Title: Hoisting, Rigging and Material Handling	Section: 27	Issue Date: February 2022
Approved by: Walter Spivak, President	Signature:	Revision Date: NA

27.1 Policy Statement

Hoisting, rigging and material handling are essential tasks to CF operations. CF recognizes that these tasks can range from simple to complex and have a varying degree of risk. CF will ensure that the individuals involved in hoisting, rigging and material handling operations are competent to perform such tasks.

27.2 Background

Hoisting, rigging and material handling activities can encompass a variety of tasks. This section of CF H&S program outlines the safe work practices and procedures required for but not limited to:

- Hoisting Equipment
  - Cranes, winches and hoists
  - Inspection requirements
- Rigging Hardware
  - Slings, chains, wire rope, hooks etc.
  - Rigging inspection
- Lift planning
  - Typical and complex lifts
- Material Handling
  - Equipment such as forklifts, concrete pump trucks, hydrovac, pile driving
  - Storage of material

27.3 Hoisting, Rigging and Material Handling

Only those qualified by knowledge, training, and experience shall perform Hoisting, Rigging and Material Handling activities.

27.4 Lifting Categories: Definitions

Typical or Common Lift

A typical or common lift does not meet the Critical Load definitions as noted below. This includes routine or repetitive lift activities below 75% of the maximum capacity of the lifting device.

Critical Lift

- Tandem lift which requires multiple cranes, or two hooks on same crane and exceeds 75% crane capacity
- Centre of gravity is significantly off from center
- Load is difficult to balance and secure (e.g., liquid filled container/vessel)
- Load subjected to high winds or adverse weather conditions causing load instability
- Load must travel over operating equipment
- Public at risk
- See H&S_FORM_052 for Critical Lift Plan, if required

27.5 Lift Plan Review

If the Supervisor determines **any** of the following conditions apply to the proposed lift; then the Supervisor shall ensure an engineering review of the lift plan is performed.

- Two or more cranes are required to lift a load (mobile or fixed) and exceeds 75% crane capacity
- Sling angle to eye bolt is less than 45 degrees, or 30 degrees for other lifting equipment
- Lift may be subject to adverse weather conditions or high wind loads causing instability
- Load weight or centre of gravity is unknown and difficult to determine.
- Lift will require the crane to be loaded to 95% of its capacity at any point in the travel of the load.
- Man basket attached to crane and worker must enter;

27.6 Special Considerations in Lift Planning

Crane or Load can swing within Limit of Approach of high voltage power lines.

- Have alternate lift/swing positions have been examined
- Is De-energizing lines/conductors feasible
- Must use a dedicated signal person designated to watch line / conductor clearance
- Signal person shall be readily identifiable and able to communicate effectively with the operator
- If voltage of power line is known safe limit of approach can be determined
- If voltage unknown either use maximum safe limit of approach or contact local electrical authority

Lift on or over any type of live / process equipment or containers

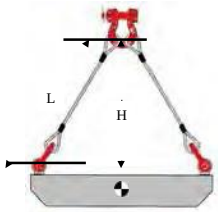
- Are the contents or function of the equipment or containers known
- Ensure All workers clearly understand potential hazards
- Facilities housing personnel must be vacated and flagged
- Best and most practical crane communication signals to be used
- A Designated channel/frequency is available for critical radio communication

27.7 SLING ANGLES

Sling angles should be maintained at greater than 45 degrees from horizontal between the connection point and the hook. Stress on the connection point and sling increases exponentially as the sling angle decreases. The chart and basic equation below provide guidance on the amount of load increase on the connection point and sling.

Common Equation for Calculating Sling Tension

Sling Angles



L/H =Load Factor

L = 144''
H= 125''
144''/ 125'' = 1.152

Angle near 60°

Sling Angle	Load Angle Factor
90º	1.000
85º	1.004
80º	1.015
75º	1.035
70º	1.064
65º	1.104
60º	1.155
55º	1.221
50º	1.305
45º	1.414
40º	1.555
35º	1.742
30º	2.000
25º	2.364
20º	2.924
15º	3.861
10º	5.747
5º	11.490

The following formula may be used to calculate sling tension:

Example:
Load Weight (L): 5000 lbs Slings: 2
Sling Angle 45 Degrees
Load Angle Factor: 1.4 (from chart)
Formula: Sling Tension = L ÷ # of Slings x Load Angle Factor
Sling Tension = 5000 / 2 x 1.4 = 3500lbs - (Each sling receives 3500 lbs of tension/load)

Note: Above equation assumes Centre of Gravity is at approximate centre of load and 2 slings are used.

27.8 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 should be done by the person handling the sling or device, or other specifically designated personnel. Hoisting Equipment Inspection Form, H&S_FORM_053 but Records are not required.
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.

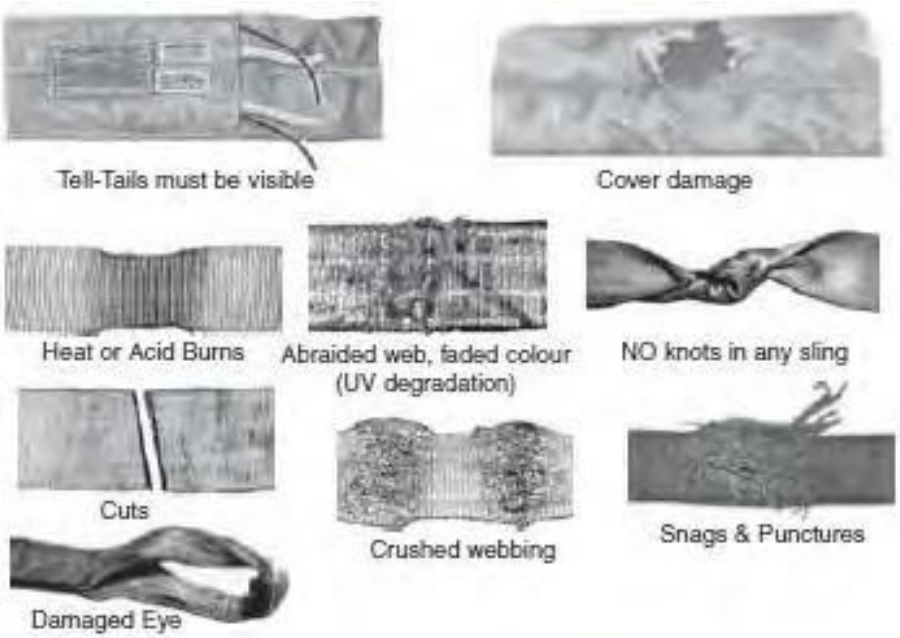
Inspection Records
Inspection must be conducted by a competent person. Inspection records must be documented. Slings must be individually identified and condition of sling at the time inspection must be recorded. Records shall be available at site or available to site.

27.9 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 question 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.



Note: To prevent the above damage, sleeves or edge guards should 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.

27.10 Wire Rope – Inspection

Standard

All Wire rope in continuous service shall be observed during normal operation and visually inspected on a weekly basis.

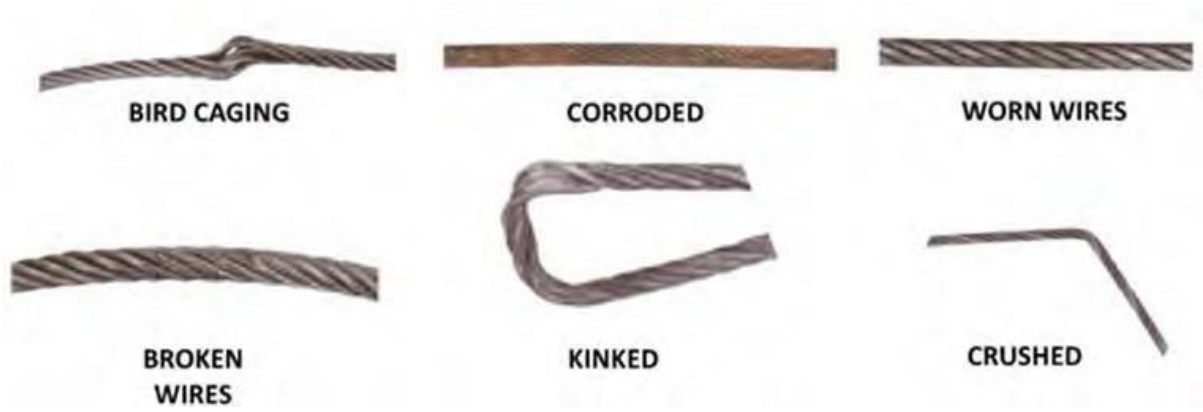
Procedure

The following defects seriously question 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

Wire Rope Nominal Size	Maximum Reduction in Diameter
Up to ¾″	3/64″
¾″ to 1 ¼″	1/16″
1 ¼″ to 1 ½″	3/32″

- Stretch
  - If lay is visibly lengthened
  - Compare to new sling/wire rope
  - 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
  - If possible, clean groves and re-lubricate
  - Results in internal friction and wear
- Fittings
  - Distorted hooks, tings, sleeves, thimbles
  - Discard if wear exceeds 10% of any dimension from new
  - Discard if hook opening has increased by 10% from new
- Unbalanced Wear
- Hear Damage, Torch Burns, Electric Arc Strikes
- Anti-Rotating Wire Rope
  - Flex rope near ear and listen for clicking noise broken interior wires



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 well be deemed ok by the manufacture.

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

27.11 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 question the chains suitability for hoisting and are reason to remove the chain from service:

- Stretch
  - Measure lengthening of links
  - Stretched links will have an hourglass shape
  - Stretched links tend to bind on each other
  - Check for leg length by hanging sling
  - If stretch exceeds 3% REPLACE the chain
  - New chain should be carefully measured when new and its length should be recorded to use as a future standard.

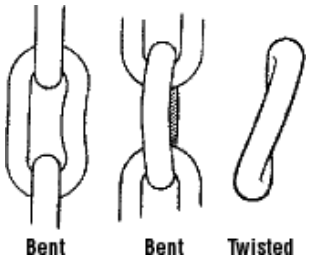
- Link Wear
  - using calipers measure diameter at point of maximum wear
  - maximum wear is normally at a crack, gouge, chip or cut
  - If reduction in diameter is more than 10%, REPLACE the chain
  - Look for wear at bearing surfaces

- Shock Loading
  - If chain is given a shock load, inspect carefully for cracks
  - When chains fail due to shock loading, flying debris acts like a bullet

- Improper Use
  - Around sharp corners or edges with no softeners
  - Dragging chain from under loads
  - Hoisting when links are locked
  - Avoid dropping chain from heights
  - Do not hammer links to straighten them
  - Shorten a chain by using a shortening clutch. NO OTHER METHOD IS ACCEPTABLE.

PITTING & CORROSION

DEFORMED COMPONENTS



No alloy chain shall be annealed or welded.

Repair of Chain Slings
Cracked, broken, or bent chain links shall not be repaired, they shall be replaced. All repaired chain slings must be proof tested to twice the Vertical rated capacity.

27.12 Nylon Web Slings – Operating Procedure

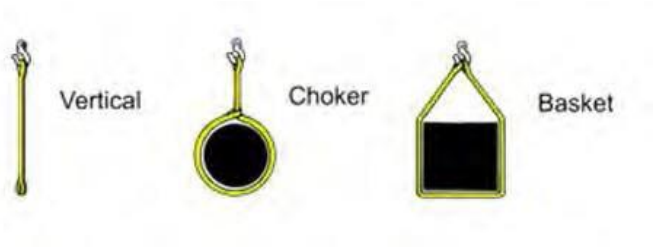
Mechanical Considerations

- Determine the weight of the load
- Select sling having suitable characteristics for the type of load, hitch and environment
- Sling shall not be loaded in excess of the rated capacity. Consideration should be given to the angle from the horizontal (load to sling angle) which affects rated capacity.
- Slings with fittings which are used in a choker hitch shall be sufficient length to assure that the choking action is on the webbing.
- Slings used in a basket hitch shall have the load balanced to prevent slippage
- Slings shall not be dragged on the floor or over an abrasive surface.
- Slings shall not be twisted or tied into knots, or joined by knotting
- Slings shall not be pulled from under loads when the load is resting on the sling.
- Slings shall always be protected from being cut by sharp corners, sharp edges, protrusions or abrasive surfaces. Softeners and sling savers are the only acceptable materials to be used when lifting.
- Do not drop slings equipped with metal fittings.
- The opening in fittings shall be the proper shape and size to ensure that the fitting will seat properly in the hook or their attachments.
- All slings must be protected from damage while being moved, and properly stored when not in use.

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

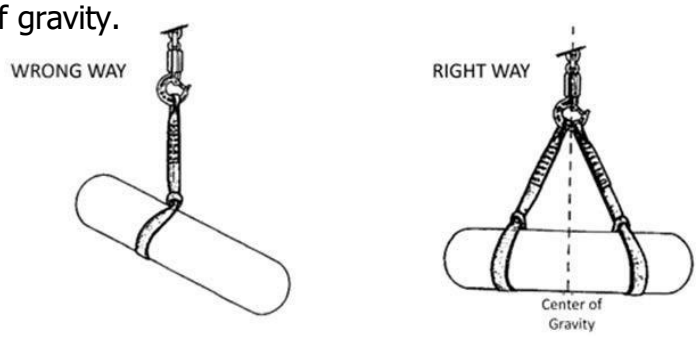
Style of Hitch to be Used

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

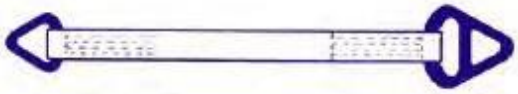


Control and Balance

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.



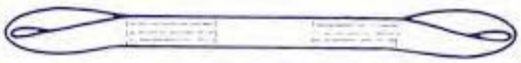
Type 1: Triangle & Choker (TC) - Hardware on each end produces the most effective choker hitch. Can also be used in vertical and basket hitches.



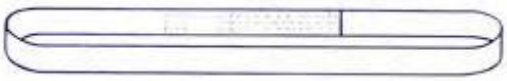
Type 2: Triangle & Triangle (TT) - Hardware on each end for use in basket or vertical hitch.

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 &/or abusive applications. Wear pads on both sides of body.

27.13 Wire Rope and Chain Slings – Operating Procedure

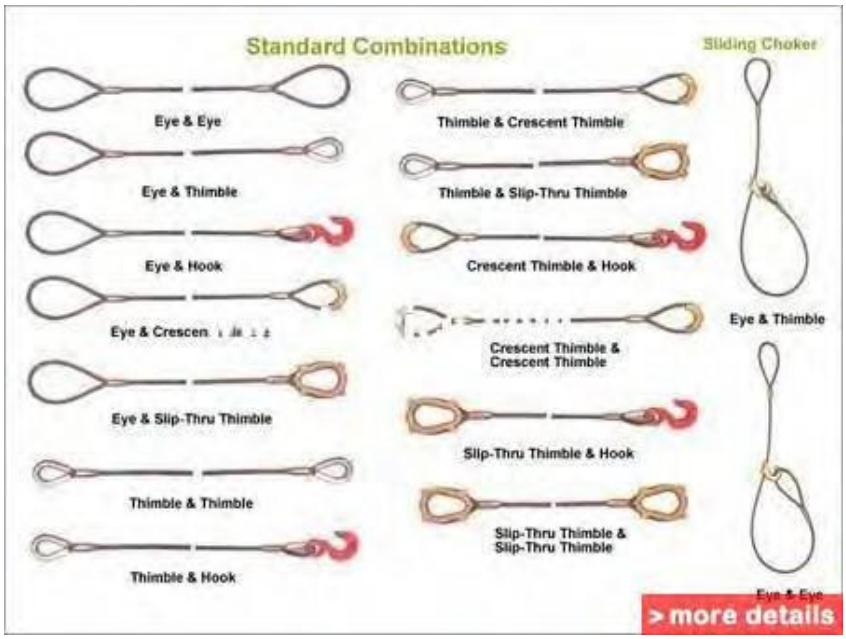
Mechanical Considerations

- Determine the weight of the load
- Select proper wire or chain sling having suitable characteristics for the type of load, hitch and environment. Only wire and chain slings with legible identification tags shall be used.
- Wire or Chain slings shall not be loaded in excess of the rated capacity. Consideration should be given to the angle from the horizontal (load to sling angle) which affects rated capacity.
- Only alloy chain shall be used for hoisting with an "8" or "T" embossed on the link.
- Wire or Chain slings with fittings which are used in a choker hitch shall be of sufficient length to assure that the choking action is on the sling and never on the fittings.
- Wire or Chain slings used in a basket hitch shall have the load balanced to prevent slippage.
- Wire or Chain slings shall not be twisted or tied into knots, or joined by knotting.
- Wire or Chain slings shall not be pulled from under loads when the load is resting on the sling.
- Consideration shall be given to the distribution of load weight on a multi-legged lift.
- Make shift fasteners, hooks, or links formed from bolts, rods, et., or other such components shall not be used
- Mechanical coupling links shall not be used within the body of an alloy chain sling to connect two pieces of chain
- Horizontal sling angles less than 30 degrees shall not be used except as per Engineering documentation.
- Slings in contact with edges, corners, or protrusions should be protected with a material of sufficient strength, thickness, and construction to prevent damage to the sling.
- The load applied to the hook should be centered in the base (bowl) of the hook to prevent point loading on the hook, unless the hook is designed for pointing loading.

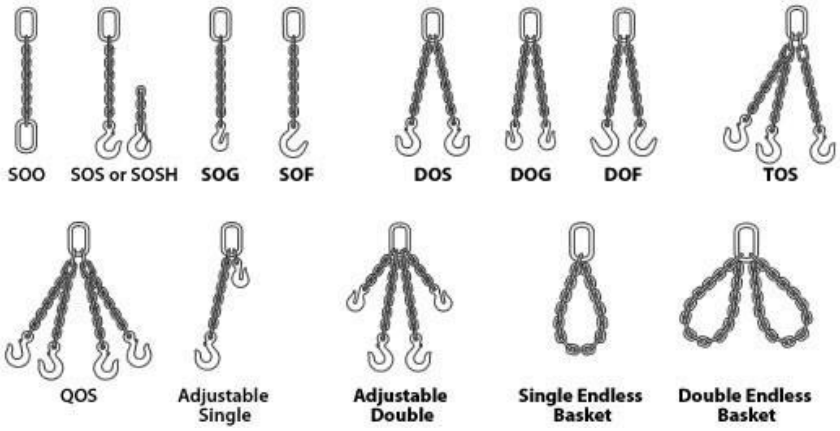
Environmental Considerations

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 manufacturer or qualified person should 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.

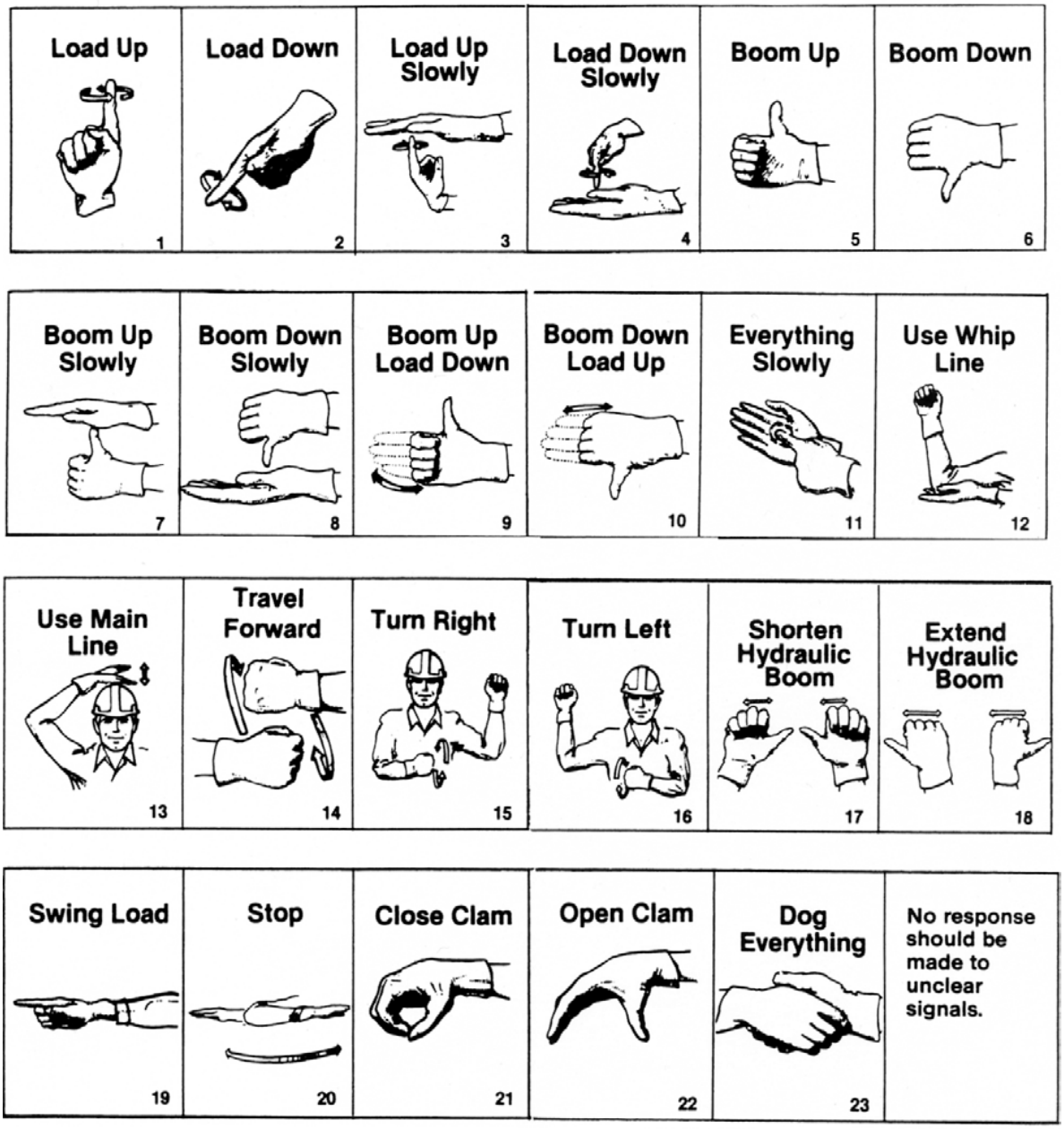
Types of Wire Slings



Types of Chain Slings



27.14 Hoisting Hand Signals



27.15 Slings and Hitches

Standard
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.

Procedure

- 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 should 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.

27.16 Hand Operated Chain Hoists

Standard
Workers involved in the use of chain hoists shall be familiar with their characteristics and the necessary safety precautions.

Procedure

- Manually operated chain hoists may be:
  - spur drive
  - geared endless chain operated
  - worm drive
  - geared (screw geared) endless chain operated
  - differential endless chain operated
  - lever operated
- The chain on these tools is a special case-hardened product. It is not marked as alloy chain with a "T" or "8".

- Never choke the hoist chain. If a link is distorted, it may jam the mechanism.
- Generally, endless chains hoists are used for hoisting and lever operated hoists are used for both vertical and horizontal pulls.
- Endless chain hoists are operated from below and the operator can control the load. They are not provided with a control for free-chain operation and the hook is raised or lowered by pulling the operating chain.
- Worm-geared and differential hoists have sufficient internal friction to prevent "running away" when lowering loads.
- Spur-geared hoists are usually provided with a load brake in the mechanism.
- Lever operated hoists are used extensively in construction and maintenance. Capacities vary from 3/4 ton to 6 ton and they are available in a load-brake (friction disc) or a ratchet-and-pawl design.
- Ratchet-and-pawl types require very little attention; operation is not affected by oil or grease.
- Ratchet hoists are unsuitable where smooth operation is required and in tight quarters.
- When using a ratchet hoist, the load is held by the hand lever during lifting and lowering and, if accidentally released, the lever will swing back forcefully.
- Accidental release of the lever may result in self-ratcheting until the load bottoms.
- The load-brake type depends on frictional resistance of the brake discs. The brakes must be dry and free from oil and grease. Hoists must be kept clean and dry at all times.
- When the hoist is in the lower mode and is very lightly loaded, it is possible for it to release the load out of control if a buildup of dirt and grease inside the case has been permitted.
- Hoists in regular service should be dismantled, inspected, and overhauled by a competent person as per the MANUFACTURERS Requirements. These intervals vary between manufacturers. Ensure that the maintenance interval is known and maintenance window is sufficient before using the device.
- Verify specific requirements with manufacturers.
- Chainfalls should not be used for long term securing of material as this may surpass the maintenance interval. Use anchors, cabling or engineer approved supports for long term in place tie offs (eg. piping tied back for long term modifications / plant renovations or lay-up).

27.17 Hoists and Winches – Anchorage

Standard

Workers involved in the use of hoists and winches shall be familiar with their characteristics and the necessary safety precautions.

Procedure

- Anchorage points should be located as close to a perpendicular support as possible.
- Columns are generally not designed to withstand significant lateral forces. Because the member is already in compression, the effect of a small deflection is amplified and the column could buckle.

- Load beams near column or other vertical support points to minimize bending. If the beam is an "I" section, it may be necessary to weld stiffeners to the web to withstand the additional shear force applied.
- With open web steel joists, anchor load to the top chord. Only very light loads may be suspended from the bottom chord.
- On suspended pipe, use nylon web sling on pipe to distribute stress and protect finish. Determine capacity of pipe hangers from catalogue and ensure hanger anchors at least as strong.
- Expansion anchors in concrete depend on:
    - compressive strength of concrete
    - anchor diameter
    - depth of anchor is embedded
    - centre to centre spacing and edge distance
- Manufactured or engineered beam clamps are very secure anchors if used correctly:
    - clamps should never be used on flange widths outside the specified range
    - most are designed for use at 90° to the flange
    - flanges that are wide and thin are subject to bending
    - the rating marked on the clamp does not necessarily apply to the beam
- Slings using the double-wrap basket hitch area preferred anchorage. Avoid sharp angles on the legs and always insert softeners at sharp bends.
- Lugs welded to a beam or column must be compatible with the member in metallic composition. The appropriate welding rod must also be used.
- Lugs should be welded to the centre line of the flange in line with the web. Avoid side loading on a lug.

27.18 Crane & Boom Truck Operations

General Operation Procedure

- Only licensed and qualified crane operators who have been properly instructed may operate the controls.
- Operator must be familiar with operator manual supplied by the crane manufacture. Manual must be available in cab.
- Operator must complete the Operator Crane Log Book, which may include, but is not limited to:
    - Crane Operation Daily Checklist
    - Monthly Crane Inspection Log
    - Record all maintenance on the Maintenance Logs as required.
- All outriggers beams (if equipped) are to be fully extended and outriggers pads are to be placed on a solid footing or blocking. All wheels are to be clear of the ground.
- The boom angle, boom length and the load radius and the crane rated capacity must be known by the operator.
- Crane must be set up level.
- The lifting hook is directly above the load's center of gravity. Load weight must also be known.
- Rigging is correct for the job.
- Crane is set up level on firm, stable ground or blocking. (Crawler cranes).

- Crane controls should be moved smoothly and gradually to avoid abrupt, jerky movements of the load. Slack must be removed from the slings and hoisting ropes before the load is lifted.
- Be sure that everyone in the immediate area is clear of the load and aware that a load is being moved.
- Do don't make any lifts beyond the rated capacity of the crane, slings chains, rope slings, etc.
- Do not operate crane if the limit switches (if equipped) are out of order, or if ropes show defects or wear.
- Make certain that before moving the load, load slings, load chains, or other lifting devices are fully seated in the saddle of the hook with the latch closed.
- At no time should a load be left suspended from the crane unless the operator is at the controls with the power on.
- When two or more cranes are used to make one lift. The design of the lift shall be engineered and communication shall occur through the designated signal person.
- Operator has total care and control of any lifts and their decision is final and must not be influence or pressured to make any pick he/she feels uncomfortable.
- Weather conditions should be considered when making a lift.
- All cranes must be inspected yearly and recertified by a competent professional engineer.
- JSA shall be completed for critical lifts.
- Load charts must be legible and visible to the operator at all times.

Note: Loads with friction such as buried pipe or poles buried in the ground must not be lifted by a crane under any circumstances. The load must be free of force to hoist.

27.19 Rigging from Booms and Buckets

Attaching Rigging, Devices or Performing Hoisting from Forklifts, Telescoping boom Equipment, Backhoes and Excavators

Rigging and hoisting from masts, forks, buckets or attached devices to lift trucks, telescoping boom equipment and excavation equipment can only be performed as per manufacturer's instructions and identified attachment points. Buckets, forks, booms, hoists, telescoping booms and other load handling attachments must only be installed and used on mobile equipment as specified by the equipment manufacturer for use on that equipment.

The installation, inspection, testing, repair and maintenance and usage of a tool, machine, device attached to a piece of equipment must be carried out in accordance with the manufacturer's instructions by a qualified person and must otherwise meet regulations and standards for the jurisdiction in which it is to be used.

Note: Certain types of fork extensions may require engineering documentation prior to use.

Note: Cutting holes in forks or buckets for the purpose of rigging and hoisting or making similar alterations equipment is not permitted.

27.20 Falling Material

No material shall be stacked, piled, or stored within 1.8 meters (6 feet) of:

- An opening in a floor or roof
- The open edge of a floor or roof or balcony
- Material or equipment used on work platforms, roofs, and other surfaces must be adequately secured to prevent it from falling or tipping.
- Where there is a risk of falling objects, overhead protection must be provided. If this is not practical, the hazardous area must be barricaded with warning signs to prevent access. Entry must not take place in the area unless the overhead work is suspended.
- All materials must be adequately secured while being moved from one location to another.
- Special attention must be paid during structural steel erection. Nuts, bolts, and tools must be secured and properly stored at all times.
- Supervisors will evaluate the work and travel areas for open grating and falling material hazards. This evaluation will include but is not limited to:
    - Erecting or dismantling scaffolds or work platforms
    - Moving material
    - Craning
    - Moving forklifts, hand carts, transport and work equipment
    - Performing housekeeping activities on the work site
    - Cutting and welding activities

To review for falling material hazards, use the Job Safety Assessment (JSA) procedure.

Note: See Working at Heights Section

27.21 Critical Material Handling Planning

Standard

Competent workers qualified by knowledge, training, and experience to identify hazards and appropriate controls to avoid endangering workers, equipment, or materials, shall conduct Critical Material Handling Planning.

Competent workers shall evaluate potential material handling item(s) to determine the extent to which any of the following conditions may be a factor in the material handling, and based on this evaluation may designate the material to be moved using Critical Material Handling Planning:

Examples:

- Lifting of personnel using a Powered Lift Truck (PLT).
- A load greater than 95% of the rated capacity of the PLT being used.
- Travel/access routes to be used during transport, considering pathway, pathway surface and impacts to load stability, intersections and potential for collisions, general pedestrian traffic, floor openings, edges of mezzanines, critical station equipment, obstructive structures, PPE exempt etc.

Critical Material Handling Plan Development

A Critical Material Handling Plan form shall be completed prior to hoisting or moving. Competent workers shall evaluate the material handling environment and identify the following on the Critical Material Handling Plan form:

- Load weight, shape and dimensions.
- Attachment points.
- Specialized rigging requirements to secure the load.
- Need to establish a Safe Work Area around the task.
    - Note safe work area may be a safe zone around the material handling task that moves with the handling equipment and material (eg – escorting load on travelled area).
- Lay Down Area (confirm load will be adequately supported and blocked).

The competent worker shall identify path of travel for load on the Critical Material Handling Plan form which considers the following;

- Use of warning signs and barricades during travel and/or closure of route pathways to personnel not involved in material handling task where warranted.
- Use of signal person and/or flag person during travel.
- Method of communication for personnel involved in the material handling.
- Avoid material being moved over personnel.
- Avoid material contacting operating equipment.
- Surface Traction and Capacities (grating floors, floor rating, surface changes).
- Avoid material handling around floor openings, mezzanine edges and mitigation of potential for load / material to fall.

27.22 Freeze Down

Environmental conditions must be considered when identifying hazards prior to hoisting any materials such as jersey barriers, pipe, lumber, skids, sea containers or equipment. Material that has been sitting on a surface where the "load" may be frozen down, which typically occurs during winter (freeze/thaw) conditions present unique hazards.

Unexpected resistance (from frozen loads or components) during hoisting or material moving operations can result in release of unexpected energy in an uncontrolled manner resulting in a high potential for injury or damage. Slings, chains, other rigging components or the load itself may break or shatter causing injury or damage.

Applying force to break loads free using other equipment may also apply uncontrolled/ uncalculated stress to points on the equipment, or material.

This also applies to existing buried pipelines that are required to be hoisted in order to tie into a new section of pipe.

The following safe work practices are necessary to ensure workers recognize freeze down / friction hazards and provide the controls required to prevent an incident/accident:

Prior to hoisting the object, it's important to determine the following:

- Is the object frozen to the ground?
- What force will be applied to move the object from its friction state?
- Is a dynamometer available on site or means to measure the potential force applied when attempting to break the object free?
- Do I have the necessary equipment and rigging to hoist the object?
- Can engineering controls such as salt or heat be applied to dislodge the object from the ground?
- Do you need to dig further back on the pipe to release pressure?

If you cannot answer these questions, further planning will be necessary such as use of thawing equipment or tenting and heating to release the material from the frozen ground.

Prevention

In order to eliminate or reduce the risk of uncontrolled force / energy caused by friction, apply the following controls:

- When storing equipment in potentially frozen conditions use plywood, 2x4's or other material as a barrier between the equipment and ground.
- Conduct FLRA cards to ensure hazards have been identified and controlled.
- All personnel not directly involved in the hoisting must be clear of the operation.
- Use the right tools and rated equipment for the task.
- Always remain clear of the line of fire
- Be aware of the potential for stored energy in any load
- Plan your work
- Back out /stop when unsure or at the limit of the equipment

27.23 Landing Loads

Landing loads / material present potential danger both at the moment and afterwards. Always ensure that the area for landing the material has been inspected and secured and is able to support the load safely:

Observe the following safe practices when landing or disengaging from load:

- Ensure chocks are available to land pipe and prevent rolling away.
- Ensure dunnage is available in sufficient dimensions and strength to land the load and safely extract forks or rigging components
- Only land loads where the ground or surface can safely support the load without settling or shifting.
- Never stack multiple tiers of material unless the landing area can support the cumulative weight over time (stacks may tip if they settle causing injury or damage
- Confirm the capacity or racks, decks an platforms (including trucks) before landing loads
- Use spotters to assist in the accurate and safe placement of loads whenever the operator does not have clear line of sight to all perspectives of the landing area.