Chapter 41: Hoisting and Rigging

Requirements for Below-the-Hook Lifting Devices, Slings, and Rigging Hardware and Accessories

1 Purpose

The purpose of these requirements is to ensure that below-the-hook lifting devices, slings, and rigging hardware and accessories are safe to operate. They cover fabrication, marking, and pre-use inspections. They apply to workers (as operators and riggers) and equipment custodians.

For an overview of required inspections, including initial and periodic inspections conducted by a qualified inspector, see Hoisting and Rigging: Equipment Requirements.

2 Requirements

Operators and riggers are responsible for conducting the pre-use inspections described below. Equipment custodians are responsible for ensuring equipment is marked and fabricated as described below.

2.1 Below-the-Hook Lifting Devices

The following requirements apply to below-the-hook lifting devices, such as spreader bars, lifting yokes, lifting baskets, and lift fixtures.

2.1.1 Structural and Mechanical Lifting Devices

2.1.1.1 Marking

- The rated capacity of each lifting device must be marked on the main structure where it is visible and legible.
- If the lifting device comprises several items, each detachable from the assembly, each lifting device must be marked with its rated capacity.
- At a minimum, a nameplate, name tag, or other permanent marker must be affixed displaying the following data:
  - Manufacturer or contractor’s name if fabricated on-site
  - Lifting device weight, if over 100 pounds
  - Serial number (if available)
  - Rated capacity
2.1.2 Vacuum Lifting Devices

2.1.2.1 Marking

- The rated capacity, maximum width and length, and minimum thickness of load must be marked on the main structure where it is visible and legible.
- Individual pads or groups of pads, controlled by shutoff valves, must be marked with the rated capacity of each pad or group of pads.
- At a minimum, a nameplate, name tag, or other permanent marker must be affixed to each lifter displaying the following data:
  - Manufacturer’s name
  - Model number or unit identification
  - Weight of lifting device
  - Electric power (when applicable)
  - Pressure and volume of compressed air (when applicable)
  - Rated capacity
  - Proof of initial/periodic inspection label
- Manual shutoff valves on individual pads or groups of pads must be marked to show operating position.
- A label or labels must be affixed to each vacuum lifting device in a readable position that displays the word CAUTION or other legend designed to bring the label to the attention of the operator. The label must also contain information cautioning against:
  - Exceeding the rated capacity or lifting loads not specified in the manufacturer’s instruction manual
  - Operating a damaged or malfunctioning unit or a unit with missing parts
  - Operating when vacuum indicators show insufficient vacuum
  - Operating the unit when vacuum pads are not spaced for equal loading
  - Incorrect positioning of the lifting device on the load
  - Lifting people
  - Moving loads above people
  - Removing/obscuring warning labels
  - Operating the lifting device when the rated capacity, lifting-device weight, or safety markings are missing (except in cases where the device cannot, for security or other reasons, be marked).
  - Making alterations or modifications to the lifting device.
  - Lifting loads higher than necessary and leaving suspended loads unattended.

A label must be affixed to each unit that directs the user to consult the manufacturer’s manual if the size or shape of the unit prohibits the inclusion of the above markings.
2.1.3 Magnets (close-proximity-operated)

2.1.3.1 Marking

- At a minimum, a nameplate, name tag, or other permanent marker must be affixed to each lifting magnet, and must display
  - Manufacturer’s name, or if the magnet has been repaired or modified, the name and address of the repairer/modifier
  - Model or unit identification
  - Weight
  - Duty cycle, if applicable
  - Cold current
  - Rated capacity
  - Proof of initial/periodic inspection label

- In addition, battery-powered and external-powered lifting electromagnets and electrically controlled permanent-magnet lifting magnets must be marked with
  - The voltage of the battery or primary power supply
  - The cold current or watts at 68°F (20°C) and rated voltage

- A label or labels must be affixed to each lifting magnet in a readable position that displays the word CAUTION or other legend designed to bring the label to the attention of the operator. The label must also contain information cautioning against
  - Operating when the battery capacity is inadequate
  - For externally powered electromagnets: exceeding magnet duty cycle and disconnecting the magnet with the power on
  - On electrically controlled permanent magnets: operating if the internal control function indicator, where applicable, does not indicate a complete cycle
  - On manually controlled permanent magnets: operating with the control handle not fully in the LIFT position

2.2 Rigging Hooks

2.2.1 Marking

The manufacturer’s identification must be forged, cast, or die-stamped on a low-stress and non-wearing area of the hook.

2.2.2 Inspecting

Rigging hooks must be inspected before each use for

- Cracks, nicks, gouges
- Deformation
Damage from chemicals
Damage, engagement, or malfunction of latch (if provided)
Evidence of heat damage
Wear
Hook attachment and securing means in working order

If any of these conditions are found, the hook must be removed from service and the equipment custodian contacted.

2.3 Slings

2.3.1 Wire-rope Sling

2.3.1.1 Fabricating

Wire rope purchased to fabricate slings must meet the requirements of DOE-STD-1090.

2.3.1.2 Marking

Wire-rope slings must be marked with the following information:

1. Name of trademark of manufacturer
2. Work load limit
3. Diameter or size
4. Purchase order or serial number
5. Inspection due date
6. RIG number

*Note* Sling identification must be maintained by the user so as to be legible during the life of the sling. (Stenciling or stamping on the swages of a sling is not recommended.)

2.3.1.3 Inspecting

Wire-rope slings must be inspected before each use. Users must carefully note any deterioration that could result in an appreciable loss of original strength and determine whether further use of the sling would constitute a safety hazard. Slings must be immediately removed from service if any of the following conditions are present:

- Missing or illegible sling identification
- Six randomly distributed broken wires in one rope lay or three broken wires in one strand in one rope lay
- Wear or scraping of one-third the original diameter of the outside individual wire
- Kinking, crushing, bird caging or any other damage resulting in distortion of the rope structure
- Evidence of heat damage
End attachments that are cracked, deformed, or worn
Corrosion of the rope or end attachments

2.3.2 Metal-mesh Slings

2.3.2.1 Inspecting

Metal-mesh slings must be inspected before each use. Metal-mesh slings must be removed from service if any of the following defects are present:

- A broken weld or brazed joint along the sling edge
- A broken wire in any part of the mesh
- Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion
- Lack of flexibility due to distortion of the mesh
- Distortion of the female handle so the depth of the slot is increased by more than 10 percent
- Distortion of either end fitting so the width of the eye opening is decreased by more than 10 percent
- A 15 percent reduction of the original cross-sectional area of metal at any point around a handle eye
- Any distortion or twisting of either end fitting out of its plane
- Cracked end fitting
- Evidence of heat damage

2.3.3 Synthetic-web Slings

2.3.3.1 Marking

Each sling must be marked with

- Manufacturer’s name or trademark
- Manufacturer’s code or stock number
- Type of synthetic web material
- Rated loads for the type of hitches used

2.3.3.2 Inspecting

Synthetic-web slings must be inspected before each use. Slings must be removed from service if any of the following defects are visible:

- Acid or caustic burns
- Melting or charring of any part of the surface
- Snags, punctures, tears, or cuts
- Broken or worn stitches
- Wear or elongation exceeding the amount recommended by the manufacturer
2.3.3.3 Using in Radiation Areas

When necessary to use synthetic slings in a radiation area, site-specific methodologies must be developed and implemented to ensure that radiation exposure does not exceed 100,000 rad during the life of the sling.

2.3.4 Synthetic Roundslings

2.3.4.1 Marking

Each polyester roundsling must be permanently marked or labeled showing
- Name or trademark of manufacturer
- Manufacturer’s code or stock number
- Rated capacities for the three basic hitches (vertical, choker, vertical basket)
- Length (reach) – bearing point to bearing point
- Each manufacturer must internally identify its product with name or trademark for traceability

2.3.4.2 Inspecting

Synthetic roundslings must be inspected before each use. Slings must be removed from service if any of the following defects are visible:
- Missing or illegible sling identification
- Acid or caustic burns
- Melting or charring of any part of the surface
- Snags, punctures, tears, cuts or abrasive wear that expose the core yarns
- Broken or worn stitches in the cover which exposes the core yarns
- Wear or elongation exceeding the amount recommended by the manufacturer
- Stretched, cracked, worn, pitted or distortion of fittings
- Knots in any part

2.3.4.3 Using in Radiation Areas

When necessary to use synthetic slings in a radiation area, site-specific methodologies must be developed and implemented to ensure that radiation exposure does not exceed 100,000 rad during the life of the sling.

2.3.5 Alloy Steel-chain Slings

The following applies to slings made from grade 80 and 100 alloy chain manufactured and tested in accordance with National Association of Chain Manufacturers welded steel chain specifications – 1990. If
chain other than this is used, it must be used in accordance with the recommendations of the chain manufacturer.

2.3.5.1 Marking

- Wire-rope slings must be marked with the following:
  - Size
  - Manufacturer’s grade
  - Rated load and angle on which the rating is based.
  - Reach
  - Numbers of legs
  - Sling manufacturer
  - Inspection due date label by hoist and rigging inspector

This information may be stenciled or stamped on a metal tag or tags affixed to the sling.

- Where slings have more than one leg, ensure that the tag is affixed to the master link.

2.3.5.2 Inspecting

Steel-chain slings must be inspected before each use as follows:

- Conduct a link-by-link inspection for the following defects: nicks, cracks, gouges, wear, bent links, stretched links, shearing of links, cracks in any section of link, scores, abrasions, heat damage, rust, corrosion or markings tending to weaken the links. Reject damaged items.

- Check steel-chain slings for uneven lengths when sling legs are hanging free.

- Check rings and hooks for bends, distortion, cracks in weld areas, corrosion, and scores, heat damage, or markings tending to weaken the links. Reject damaged items.

- Perform inspection on an individual-link basis. If any link does not hinge freely with the adjoining link, remove the assembly from service.

- Remove from service assemblies with deformed master links or coupling links.

- Remove from service assemblies if hooks 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.

- Do not straighten deformed hooks or other attachments on the job. Assemblies with such defects must be reconditioned by the manufacturer or discarded.

- Remove from service assemblies with cracked hooks or other end attachments; assemblies with such defects must be reconditioned or repaired before return to service.

- Do not use homemade links, makeshift fasteners formed from bolts, rods, and the like, or other nonstandard attachments. Reject if discovered.

- Do not use makeshift or field-fabricated hooks on steel-chain slings. Reject if discovered.
2.4 Rigging Hardware and Accessories

2.4.1 Shackles

2.4.1.1 Fabricating
- Grade A shackles (regular strength) together with their pins and bolts must be forged from carbon steel.
- Grade B shackles (high strength) together with their pins and bolts must be forged from alloy steel.
- Shackles pins must fit freely (without binding) and seat properly.

2.4.1.2 Marking
Each shackle body must be permanently and legibly marked in raised letters by the manufacturer. Raised or stamped letters on the side of the bow must be used to show:
- Manufacturer’s name or trademark
- Size
- Rated capacity, recommended safe working load

2.4.1.3 Inspecting
Shackles must be inspected for the following conditions and removed from service and only returned to service when approved by a qualified person:
- Missing or illegible manufacturer’s name or trademark and/or rated load identification
- Indications of heat damage including weld spatter or arc strikes
- Excessive pitting or corrosion
- Bent, twisted, distorted, stretched, elongated, cracked, or broken load-bearing components
- Excessive nicks or gouges
- A 10 percent reduction of the original or catalog dimension at any point around the body or pin
- Incomplete pin engagement
- Excessive thread damage
- Evidence of unauthorized welding
- Other conditions, including visible damage, that cause doubt as to the continued use of the shackle

2.4.2 Eyebolts

2.4.2.1 Fabricating
- Eyebolts used for hoisting must be fabricated from forged carbon or alloy steel.
2.4.2.2 Marking

- Carbon steel eyebolts must have the manufacturer’s name or identification trademark forged in raised characters on the surface of the eyebolt.
- Alloy steel eyebolts must have the symbol “A” (denoting alloy steel) and the manufacturer’s name or identification mark forged in raised characters on the surface of the eyebolt.

2.4.2.3 Inspecting

Eyebolts must be inspected before each use:

- Visually inspect the hole to ensure that there has been no deformation.
- Check the condition of the threads in the hole to ensure that the eyebolt will secure and the shoulder can be brought down snug.
- Ensure that the shank of the eyebolt is not undercut and is smoothly radiused into the plane of the shoulder or the contour of the ring for non-shouldered eyebolts.
- Destroy eyebolts that are cracked, bent, or have damaged threads.

2.4.3 Turnbuckles

Turnbuckles may be used in sling systems provided that they are engineered, designed, and approved as a part of the sling system. Approved turnbuckles must be marked and identified for use with the sling set for which they were designed and must be load-tested as part of the sling set.

2.4.3.1 Fabricating

- Eyebolts must be fabricated from forged alloy steel.
- Eyebolts must be provided with a jam nut of a type that does not depend upon deformation of the threads for security.

2.4.3.2 Marking

- Manufacturer’s name or trademark and turnbuckle size must be permanently marked on the turnbuckle body.

2.4.3.3 Inspecting

- Turnbuckles must be inspected for damage before each use. Damaged threads, jamb nuts, or bent frame members make the unit unsuitable for use.

2.4.4 Links and Rings

Links and rings are usually designed and manufactured as a part of the lifting hardware for a specific purpose, such as the peak link on multiple-leg slings. However, the rings and links may also be found on the load-attachment end of slings.

2.4.4.1 Fabricating

- Rings must be forged or welded from low alloy steel.
2.4.4.2 Marking

- Rings or links should be marked by the manufacturer with the manufacturer’s name or trademark and ring or link size.

2.4.4.3 Inspecting

- Welded rings or links must be subjected to a non-destructive test

2.4.5 Swivel Hoist Rings

2.4.5.1 Fabricating

- Check that swivel hoist rings for hoisting are fabricated from forged carbon or alloy steel.

2.4.5.2 Marking

Swivel hoist rings must have the manufacturer’s name or trademark, working load limit, and recommended torque value permanently marked (forged, stamped, or inscribed) by the manufacturer on the swivel hoist ring. Permanently attached metal tag bearing the same information may also be used.

2.4.5.3 Inspecting

Permanently installed hoist rings must be inspected before each use as follows:

- Ensure free movement of bail and swivel.
- Inspect swivel hoist rings thoroughly.
- Inspect the hole to ensure that there has been no deformation.
- Check the condition of the threads in the hole to ensure that the hoist ring will secure and the bushing can be brought down for a snug fit.

Destroy hoist rings that are cracked, bent, have damaged threads, or do not operate freely

2.4.6 Wire-rope Clips (clamps)

2.4.6.1 Marking

- Wire-rope clips must be permanently and legibly marked with the size and manufacturer’s identifying mark.

3 Forms

The following forms and systems are required by these requirements:

- Hoisting and Rigging Equipment Database
  - Rigging Equipment Database (RED, contact hoisting and rigging inspector). Database for hoisting and rigging equipment other than cranes, hoists, and miscellaneous lifting devices
4 Recordkeeping

The following recordkeeping requirements apply for these requirements:

- The equipment custodian maintains custodian records.
- The hoisting and rigging inspector maintains inspection records.

5 References

- **SLAC Environment, Safety, and Health Manual** (SLAC-I-720-0A29Z-001)
  - Chapter 41, “Hoisting and Rigging”
    - Hoisting and Rigging: Equipment Requirements (SLAC-I-730-0A21S-035)

Other Documents

- Department of Energy Standard 1090, “Hoisting and Rigging” ([DOE-STD-1090](#)) and third-party standards referenced in it