

## Section 18 Slings, Chains, and Accessories

This section sets forth the requirements for using slings, chains, and accessories. It specifically addresses using alloy steel chains; wire rope slings; synthetic fiber rope; synthetic webbing slings; synthetic roundslings; and shackles, hooks, and other rigging hardware.

### 18.1 General Requirements for Using Slings, Chains, and Accessories

**18.1.1 Standard Criteria.** The *Rigging Manual*, latest edition, published by the Construction Safety Association of Ontario, 21 Voyager Court South, Etobicoke, Ontario, Canada M9W 5M7 is the designated Reclamation Rigging Manual. Reclamation will use this manual as a guide to determine if rigging practices are safe and conform to industry-wide practices. Although used by Reclamation and contractors, both as a rigging manual and a training text, contractually, it is advisory in nature (except where specifically referenced) and intended only to complement the safety requirements set forth in this section.

**18.1.2 Safe Usage.** Use of ropes, slings, and chains must conform to equipment manufacturer's recommendations, this subsection, applicable current American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) standards, and Occupational Safety and Health Administration (OSHA) regulations.

**18.1.3 Safe Working Loads.** Determine the safe working load of slings, chains, accessories, and rigging equipment before use. The safe working loads of slings must not exceed the rated capacities. For types of slings not included in these tables, follow the manufacturer's recommended safe working load for the specific angle of loading, provided that you maintain a safety factor of five.

**18.1.4 Job-Fabricated Rigging Hardware.** A professional engineer must design and certify use of any job-fabricated rigging hardware and test it at twice the rated safe working load or in accordance with applicable standards.

**18.1.5 Use, Repair and Maintenance.** The use, repair, and maintenance of ropes, chains, slings, and rigging accessories must conform to the manufacturer's written instructions. Test repaired slings and accessories at twice their rated load before use.

**18.1.6 Inspection.** Make frequent and periodic inspections. Immediately remove defective equipment from service.

- a. **Frequent Inspections.** The user must inspect rigging equipment before each shift.

b. **Thorough Periodic Inspections.** A designated person must thoroughly inspect rigging equipment and maintain a written record. The field location must determine the frequency of the periodic inspection on the basis of use, severity of service conditions, nature of the lifts, and experience on the service life of slings used in similar circumstances. Conduct inspections periodically and at least once every 12 months.

c. **Special or Infrequent Service.** For slings that are used infrequently, inspect before each use. At the time of use, document the inspection.

18.1.7 **Removal From Service.** Routinely inspect chain, wire rope, fiber, synthetic webbing, and sling hooks. Remove from service if any are deformed, damaged, or otherwise do not meet inspection criteria and are not safe for use. Cut up and discard slings removed from service due to defects or plainly mark them as being unfit for load-bearing service. Do not repair cracked, broken, or bent end attachments. Replace them.

18.1.8 **Protection.** Appropriately protect slings from sharp, rough, or square corners to prevent damage to the strands, wires, or links. Properly store slings when not in use to protect them from damage.

## 18.2 Requirements for Using Alloy Steel Chains

18.2.1 **Safe Working Load.** The safe working load applied to chains must not exceed the strength (certified by the manufacturer) divided by the required safety factor (usually four, unless specified otherwise). If the working load exceeds the capacities as shown in table E-2, make the manufacturer's data available at the site for employee review. When heated in excess of 600 °F, or used in temperatures below -40 °F, adjust the chain's safe working capacity to conform to the manufacturer's instructions.

18.2.2 **Grade.** Use only heat-treated alloy steel chains in hoisting operations, meeting at least grade 80. Each link of heat-treated alloy steel chains must be marked with an "A," "T," or "8." The marking designates heat-treated alloy steel meeting at least grade 80.

18.2.3 **Identification.** Durable identification tags must be permanently affixed to welded alloy steel chain slings. The tags must state the size, grade, rated load, and sling manufacturer. Tags for multi-leg slings must also identify the angle the load rating is based on, the reach, and the number of legs.

18.2.4 **Accessories.** The rated capacity of hooks, rings, links, or other attachments used with alloy steel chains must at least equal that of the chains. Do not use job-made hooks, links, or makeshift fasteners made from bolts or rods.

18.2.5 **Impact Loading.** Do not subject chains to impact loading.

**18.2.6 Excessive Wear.** Whenever wear at any point in any chain link or the depth of gouge or rounded out portion exceed the measurements in the appendix, table E-1, reduce the assembly's capacity or remove it from service. An identification tag must reflect the newly established reduced capacity. Use a device capable of measuring to one one-thousandth of an inch to measure chain wear. Remove any sharp nicks by grinding.

**18.2.7 Removal From Service.** Remove from service any assemblies with deformed master or coupling links or cracked hooks or attachments. Permanently remove from service alloy steel chains heated above 1,000 °F, and reduce their capacities if exposed to temperatures at or above 600 °F.

**18.2.8 Proof Testing.** When repaired, a chain sling must be permanently marked to identify the repairing agency. Before use, proof test each new, repaired, or reconditioned alloy steel chain sling and all welded parts in the sling assembly to twice the rated capacity. Make a copy of the proof test certificate, with date and weight, available for examination.

### 18.3 Requirements for Using Wire Rope Slings

**18.3.1 Safe Working Load.** The safe working load of wire rope slings must not exceed rated capacities, as shown in tables E-3 through E-14. For types of slings not included in the appendix on wire rope slings, follow the manufacturer's recommended safe working load for the specific angle of loading, provided that you maintain a safety factor of 5.

**18.3.2 Grade.** Wire rope slings covered by this section are based on nominal wire rope strength as shown in Federal Specification RR-W-410, *Wire Rope and Strand*, and Military Specification MIL-W-83420, *Wire Rope, Flexible, for Aircraft Control*, (except for fatigue requirements). When using grades, types, sizes, and constructions other than those specified in the appendix, consult the sling manufacturer for specific data.

**18.3.3 Identification.** Develop and use a system to identify individual slings that include at least the manufacturer and safe working load. If the wire rope sling no longer has an original identification tag, first determine the construction of the sling, then use the applicable capacity chart to find the safe working load.

**18.3.4 Proof Test.** Proof-test all job-made or repaired slings. Proof-test all swaged socket and poured socket assemblies to the wire rope or fitting manufacturer's recommendations but, in no case, to more than 50 percent of the component wire ropes' nominal strength. The proof test for a single-leg, hand-tucked sling must be 1.25 times the rated load. The proof test for mechanical splice single-leg slings and endless slings must be 2 times the vertical load. Apply the proof load for multiple leg bridle slings to the individual legs at 1.25 times the rated vertical load for hand tucked splice, or 2, for mechanical splice. Load any master

link connected to multiple-leg slings to 2 times the force of the combined legs. Make a copy of the proof test certificate, with date and weight, and make the records available for examination.

**18.3.5 Environmental Effects.** Do not expose fiber core wire rope slings to temperatures above 180 °F. Consult sling manufacturers before using slings in chemically active environments or in temperatures above 400 °F or below -60 °F.

**18.3.6 End Fittings and Connections.** See the corresponding appendix for instructions on selecting and using end connectors. Do not form eyes in wire rope slings or chokers with wire clips or a fold back eye with pressed metal sleeve.

**18.3.7 Protruding Ends.** Cover or blunt protruding ends of strands in splices on slings and bridles.

**18.3.8 Sling Inspection and Replacement.** Inspect slings periodically and remove them from service if one or more of the following conditions are present:

- a. Six randomly distributed broken wires in one rope lay, or three broken wires in one strand in one rope lay.
- b. Wear or scraping on one-third the original diameter of outside individual wires.
- c. Kinking, crushing, bird caging, or any other damage resulting in distortion of the rope structure.
- d. Evidence of heat damage.
- e. Cracked, deformed, or worn end attachments.
- f. Corrosion of the rope or end attachments.

Permanently remove from service fiber core rope slings if exposed to temperatures above 180 °F. Nonfiber core rope temperatures must not exceed 400 °F or minus 60 °F without manufacturer's recommendation.

## **18.4 Requirements for Using Synthetic Fiber Rope**

**18.4.1 Safe Working Load.** The safe working loads for synthetic fiber rope and slings must not exceed rated capacities, as shown in tables E-15 through E-17.

**18.4.2 Identification.** Each sling must be marked to show the manufacturer, code or stock number, rated load for the various types of hitches used, type of material, and date of manufacture.

**18.4.3 Splices.** In addition to the manufacturer's recommendations, use the following minimum requirements for splicing fiber rope:

- a. **Synthetic Fiber.** Eye splices must have at least four full tucks, and short splices must have at least eight full tucks, with four on each side of the centerline of the splice.
- b. **Strand End Tails.** Fiber ropes less than 1 inch in diameter must have tails that project at least six rope diameters beyond the last full tuck. Ropes 1 inch in diameter and larger must have tails that project at least 6 inches beyond the last full tuck. You may taper and splice the required length of strand and tails into the body of the rope using at least two additional tucks.
- c. **Eye of Splice.** The eye must be large enough to provide no more than a 60-degree angle at the splice when placing the eye over the load or support.
- d. **Knots.** Do not use knots in rigging applications.

**18.4.4. Environmental Effects.** Load capacities, as shown in tables E-15 through E-17, apply in the temperature range of -20 °F to 150 °F for polypropylene slings and from -20 °F to 180 °F for nylon and polyester slings. For service in temperatures outside this range, or in chemical environments, consult the fiber rope manufacturer.

**18.4.5 Electrical Hazard.** Use only nonconductive, synthetic fiber rope near energized conductors or equipment, including handlines for work on electrical facilities.

**18.4.6 Care of Fiber Ropes.** Properly care for fiber ropes to keep them in safe condition. Do not use fiber ropes subjected to acids, alkalies, freezing, or excessive heat to carry loads. Use padding to protect fiber rope from abrasion when it is drawn over square corners or sharp or rough surfaces.

**18.4.7 Inspection and Replacement.** Inspect slings and remove them from service if one or more of the following conditions are present:

- a. Slings shortened with knots, bolts, or other unapproved methods.
- b. Damaged slings.
- c. Rope less than 1/2 inch in diameter.

- d. Slings subjected to a sustained load equal to the rated capacity for more than 3 days.
- e. Slings made from old rope.
- f. Slings subjected to chemical environments, unless permitted by the rope manufacturer.

## 18.5 Requirements for Using Synthetic Webbing Slings

**18.5.1 Safe Working Load.** Do not use a webbing sling at a load greater than established safe working loads, as shown in tables E-18 through E-20. Follow the manufacturer's recommended safe working load for the specific angle of loading, provided that you maintain a minimum safety factor of five.

**18.5.2 Identification.** Synthetic webbing slings must be marked or coded with the manufacturer's name, code or stock number, type of material, and the rated capacity for the type of hitches used.

### 18.5.3 Care and Maintenance

- a. **Webbing.** Synthetic webbing must be of uniform thickness and width; do not split selvage edges from the webbing's width.
- b. **Fittings.** The minimum breaking strength of fittings must equal that of the sling and must be free of all sharp edges that could damage the webbing.
- c. **Attachments.** Use only stitching to attach fittings and form eyes. The thread must be in an even pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling.
- d. **Storage and Use.** Do not use or store nylon web, polyester, and polypropylene web slings and web slings with aluminum fittings where caustic fumes, vapors, sprays, mists, or liquids are present. Store slings out of direct sunlight to avoid deterioration from ultraviolet light and away from sources of ozone generation.
- e. **Temperature.** Do not use synthetic web slings of polyester and nylon in temperatures above 180 °F or below -40 °F. Do not use polypropylene web slings in temperatures above 200 °F.

**18.5.4 Removal From Service.** Immediately remove synthetic webbing slings from service if one or more of the following visible defects is present:

- a. Acid or caustic burns.
- b. Melting or charring of any part of the surface.
- c. Snags, punctures, tears, or cuts.

- d. Broken or worn stitches.
- e. Wear or elongation exceeding the amount recommended by the manufacturer.
- f. Distortion of fittings.
- g. End of service life.

**18.5.5 Repairs.** Do not use repaired synthetic web slings unless a sling manufacturer or an equivalent entity repairs them. Proof-test each repaired sling to twice the rated load before returning it to service. Maintain documentation of the proof test.

## 18.6 Requirements for Synthetic Roundslings

**18.6.1 Safe Working Load.** The safe working load for single-leg polyester roundslings must conform to the values shown in the appendix, table E-21. The minimum safety factor for roundslings is five. Load capacities are in the temperature range of -40 °F to 194 °F. When using them in temperatures outside this range, in chemical environments, or when constructed with yarns of nonpolyester materials, consult the sling manufacturer.

**18.6.2 Identification.** Each roundsling must be tagged to show the manufacturer's identification, code or stock number, type of material in the core and cover (if different), and the rated capacity for the type of hitches used.

**18.6.3 Removal From Service.** Immediately remove roundslings from service if any of the following conditions are present:

- a. Acid or caustic burns.
- b. Melting or charring of any part of the sling surface.
- c. Snags, punctures, tears, or cuts.
- d. Broken or worn stitches.
- e. Distortion of fittings.
- f. Appearance of wear indicators.
- g. End of service life.

**18.6.4 Repairs.** Do not make temporary repairs to either roundslings or fittings. Do not repair load-bearing yarns or fittings. Allow only a roundsling manufacturer or qualified person to repair protective covers. When repaired, the roundsling must be marked and proof-tested to twice the rated vertical load before returned to service.

## 18.7 Requirements for Shackles, Hooks, and Other Rigging Hardware

### 18.7.1 Shackles

- a. **Safe Working Load.** Use the appendix, table E-22, to determine the safe working loads of shackles. Higher safe working loads recommended by the manufacturer are acceptable for specific identifiable products if you maintain a minimum safety factor of five.
- b. **Hoisting.** Shackles used for hoisting must be of forged alloy steel and must be of the screw pin or bolt type.
- c. **Wear or damage.** Remove shackles from service if they are bent, distorted, or worn in the crown or pin by more than 10 percent of their original diameter.

### 18.7.2 Hooks

- a. **Requirement.** Manufacturing, testing, inspecting, and use of hooks must conform to the more stringent requirements contained in ANSI B30.10, *Hooks*, manufacturer specifications and recommendations, or these standards.
- b. **Safe Working Load.** Follow the manufacturer's recommendation to determine the safe working load for the specific size and type of hook used. If a manufacturer's recommendation is not available, test hooks at twice the intended safe working load before use. Maintain a record of the dates and results of the tests.
- c. **Inspection.** Inspect hooks frequently and remove them from service if they are cracked, severely corroded, have been opened more than 15 percent of the normal throat opening measured at the narrowest point, or twisted more than 10 degrees from the plane of the unbent hook.

18.7.3 **Rings, Links, and Swivels.** Hardware items, including rings, links, and swivels, must be forged alloy steel of weldless construction. Follow manufacturer's safe working loads.

18.7.4 **Eyebolts.** Eyebolts used for hoisting must be of forged alloy steel and equipped with shoulders or collars.

- a. **Tapped Hole.** The minimum depth of the tapped hole for screwed eyebolts must be one and one-half times the bolt diameter.
- b. **Application of Load.** Apply loads in the plane of the eye of the eyebolt. Do not reeve slings through eyebolts or attach hooks directly to the eyebolt. Use a shackle to distribute the load.