Hoisting and Rigging

PURPOSE

Some of the hazards in hoisting and rigging operations and the typical equipment used are outlined in this section. All hoisting and rigging equipment (cables, slings, chains) must comply with Sections 103, 168-180 in the Construction Regulations (O. Reg 213/91).

Hazards

Only competent workers can perform safe rigging and lifting. A safe rigging operation requires the worker to know the:

- weight of the load
- capacity of the hoisting device
- working load limit (WLL) of the hoisting rope, slings, and hardware.

The worker must also know how to properly inspect the equipment they are using.

Other workplace hazards (i.e. powerlines) must also be identified and controlled for a safe lift to occur. When the weights and capacities are known, the worker must then determine how to lift the load so that it is stable.

If the load or work area requires the help of a signaller because the view is obstructed, then the operator must request one from the supervisor. Do not proceed without a signaller.

Most rigging accidents can be prevented by field personnel following basic safe hoisting and rigging practices.

What Can Affect Hoisting Safety?

Working Load Limit (WLL) Not Known

Don't assume. Know the working load limits of the equipment being used. Never exceed these limits. On equipment, a load chart is typically available in the cab.

A chain used for hoisting shall,

a) be labelled to indicate its load rating capacity.
b) be repaired and reconditioned in accordance with the specifications of its manufacturer.
c) after being repaired or reconditioned, be proof tested in accordance with the specifications of its manufacturer.
d) be visually inspected by a competent worker as frequently as recommended by its manufacturer and, in any case, at least once a week when the chain is in service.

Hoisting and Rigging

Defective Components

Examine and inspect all hardware and slings before use. Tag out all defective hardware. Do not leave defective components lying around the site or in the trailer.

Weather Conditions

When visibility is impaired by snow, fog, rain, darkness, or dust, extra caution must be exercised. At freezing temperatures, loads are likely to be frozen to the ground or structure they are resting on. In extreme cold conditions avoid shock-loading or impacting the hoist equipment and hardware, which may have become brittle.

Electrical contact

One of the most frequent killers of workers is electrocution. An electrical path can be created when a part of the hoist, load line, or load comes into proximity to an energized overhead powerline. Use the electrical hazard plan to avoid injury.

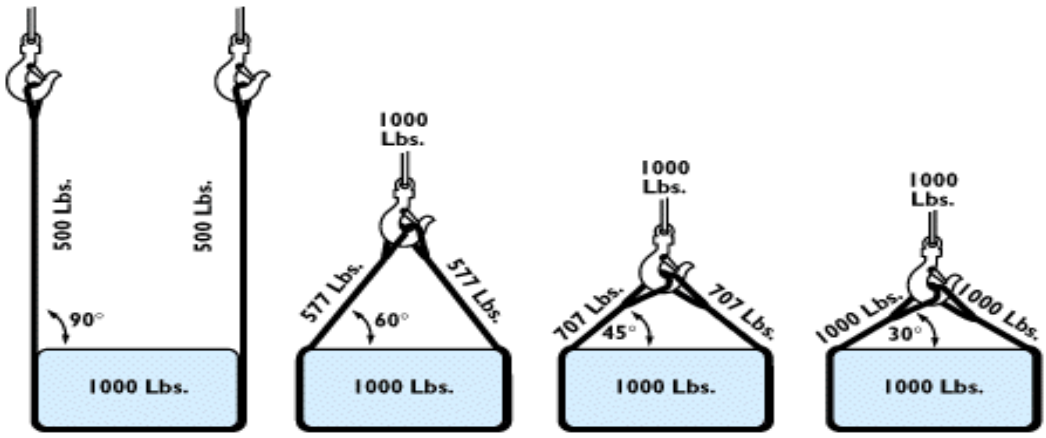
Inexperience or Lack of Training

If a worker is not sure what equipment to use or uses it improperly, this poses a hazard for themselves and everyone else around them.

Note: The *Construction Regulations Section 103 (1)* states: "No worker shall operate a shovel, backhoe or similar excavating machine in such a way that it or part of its load passes over a worker."

Equipment (i.e. excavators) must be inspected daily along with all rigging equipment.

Check on Sling Angle



Hoisting and Rigging

The total weight that you can pick up with a set of slings is reduced when the slings are used at angles (formed with horizontal). For instance, two slings used to lift 1000 pounds will have a 500-pound force on each sling (or leg) at a sling angle of 90 degrees. The force on each leg increases as the angle goes down. At 30 degrees the force will be 1000 pounds on each leg.

Keep sling angles greater than 45 degrees whenever possible. Using any sling at an angle lower than 30 degrees is extremely hazardous.

Rigging Hardware

Only forged alloy steel load-rated hardware shall be used for overhead lifting. Load-rated hardware is stamped with its WLL.

Inspect hardware regularly and before each lift.

Shackles

- Must be manufactured of forged alloy steel.
- Do not replace shackle pins with bolts. Pins are designed and manufactured to match shackle capacity.
- Check for wear, distortion, and opening. Check crown regularly for wear. Discard shackles noticeably worn at the crown.
- Do not use a shackle where it will be pulled or loaded at an angle. This severely reduces its
- capacity and opens the legs.
- Do not use screw pin shackles if the pin can roll under load and unscrew.

Whenever two or more ropes are to be placed over a hook, use a shackle to reduce wear and tear on thimble eyes.

Hoisting and Rigging

Hoisting and Rigging Equipment Inspection Requirements

Initial Inspection

This inspection is done at the time the product is first received to ensure that damage has not occurred during shipment. Verify that the goods are in compliance with the specification of the purchase order.

Verify that all inspection and maintenance records are with the equipment and up to date before putting the unit into service.

Pre-use Inspection

This level of visual inspection shall be done by the person handling the sling or device, or other specifically designated personnel.

A. Normal service – daily when in use
B. Severe service – each use
C. Special or infrequent service – as recommended by a qualified person before and after each use.

Periodic Inspection / Annual Inspection

The periodic level of inspection is done by designated personnel at regular intervals. At a minimum this inspection must be carried out at the interval required by the manufacturer (check manual for each piece of equipment). In addition, the interval may be based upon the frequency of use, severity of service conditions, and information derived through the pre-use inspection process.

Nylon Web Slings – Inspection Standard

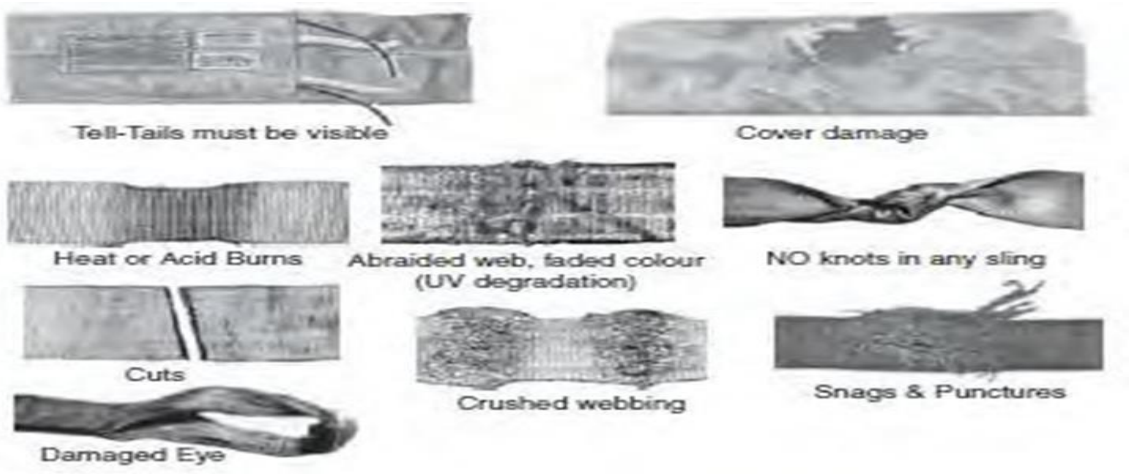
Workers involved in the use of nylon web slings shall be familiar with their characteristics and the necessary safety precautions.

Procedure

The following defects seriously impact the nylon web safety and are reason to remove the web from service:

- Nylon web slings that are cut, torn, frayed, burned, or otherwise worn are no longer trustworthy. It is not possible to calculate the strength left in damaged slings.
- Chemical action, heat, sunlight, and acid fumes discolour the nylon and indicate a loss in strength.
- When stitching is broken, the sling will not take the load evenly, but will put greater stress on the remaining stitching.
- Holes in the web where fibers are separated are cause for replacement.
- Manufacturers tag must be legible and affixed to all slings.

Hoisting and Rigging



Note: To prevent the above damage, sleeves or edge guards must be used. These protect the lifting capability of the sling and when cut or damaged are easily replaced. Wide sling angles cause the outside edge of the sling to tear.

Wire Rope – Inspection Standard
All wire rope in continuous service shall be observed during normal operation and visually inspected.

Procedure
The following defects seriously impact the wire rope safety and are reason to remove the wire rope from service:

- Broken wires.
- 6 randomly distributed broken wires in one rope lay.
- 3 or more broken wires in on strand.
- One or more broken wires at end fitting.
- Worn or abraded wires.
- If wear exceeds 1/3 of rope diameter.
- Look for shiny flat areas.
- Reduction in diameter.
- Normal wear reduces diameter.
- Stretch
- If lay is visibly lengthened.
- Compare to new sling/wire rope.

Hoisting and Rigging

- Caused by overloading.
- Corrosion
- Exterior rust, pitting, discoloration.
- Interior damage is hidden.
- Corrosion at base of end attachment.
- Kinking
- Permanent bend/dog.
- Caused by faulty handling.
- Bird-caging
- Permanent “see-through” distortion.
- Caused by sudden release of tension.
- Never returns to original shape.
- Core protrusion.
- Core is visible.
- Caused by shock-loading.
- Bulges
- Isolated increases in diameter.
- Caused by core slippage.
- Poor lubrication.
- If grooves are packed with hard grease or dirt.
- Unbalanced wear.
- Heat damage, torch burns, electric arc strikes.
- Anti-rotating wire rope.
- Flex rope near ear and listen for clicking noise broken interior wires.

Hoisting and Rigging

Repair of Wire Rope Slings
There shall be no repairs done to the wire used in a wire rope sling. Repairs shall be restricted to end attachments and fittings, which shall be deemed acceptable by the manufacturer.

Note: If any of the above defects are present, the wire rope/fitting shall be removed from service.

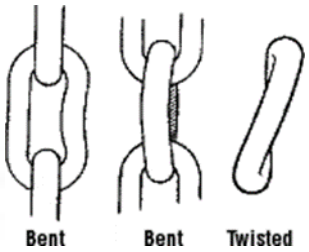
Chain Sling – Inspection Standard
Chain used for hoisting shall be observed during normal operation and visually inspected on a weekly basis. Only alloy chain shall be used for hoisting with an "8" or "T" embossed on the link.

Procedure
The following defects seriously impact the chains suitability for hoisting and are reason to remove the chain from service:

- Stretch
- Lengthening of links.
- Stretched links (hourglass shape).
- Stretched links tend to bind on each other.
- Check for leg length by hanging sling.
- If stretch exceeds 3% REPLACE the chain.
- Link wear.
- Reduction in diameter is more than 10%, REPLACE the chain.
- Wear at bearing surfaces.
- Shock loading.
- Improper use.

PITTING & CORROSION

DEFORMED COMPONENTS



Repair of Chain Slings
Cracked, broken, or bent chain links shall not be repaired, they shall be replaced by a qualified supplier.

Hoisting and Rigging

Environmental Considerations

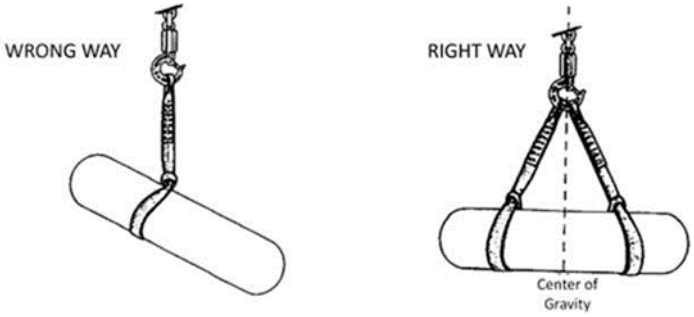
Slings shall be stored in a cool, dry and dark place; and must not be exposed to ultraviolet light (sunlight). Chemically active environments can affect the synthetic web slings in varying degrees ranging from none to total degradation. The sling manufacturer must be consulted before slings are used in a chemically active environment.

Style of Hitch to be Used

Slings can be used in any of the three Hitches illustrated. Some slings are designed to be used in a specific hitch application only.

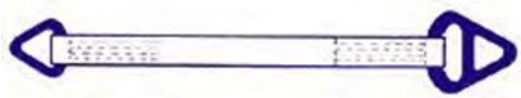
Control and Balance

Use a hitch that will keep the load under control at all times and be sure the lifting device is directly over the center of gravity.



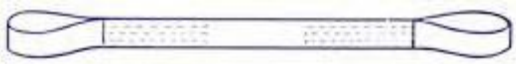
Type 1: Triangle & Choker (TC) - Hardware on each end produces the most effective choker hitch. Can also be used in vertical and basket hitches.

Hoisting and Rigging

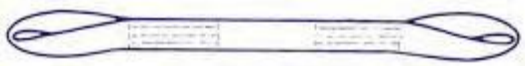


Type 2: Triangle & Triangle (TT) - Hardware on each end for use in basket or vertical hitch.

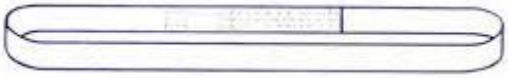
Type 3: Flat Eye & Eye (EE) - Popular, versatile sling used in vertical, choker & basket hitches. Easy to remove from underneath loads.



Type 4: Twisted Eye & Eye (EE) - Eyes turned at a right angle to sling body. Forms superior choker hitch & allows better fit on crane hook in basket hitch.



Type 5: Endless (EN) - Economical & adaptable sling with no fixed wear points. Used in all hitches.



Type 6: Reversed Eye (RE) - Extremely strong & durable for continuous and/or abusive applications. Wear pads on both sides of body.

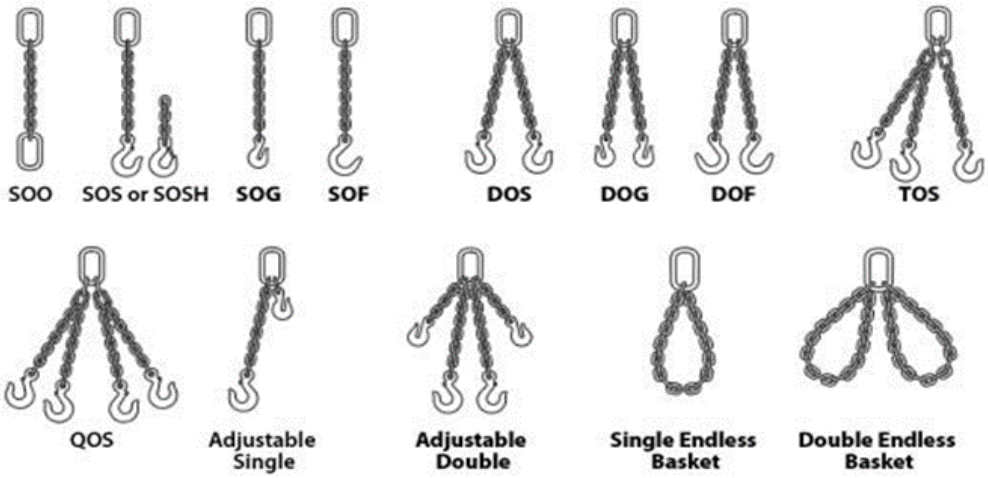
Environmental Considerations

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

Hoisting and Rigging

manufacturer or qualified person shall be consulted before slings are used in the chemically active environments.

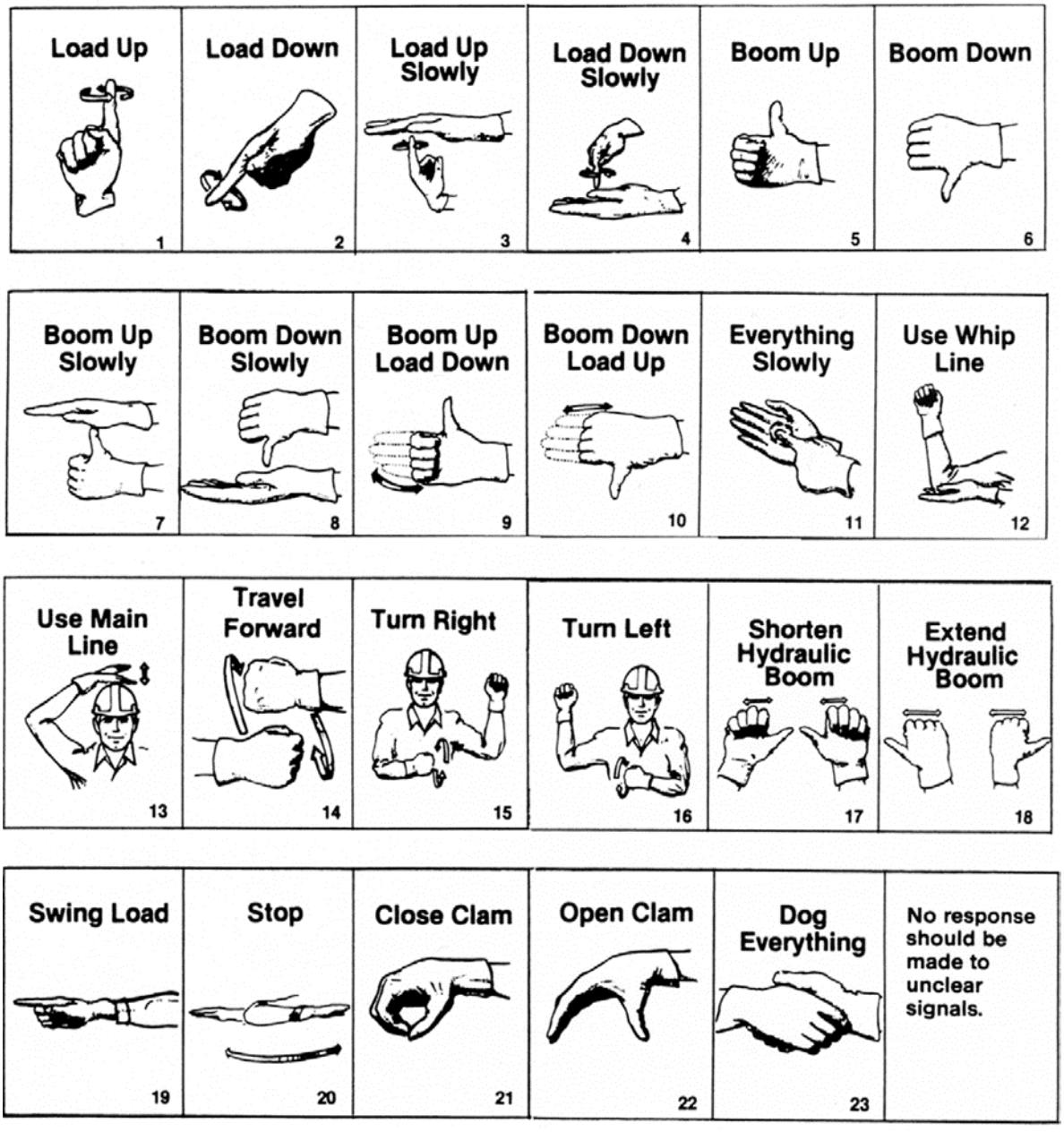
Sling shall be stored in an area where they will not be subjected to mechanical damage corrosive action, moisture, and extreme temperatures or kinking.



Hoisting and Rigging

Commonly Used Hand Signals

Ensure operator and signal person establish a common means of communication before beginning the task.



Hoisting and Rigging

Slings and Hitches

Workers involved in the use of chain, fiber rope, wire rope or nylon web slings shall be familiar with their characteristics and the necessary safety precautions.

- Safe working loads are reduced as legs are spread. When the angle formed by the spreader leg and the horizontal is 45°, the safe working load is reduced by 1/4.
- When a choker hitch is used, the safe working load is reduced by 1/4.
- If a three-legged sling is used, the sling size selected must be based on a two- legged sling (the third leg does not carry its share of the load).
- If a four-legged sling is used, the two diagonally opposite legs take most of the load. The remaining two only balance; therefore, select sling size based on a two-legged sling.
- Hoisting chains must be alloy steel stamped on links with a “T” or “8”. NO OTHER CHAIN IS ACCEPTABLE for hoisting purposes.
- An example of a field calculation for fiber rope safe working loads are: Manila – number of eighths in diameter x itself x 20 = SWL (pounds) i.e. 3/4" manila 6 x 6 x 20 = 720 pounds Chart SWL = 1,080 pounds
- Polypropylene –number of eighths in diameter x itself x 40 = SWL (pounds) i.e.3/4" polypropylene 6 x 6 x 40 = 1,440 pounds Chart SWL -1,700 pounds
- Nylon –number of eighths in diameter x itself x 60 = SWL (pounds) i.e.3/4" nylon 6 x 6 x 60 = 2,160 pounds Chart SWL –2,800 pounds
- An example of field calculations for nylon web safe working load is .8 ton (1,600 pounds) per h of webbing. i.e.8" nylon web .8 x 8" = 6.4 tons (12,800 pounds) Many manufacturers chart SWL = 12,000-12,800 pounds
- Field calculation is never as accurate as manufacturer's specifications but can serve as a quick guideline. The above filed calculation observes a 5 to 1 safety factor on new material on a straight pull.