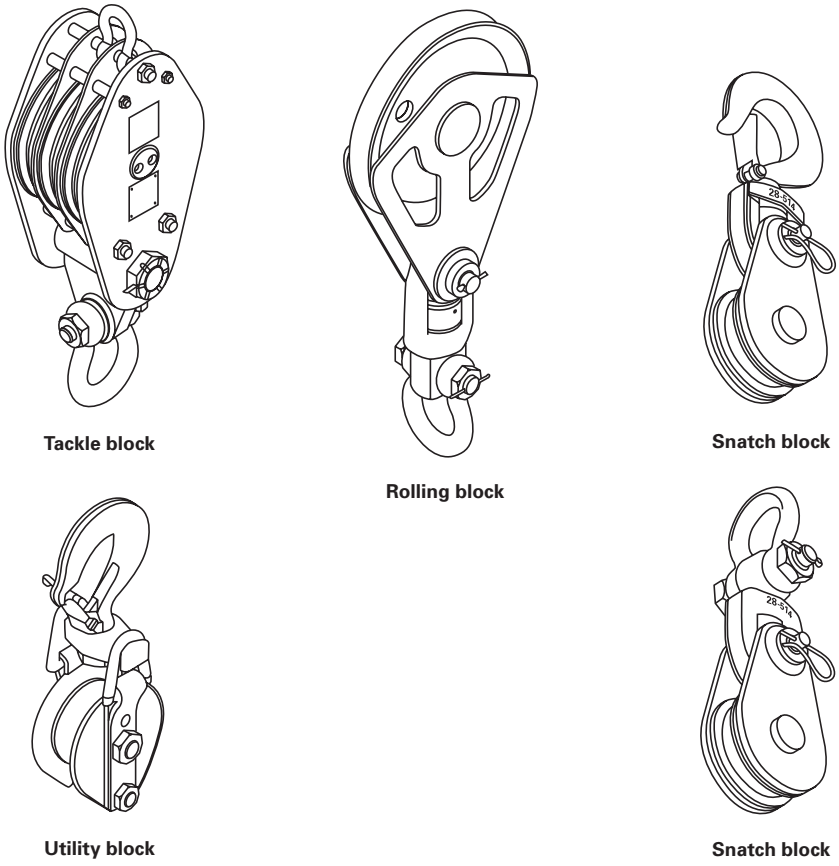


Fig. 15 Rigging Block Types

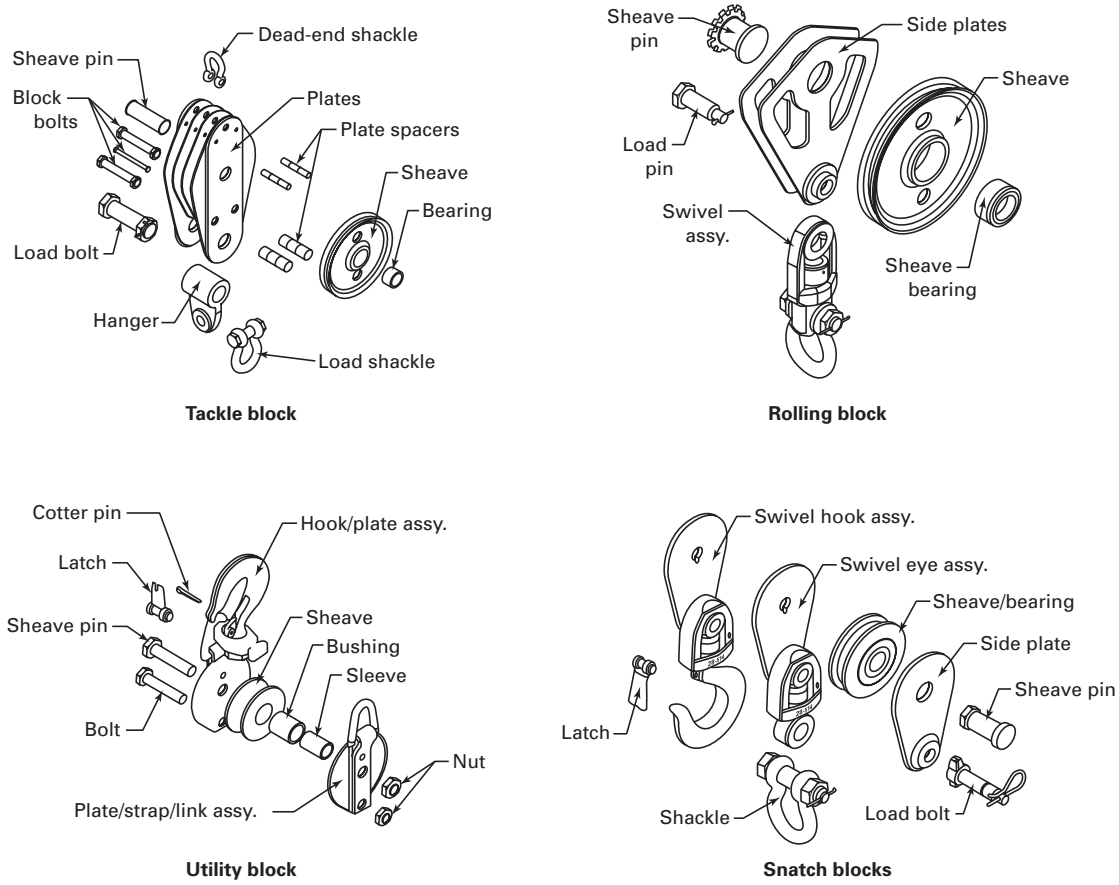


Fig. 16 Typical Rigging Block Components

SECTION 26-5.3: RATED LOADS

Rated load shall be in accordance with the recommendation of the rigging block manufacturer. The terms "rated capacity" and "working load limit" are commonly used to describe rated load.

Note: **The block rated load is the maximum load applied to the primary load fitting, not the line pull (see Fig. 17).**

SECTION 26-5.4: PROOF TEST

26-5.4.1 Proof Test Requirements

(*a*) Rigging blocks are not required to be proof tested unless specified by the purchaser.

(*b*) If proof tested, a rigging block shall be inspected after the test for the conditions stated in para. 26-5.8.4.

26-5.4.2 Proof Load Requirements

The proof load for a rigging block shall be a minimum of 1.5 and a maximum of 2 times the rated load unless approved by the manufacturer or a qualified person.

SECTION 26-5.5: IDENTIFICATION

26-5.5.1 Marking

Each new rigging block shall be marked by the manufacturer to show:

(*a*) name or trademark of manufacturer
(*b*) rated load
(*c*) rope size(s)

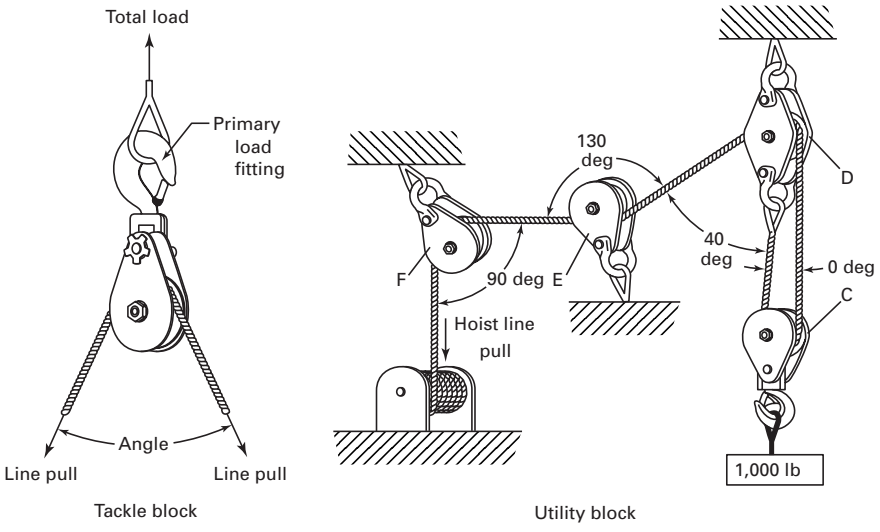
26-5.5.2 Maintenance of Identification

Rigging block identification should be maintained by the user so as to be legible throughout the life of the block.

SECTION 26-5.6: EFFECTS OF ENVIRONMENT

26-5.6.1 Temperature

When rigging blocks are to be used at temperatures above 150°F (66°C) or below 0°F (−18°C), the rigging block manufacturer or a qualified person should be consulted.



Multipliers

Angle, deg	Factor	Angle, deg	Factor
0	2.00	100	1.29
10	1.99	110	1.15
20	1.97	120	1.00
30	1.93	130	0.84
40	1.87	135	0.76
45	1.84	140	0.68
50	1.81	150	0.52
60	1.73	160	0.35
70	1.64	170	0.17
80	1.53	180	0.00
90	1.41	—	—

Block Load = Line Pull × Multiplier Factor

Example: Load = 1,000 lb
Line Pull: 1,000 lb ÷ 2 = 500 lb
Load Block "C" = 500 lb × 2 = 1,000 lb
(line pull × factor for 0 deg angle)
Load Block "D" = 500 lb × 1.87 + 500 lb = 1,435 lb
(line pull × factor for 40 deg angle + dead-end load)
Load Block "E" = 500 lb × 0.84 = 420 lb
(line pull × factor for 130 deg angle)
Load Block "F" = 500 lb × 1.41 = 705 lb
(line pull × factor for 90 deg angle)

Fig. 17 Block Load Factor Multipliers

26-5.6.2 Chemically Active Environments

Chemically active environments such as caustic or acid substances or fumes can affect the strength, operating characteristics, or both, of rigging blocks. The rigging block manufacturer or a qualified person should be consulted when rigging blocks are used in chemically active environments.

SECTION 26-5.7: TRAINING

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

SECTION 26-5.8: INSPECTION, REPAIR, AND REMOVAL

26-5.8.1 Initial Inspection

Prior to use, all new, altered, modified, or repaired rigging blocks shall be inspected by a designated person to verify compliance with the applicable provisions of this Chapter. Written records are not required.

26-5.8.2 Frequent Inspection

(*a*) A visual inspection shall be performed by the user or other designated person each shift before the rigging block is used. Semi-permanent and inaccessible locations where frequent inspections are not feasible shall have periodic inspections performed.

(*b*) Conditions such as those listed in para. 26-5.8.4, or any other condition that may result in a hazard, shall cause the rigging block to be removed from service. Rigging blocks shall not be returned to service until approved by a qualified person.

(*c*) Written records are not required.

26-5.8.3 Periodic Inspection

(*a*) A complete inspection of the rigging block shall be performed by a designated person. The hardware shall be examined for conditions such as those listed in para. 26-5.8.4 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 use

(2) severity of service conditions
(3) nature of lifts being made
(4) experience gained on the service life of hardware used in similar circumstances
(5) Guidelines for the time intervals are
(*a*) normal service – yearly
(*b*) severe service – monthly to quarterly
(*c*) special service – as recommended by a qualified person
(*c*) Written records are not required.

26-5.8.4 Removal Criteria

Rigging blocks shall be removed from service if conditions such as the following are present and shall only be returned to service when approved by a qualified person:
(*a*) missing or illegible identification
(*b*) misalignment or wobble in sheaves
(*c*) excessive sheave groove corrugation or wear
(*d*) loose or missing nuts, bolts, cotter pins, snap rings, or other fasteners and retaining devices
(*e*) indications of heat damage, including weld spatter or arc strikes
(*f*) excessive pitting or corrosion
(*g*) bent, cracked, twisted, distorted, stretched, elongated, or broken load bearing components
(*h*) excessive wear, nicks, or gouges
(*i*) a 10% reduction of the original or catalog dimension at any point
(*j*) excessive damage to load bearing threads
(*k*) evidence of unauthorized welding or modifications
(*l*) for hooks, the removal criteria specified in B30.10
(*m*) for shackles, the removal criteria specified in B30.26
(*n*) other conditions, including visible damage that cause doubt as to the continued use of the rigging block

26-5.8.5 Repairs and Modifications

(*a*) Repairs, alterations, or modifications shall be as specified by the rigging block manufacturer or a qualified person.
(*b*) Replacement parts, such as pins, hooks and sheaves, shall meet or exceed the original equipment manufacturer's specifications.

SECTION 26-5.9: OPERATING PRACTICES

26-5.9.1 Rigging Block Selection

(*a*) Rigging blocks having suitable characteristics for the application and environment shall be selected in accordance with the recommendations of the rigging block manufacturer or a qualified person.
(*b*) The rated load of the rigging block shall not be exceeded.

NOTE: The included angle formed between the load lines affects the load on the block. As the included angle decreases, the load increases in the rigging block (see Fig. 16).

(*c*) Rigging blocks that appear to be damaged shall not be used until inspected and accepted as usable under para. 26-5.8.4.
(*d*) The minimum D/d ratio between the sheave pitch diameter and the wire rope diameter is 6.

26-5.9.2 Cautions to Personnel

(*a*) All portions of the human body shall be kept from between the rigging block, its running lines, the load, and any other rigging during the lift.
(*b*) Personnel should stand clear of the suspended load.
(*c*) Personnel shall not ride rigging blocks.

26-5.9.3 Storage & Work Environments

(*a*) Rigging blocks should be stored in an area where they will not be subjected to damage, corrosive action, or extreme temperatures.
(*b*) If extreme temperatures or chemically active environments are involved, the guidance provided in paras. 26-5.6.1 or 26-5.6.2 shall be followed.

26-5.9.4 Rigging Practices

(*a*) The rigging block components shall be fully engaged, with all fasteners and retaining devices in place and in good working order before use. Alterations or modifications shall comply with para. 26-5.8.5.
(*b*) Contact with sharp edges that could damage the rigging block should be avoided.
(*c*) Shock loading should be avoided.
(*d*) The load applied to the rigging block should be in-line with the sheave and load fitting(s) to prevent side loading of the block.
(*e*) Ensure the rope is in the sheave groove when the rigging block begins to take load.
(*f*) The line load multiplied by the block load factor shall not exceed the rated load of the rigging block (see Fig. 17).
(*g*) Rigging blocks should not be dragged on an abrasive surface.
(*h*) Load line fittings shall not contact the rigging block sheave(s).

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