## GENERAL REQUIREMENTS

These requirements apply regarding the hazards associated with hoisting and rigging.

### Pre-shift Visual Inspection of Cranes

- Cranes being used in steel erection activities will be visually inspected prior to each shift by a competent person; the inspection will include observation for deficiencies during operation. At a minimum this inspection will include the following:
  - All control mechanisms for maladjustments.
  - Control and drive mechanism for excessive wear of components and contamination by lubricants, water or other foreign matter.
  - Safety devices, including but not limited to boom angle indicators, boom stops, boom kick out devices, anti-two block devices, and load moment indicators where required.
  - Air, hydraulic, and other pressurized lines for deterioration or leakage, particularly those which flex in normal operation.
  - Hooks and latches for deformation, chemical damage, cracks, or wear.
  - Wire rope reeving for compliance with hoisting equipment manufacturer's specifications.
  - Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, or moisture accumulation.
  - Hydraulic system for proper fluid level.
  - Tires for proper inflation and condition.
  - Ground conditions around the hoisting equipment for proper support, including ground settling under and around outriggers, ground water accumulation, or similar conditions.
  - The hoisting equipment for level position.
  - The hoisting equipment for level position after each move and setup.
- If any deficiency is identified, an immediate determination will be made by the competent person as to whether the deficiency constitutes a hazard.
- If the deficiency is determined to constitute a hazard, the hoisting equipment will be removed from service until the deficiency has been corrected.
- The operator will be responsible for those operations under the operator's direct control.

  Whenever there is any doubt as to safety, the operator will have the authority to stop and refuse to handle loads until safety has been assured.
- A qualified rigger (a rigger who is also a qualified person) will inspect the rigging prior to each shift.
- The headache ball, hook or load will not be used to transport personnel.
- Cranes or derricks may be used to hoist employees on a personnel platform provided that all provisions are met.
- Safety latches on hooks will not be deactivated or made inoperable except:
- When a qualified rigger has determined that the hoisting and placing of purlins and single joists can be performed more safely by doing so.
- When equivalent protection is provided in a site-specific erection plan.

## WORKING UNDER LOADS

Routes for suspended loads will be pre-planned to ensure that no employee is required to work directly below a suspended load except for:

- Employees engaged in the initial connection of the steel.
- Employees necessary for the hooking or unhooking of the load.
- When working under suspended loads, the following criteria will be met:
  - Materials being hoisted will be rigged to prevent unintentional displacement.
  - Hooks with self-closing safety latches or their equivalent will be used to prevent components from slipping out of the hook.
  - All loads will be rigged by a qualified rigger.

## MULTIPLE LIFT RIGGING PROCEDURE

A multiple lift will only be performed if the following criteria are met:

- A multiple lift rigging assembly is used.
- A maximum of five members are hoisted per lift.
- Only beams and similar structural members are lifted.
- All employees engaged in the multiple lift have been trained in these procedures.
- No crane is permitted to be used for a multiple lift where such use is contrary to the manufacturer's specifications and limitations.

Components of the multiple lift rigging assembly will be specifically designed and assembled with a maximum capacity for total assembly and for each individual attachment point. This capacity, certified by the manufacturer or a qualified rigger, will be based on the manufacturer's specifications with a 5 to 1 safety factor for all components.

The total load will not exceed:

- The rated capacity of the hoisting equipment specified in the hoisting equipment load charts.
- The rigging capacity specified in the rigging rating chart.

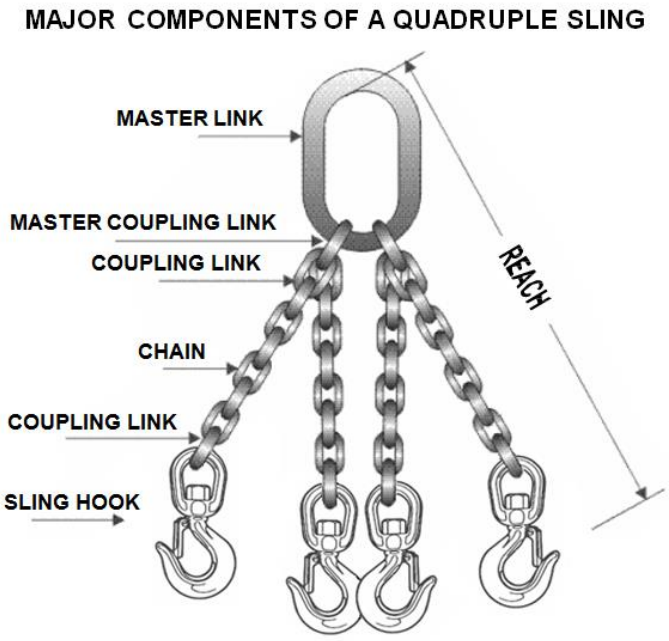
The multiple lift rigging assembly will be rigged with members:

- Attached at their center of gravity and maintained reasonably level.
- Rigged from top down.
- Rigged at least 7 feet apart.

The members on the multiple lift rigging assembly will be set from the bottom up. Controlled load lowering will be used whenever the load is over the connectors

## INTRODUCTION TO SLINGS

The ability to handle materials – to move them from one location to another, whether during transistor at the worksite – is vital to all segments of industry. Materials must be moved, for example, for industry to manufacture, sell, and utilize products. In short, without materials-handling capability, industry would cease to exist.




To varying degrees, all employees in numerous workplaces take part in materials handling. Consequently, some employees are injured. In fact, the mishandling of materials is the single largest cause of accidents and injuries in the workplace. Most of these accidents and injuries, as well as the pain and loss of salary and productivity that often result, can be readily avoided.

Whenever possible, mechanical means should be used to move materials to avoid employee injuries such as muscle pulls, strains, and sprains. In addition, many loads are too heavy and/or bulky to be safely moved manually.

Various types of equipment, therefore, have been designed specifically to aid in the movement of materials: cranes, derricks, hoists, powered industrial trucks, and conveyors.

Because cranes, derricks, and hoists rely upon slings to hold their suspended loads, slings are the most commonly used materials-handling apparatus. This section provides information on the proper selection, maintenance, and use of slings to assist.

## IMPORTANCE OF THE OPERATOR

The operator must exercise intelligence, care, and common sense when selecting and using slings. Slings must be selected in accordance with their intended use, based upon the size and type of load, and the environmental conditions of the workplace. All slings must be visually inspected before use to ensure their effectiveness.

A well-trained operator can prolong the service life of equipment and reduce costs by avoiding the potentially hazardous effects of overloading equipment, operating it at excessive speeds, taking up slack with a sudden jerk, and suddenly accelerating or decelerating equipment. The operator can look for causes and seek corrections whenever a danger exists. He or she should cooperate with coworkers and supervisors and become a leader in carrying out safety measures– not merely for the good of the equipment and the production schedule but, more importantly, for the safety of everyone concerned.

## SLING TYPES

The dominant characteristics of a sling are determined by the components of that sling. For example, the strengths and weaknesses of a wire rope sling are essentially the same as the strengths and weaknesses of the wire rope of which it is made.

Slings are generally one of six types: Chain, wire rope, metal mesh, natural fiber rope, synthetic fiber rope, or synthetic web. In general, use and inspection procedures tend to place these slings into three groups: chain, wire rope and mesh, and fiber rope web. Each type has its own particular advantages and disadvantages. Factors to consider when choosing the best sling for the job include the size, weight, shape, temperature, and sensitivity of the material to be moved, as well as the environmental conditions under which the sling will be used.

## CHAINS

Chains are commonly used because of their strength and ability to adapt to the shape of the load. Care should be taken, however, when using alloy chain slings because sudden shocks will damage them. Misuse of chain slings could damage the sling, resulting in sling failure and possible injury to an employee.

Chain slings are the best choice for lifting very hot materials. They can be heated to temperatures of up to 1,000˚ Fahrenheit; however, when alloy chain slings are consistently exposed to service temperatures in excess of 600˚ Fahrenheit, operators must reduce the working load limits in accordance with the manufacturer's recommendations.

All sling types must be visually inspected prior to use. When inspecting alloy steel chain slings, pay special attention to any stretching, or excess wear of the allowances made by the manufacturer, and nicks and gouges. These signs indicate that the sling may be unsafe and they must be removed from service.

## WIRE ROPE

A second type of sling is made of wire rope. Wire rope is composed of individual wires that have been twisted to form strands. Strands are then twisted to form a wire rope. When wire rope has a fiber core, it is usually more flexible but is less resistant to environmental damage. Conversely, a core that is made of a wire rope strand tends to have greater strength and is more resistant to heat damage.

Wire rope may be further determined by the "lay." The lay of a wire rope describes the direction the wires and strands are twisted during the construction of the rope. Most wire rope is right lay, regular lay – which means that the strands pass from left to right across the rope and the wires in the rope are laid opposite in direction to the lay of the strands. This type of rope has the widest range of applications.

Lang lay (where the wires are twisted in the same direction as the strands) is recommended for many excavating, construction, and mining applications, including draglines, hoist lines, dredgelines, and other similar lines.

Lang lay ropes are more flexible and have greater wearing surface than regular lay ropes. In addition, since the outside wires in lang lay rope lie at an angle to the rope axis, internal stress due to bending over sheaves and drums is reduced causing lang lay ropes to be more resistant to bending fatigue.

A left lay rope is one in which the strands for a left-hand helix similar to the threads of a left- hand screw thread. Left lay rope has its greatest usage in oil fields on rod and tubing lines, blast hole rigs, and spudders where rotation of right lay would loosen couplings. The rotation of a left lay rope tightens a standard coupling.

## WIRE ROPE SLING SELECTION

When selecting a wire rope sling to give the best service, there are four characteristics to consider: strength, ability to bend without distortion, ability to withstand abrasive wear, and ability to withstand abuse.

- **Strength —** The strength of a wire rope is a function of its size, grade, and construction. It must be sufficient to accommodate the applied maximum load. The maximum load limit is determined by means of an appropriate multiplier. This multiplier is the number by which the ultimate strength of a wire rope is divided to determine the working load limit. Thus, a wire rope sling with strength of 10,000 pounds and total working load of 2,000 pounds has a design factor (multiplier) of 5. New wire rope slings have a design factor of 5. As a sling suffers from the rigors of continued service, however, both the design factor and the sling's ultimate strength are proportionately reduced. If a sling is loaded beyond its ultimate strength, it will fail. So, older slings must be more rigorously inspected to ensure that rope conditions adversely affecting the strength of the sling are considered in determining if a wire rope sling should be allowed to continue in service.
- **Fatigue (Bending without Failure) —** A wire rope must have the ability to withstand repeated bending without the wires failing from fatigue. Fatigue failure of the wires in a wire rope is the result of the development of small cracks from repeated applications of bending loads. It occurs when ropes make small radius bends. The best means of preventing fatigue failure of wire rope slings is to use blocking or padding to increase the radius of bend.
- **Abrasive Wear —** the ability of a wire rope to withstand abrasion is determined by the size, number of wires, and construction of the rope. Smaller wires bend more readily and therefore offer greater flexibility but are less able to withstand abrasive wear. Conversely, the larger wires of less flexible ropes are better able to withstand abrasion than are the smaller wires of more flexible ropes.
- **Abuse —** All other factors being equal, misuse oor abuse of wire rope will cause a wire rope sling to become unsafe long before any other factor. Abusing a wire rope sling can cause serious structural damage to the wire rope, such as kinking or bird caging, which reduces the strength of the wire rope. (In bird caging, the wire rope strands are forcibly untwisted and become spread outward.) So, to prolong the life of the sling and protect the lives of employees, the manufacturer's suggestion for safe and proper use of wire rope slings must be strictly adhered to.

**Wire Rope Life**

Many operating conditions affect wire rope life. They are bending, stresses, loading conditions, speed of load application (jerking), abrasion, corrosion, sling design, materials handled, environmental conditions, and history of previous usage.

In addition to the above operating conditions, the weight, size, and shape of the loads to be handled also affect the service life of a wire rope sling. Flexibility also is a factor. Generally, more flexible ropes are selected when smaller radius bending is required. Less flexible ropes should be used when the rope must move through or over abrasive materials.

**Wire Rope Sling Inspection**

Wire rope slings must be visually inspected before each day's use. The operator should check the twists or lay of the sling. If ten randomly distributed wires in one lay are broken, or five wires in one strand of a rope lay are damaged, the sling must not be used. It is not sufficient, however, to check only the condition of the wire rope. End fittings and other components should also be inspected for any damage that could make the sling unsafe.

To ensure safe sling usage between scheduled inspections, all workers should participate in a safety awareness program. Each operator should keep a close watch on those slings he or she is using. If any accident involving the movement of materials occurs, the operator should immediately shut down the equipment and report the accident to a supervisor. The cause of the accident should be determined and corrected before resuming operations.

**Field Lubrication**

Although every rope sling is lubricated when manufactured, it also must be lubricated "in the field" to increase the sling's useful service life. There is no set rule on how much or how often this should be done. It depends on the conditions under which the sling is used. The heavier the loads, the greater the number of bends, or the more adverse the conditions under which the sling operates, the more frequently lubrication is required.

## STORAGE

Wire rope slings should be stored in a well-ventilated, dry building or shed. To avoid corrosion and rust, never store wire rope slings on the ground or allow them to be continuously exposed to the elements. And, if it is necessary to store wire rope slings outside, make sure that they are set off the ground and protected.

Note: Using the sling several times a week, even with light loads, is a good practice. Records show that frequently or continuously used slings give useful service far longer than idle ones.

## DISCARDING SLINGS

Wire rope slings can provide a margin of safety by showing early signs of failure. The following factors indicate when a wire sling needs to be discarded:

- Severe corrosion
- Localized wear (shiny worn spots) on the outside
- A one-third reduction in outer wire diameter
- Damage or displacement of end-fittings – hooks, rings, links, or collars – by overload or misapplication
- Distortion, kinking, bird caging, or other evidence of damage to the wire rope structure
- Excessive broken wires

## FIBER ROPE AND SYNTHETIC WEB

Fiber rope and synthetic web slings are used primarily for temporary work, such as construction and painting jobs, and in marine operations. They also are the best choice for use on expensive loads, highly finished parts, fragile parts, and delicate equipment.

**Fiber Rope Slings**

Fiber rope deteriorates on contact with acids and caustics. Fiber rope slings, therefore, must not be used around these substances unless the manufacturer recommends them for that use.

When inspecting a fiber rope sling, look first at its surface. Look for cuts, gouges, or worn surface areas; dry, brittle, scorched, or discolored fibers; or melting or charring of any part of the sling. If any of these conditions are found, the supervisor must be notified and a determination made regarding the safety of the sling. If the sling is found to be unsafe, it must be discarded.

Next, check the sling's interior. It should be as clean as when the rope was new. A buildup of powder like sawdust on the inside of the fiber rope indicates excessive internal wear and that the sling is unsafe.

Finally, scratch the fibers with a fingernail. If the fibers separate easily, the fiber sling has suffered some kind of chemical damage and must be discarded.

**Synthetic Rope and Web Slings**

The most commonly used synthetic web slings are made of nylon, polypropylene, and polyester. They have the following properties in common:

- Strength – can handle a load of up to 300,000 pounds.
- Convenience – can conform to any shape.
- Safety – will adjust to the load contour and hold it with a tight, non-slip grip.
- Load protection – will not mar, deface, or scratch highly polished or delicate surfaces.
- Long life – are unaffected by mildew, rot, or bacteria; resist some chemical action; and have excellent abrasion resistance.
- Economy – have a low initial cost plus a long service life.
- Shock absorbency – can absorb heavy shocks without damage.
- Temperature resistance – are unaffected by temperatures up to 180˚ Fahrenheit.

Because each synthetic material has unique properties, it should be used according to the manufacturer's instructions, especially when dealing with chemically active environments.

## POSSIBLE DEFECTS

Synthetic web slings must be removed from service if any of the following defects exist:

- 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
- Distortion of fittings

## SAFE LIFTING PRACTICES

Now that the sling has been selected (based upon the characteristics of the load and the environmental conditions surrounding the lift) and inspected prior to use, the next step is learning how to use it safely. There are four primary factors to consider when safely lifting a load:

- The size, weight, and center of gravity to the load.
- The number of legs and the angle the sling makes with the horizontal line.
- The rated capacity of the sling.
- The history of the care and usage of the sling.

## SIZE, WEIGHT, AND CENTER OF GRAVITY OF THE LOAD

The center of gravity of an object is that point at which the entire weight may be considered as concentrated. To make a level lift, the crane hook must be directly above this point. While slight variations are usually permissible, if the crane hook is too far to one side of the center of gravity, dangerous tilting will result causing unequal stresses in the different sling legs. This imbalance must be compensated for at once.

## NUMBER OF LEGS AND ANGLE WITH THE HORIZONTAL

As the angle formed by the sling leg and the horizontal line decreases, the rated capacity of the sling also decreases. In other words, the smaller the angle between the sling leg and the horizontal, the greater the stress on the sling leg and the smaller (lighter) the load the sling can safely support. Larger (heavier) loads can be safely moved if the weight of the load is distributed among more sling legs.

## RATED CAPACITY OF THE SLING

The rated capacity of a sling varies depending upon the type of sling, the size of the sling, and the type of hitch. Operators must know the capacity of the sling. Charts or tables that contain this information generally are available from sling manufacturers. The values given are for new slings. Older slings must be used with additional caution. Under no circumstances will a sling's rated capacity be exceeded.

## HISTORY OF CARE AND USAGE

The mishandling and misuse of slings are the leading cause of sling-related accidents. The majority of injuries and accidents, however, can be avoided by becoming familiar with the essentials of proper sling care and use.

Proper care and use are essential for maximum service and safety. Slings must be protected with cover saddles, burlap padding, or wood blocking as well as from unsafe lifting procedures such as overloading to prevent sharp bends and cutting edges.

Before making a lift, check to be certain that the sling is properly secured around the load and that the weight and balance of the load have been accurately determined. If the load is on the ground, do not allow the load to drag along the ground. This could damage the sling. If the load is already resting on the sling, ensure that there is no sling damage prior to making the lift.

Next, position the hook directly over the load and seat the sling squarely within the hook bowl. This gives the operator maximum lifting efficiency without bending the hook or overstressing the sling.

Wire rope slings also are subject to damage resulting from contact with sharp edges of the loads being lifted. These edges can be blocked or padded to minimize damage to the sling.

After the sling is properly attached to the load, there are a number of good lifting techniques that are common to all slings. First, make sure that the load is not lagged, clamped, or bolted to the floor. Second, guard against shock loading by taking up the slack in the sling slowly. Apply power cautiously to prevent jerking at the beginning of the lift, and slowly accelerate or decelerate. Third, check the tension on the sling. Raise the load a few inches, stop, and check for proper balance and that all items are clear of the path of travel.

Never allow anyone to ride on the hook or load. Fourth, keep all personnel clear while the load is being raised, moved, or lowered. Crane or hoist operators should watch the load at all times when it is in motion. Finally, obey the following “nevers.” Never allow more than one person to control a lift or give signals to a crane or hoist operator except to warn of a hazardous situation. Never raise the load more than necessary. Never leave the load suspended in the air. And never work under a suspended load or allow anyone else to.

Once the lift has been completed, clean the sling, check it for damage, and store it in a clean, dry, airy place. It is best to hang it on a rack or wall.

Remember, damaged slings cannot lift as much weight as new or older well-cared for slings. Proper and safe use and storage of slings will increase their service life.

# MAINTENANCE OF SLINGS

## CHAINS

Chain slings must be cleaned prior to each inspection, as dirt or oil may hide damage. The operator must be certain to inspect the total length of the sling, periodically looking for stretching, binding, wear, or nicks and gouges. If a sling has stretched so that it is now more than three percent longer than when it was new, it is unsafe and must be discarded.

Binding is the term used to describe the condition that exists when a sling has become deformed to the extent that its individual links cannot move within each other freely. It indicates that the sling is unsafe. Generally, wear occurs on the load-bearing inside ends of the links. Pushing links together so that the inside surface becomes clearly visible is the best way to check for this type of wear. Wear may also occur, however, on the outside of links when the chain is dragged along abrasive surfaces or pulled out from under heavy loads. Either type of wear weakens slings and makes accidents more likely.

Heavy nicks and/or gouges must be filed smoothly, measured with calipers, and then compared with the manufacturer's minimum allowable safe dimensions. When in doubt, or in borderline situations, do not use the sling. In addition, never attempt to repair the welded components on a sling. If the sling needs repair of this nature, the supervisor must be notified.

## WIRE ROPE

Wire rope slings, like chain slings, must be cleaned prior to each inspection because they are subject to damage hidden by dirt or oil. In addition, they must be lubricated according to manufacturer's instructions. Lubrication prevents or reduces corrosion and wear due to friction and abrasion. Before applying any lubricant, however, the sling user should make certain that the sling is dry. Applying lubricant to a wet or damp sling traps moisture against the metal and hastens corrosion.

Corrosion deteriorates wire rope. It may be indicated by pitting, but it is sometimes hard to detect. If a wire rope sling shows any sign of significant deterioration, that sling must be removed until it can be examined by a person who is qualified to determine the extent of the damage.

By following these guidelines to proper sling use and maintenance, and by the avoidance of kinking, it is possible to greatly extend the useful service life of a wire rope sling.

## FIBER AND SYNTHETIC ROPES

Fiber ropes and synthetic webs are generally discarded rather than service or repaired. Operators must always follow the manufacturer's recommendations.

# OSHA REGULATIONS FOR SLINGS

## SCOPE

This section applies to slings used in conjunction with other material handling equipment for the movement of material by hoisting, in employments covered by this part. The types of slings covered are those made from alloy steel chain, wire rope, metal mesh, natural or synthetic fiber rope (conventional three strand construction), and synthetic web (nylon, polyester, and polypropylene).

## DEFINITIONS

**Angle of loading —** is the inclination of a leg or branch of a sling measured from the horizontal or vertical plane, provided that an angle of loading of five degrees or less from the vertical may be considered a vertical angle of loading.

**Basket hitch —** is a sling configuration whereby the sling is passed under the load and has both ends, end attachments, eyes or handles on the hook or a single master link.

**Braided wire rope** — is a wire rope formed by plaiting component wire ropes.

**Bridle wire rope sling —** is a sling composed of multiple wire rope legs with the top ends gathered in a fitting that goes over the lifting hook.

**Cable laid endless sling-mechanical joint —** is a wire rope sling made endless by joining the ends of a single length of cable laid rope with one or more metallic fittings.

**Cable laid grommet-hand tucked —** is an endless wire rope sling made from one length of rope wrapped six times around a core formed by hand tucking the ends of the rope inside the six wraps.

**Cable laid rope —** is a wire rope composed of six wire ropes wrapped around a fiber or wire rope core.

**Cable laid rope sling-mechanical joint —** is a wire rope sling made from a cable laid rope with eyes fabricated by pressing or swaging one or more metal sleeves over the rope junction.

**Choker hitch —** is a sling configuration with one end of the sling passing under the load and through an end attachment, handle or eye on the other end of the sling.

**Coating —** is an elastomer or other suitable material applied to a sling or to a sling component to impart desirable properties.

**Cross rod** — is a wire used to join spirals of metal mesh to form a complete fabric.

**Designated —** means selected or assigned by the employer or the employer's representative as being qualified to perform specific duties.

**Equivalent entity —** is a person or organization (including an employer) which, by possession of equipment, technical knowledge and skills, can perform with equal competence the same repairs and tests as the organization with which it is equated.

**Fabric (metal mesh) —** is the flexible portion of a metal mesh sling consisting of a series of transverse coils and cross rods.

**Female handle (choker) —** is a handle with a handle eye and a slot of such dimension as to permit passage of a male handle thereby allowing the use of a metal mesh sling in a choker hitch.

**Handle —** is a terminal fitting to which metal mesh fabric is attached.

**Handle eye —** is an opening in a handle of a metal mesh sling shaped to accept a hook, shackle or other lifting device.

**Hitch —** is a sling configuration whereby the sling is fastened to an object or load, either directly to it or around it.

**Link —** is a single ring of a chain.

**Male handle (triangle) —** is a handle with a handle eye.

**Master coupling link —** is an alloy steel welded coupling link used as an intermediate link to join alloy steel chain to master links.

**Master link or gathering ring —** is a forged or welded steel link used to support all members (legs) of an alloy steel chain sling or wire rope sling.

**Mechanical coupling link —** is a nonwelded, mechanically closed steel link used to attach master links, hooks, etc., to alloy steel chain.

**Proof load —** is the load applied in performance of a proof test.

**Proof test —** is a nondestructive tension test performed by the sling manufacturer or an equivalent entity to verify construction and workmanship of a sling.

**Rated capacity or working load limit —** is the maximum working load permitted by the provisions of this section.

**Reach —** is the effective length of an alloy steel chain sling measured from the top bearing surface of the upper terminal component to the bottom bearing surface of the lower terminal component.

**Selvage edge —** is the finished edge of synthetic webbing designed to prevent unraveling.
**Sling —** is an assembly which connects the load to the material handling equipment.

**Sling manufacturer —** is a person or organization that assembles sling components into their final form for sale to users.

**Spiral —** is a single transverse coil that is the basic element from which metal mesh is fabricated.

**Strand laid endless sling-mechanical joint —** is a wire rope sling made endless from one length of rope with the ends joined by one or more metallic fittings.

**Strand laid grommet-hand tucked —** is an endless wire rope sling made from one length of strand wrapped six times around a core formed by hand tucking the ends of the strand inside the six wraps.

**Strand laid rope —** is a wire rope made with strands (usually six or eight) wrapped around a fiber core, wire strand core, or independent wire rope core (IWRC).

**Vertical hitch —** is a method of supporting a load by a single, vertical part or leg of the sling.

## SAFE OPERATING PRACTICES

Whenever any sling is used, the following practices will be observed:

- Slings that are damaged or defective will not be used.
- Slings will not be shortened with knots or bolts or other makeshift devices.
- Sling legs will not be kinked.
- Slings will not be loaded in excess of their rated capacities.
- Slings used in a basket hitch will have the loads balanced to prevent slippage.
- Slings will be securely attached to their loads.
- Slings will be padded or protected from the sharp edges of their loads.
- Suspended loads will be kept clear of all obstructions.
- All employees will be kept clear of loads about to be lifted and of suspended loads.
- Hands or fingers will not be placed between the sling and its load while the sling is being tightened around the load.
- Shock loading is prohibited.
- A sling will not be pulled from under a load when the load is resting on the sling.

## INSPECTIONS

Each day before being used, the sling and all fastenings and attachments will be inspected for damage or defects by a competent person designated by the employer. Additional inspections will be performed during sling use, where service conditions warrant. Damaged or defective slings will be immediately removed from service.

## ALLOY STEEL CHAIN SLINGS

**Sling Identification**

Alloy steel chain slings will have permanently affixed durable identification stating size, grade, rated capacity, and reach.

**Attachments**

- Hooks, rings, oblong links, pear shaped links, welded or mechanical coupling links or other attachments will have a rated capacity at least equal to that of the alloy steel chain with which they are used or the sling will not be used in excess of the rated capacity of the weakest component.
- Makeshift links or fasteners formed from bolts or rods, or other such attachments, will not be used.

**Inspections**

- In addition to the inspection required, a thorough periodic inspection of alloy steel chain slings in use will be made on a regular basis, to be determined on the basis of **A-** frequency of sling use; **B-**severity of service conditions; **C-**nature of lifts being made; and **D-**experience gained on the service life of slings used in similar circumstances.
- Such inspections will in no event be at intervals greater than once every 12 months.
- The employer will make and maintain a record of the most recent month in which each alloy steel chain sling was thoroughly inspected, and will make such record available for examination.
- The thorough inspection of alloy steel chain slings will be performed by a competent person designated by the employer, and will include a thorough inspection for wear, defective welds, deformation and increase in length. Where such defects or deterioration are present, the sling will be immediately removed from service.

**Proof Testing**

The employer will ensure that before use, each new, repaired, or reconditioned alloy steel chain sling, including all welded components in the sling assembly, will be proof tested by the sling manufacturer or equivalent entity, in accordance with paragraph 5.2 of the American Society of Testing and Materials Specification A391-65, (ANSI G61.1-1968). The employer will retain a certificate of the proof test and will make it available for examination.

**Sling Use**

Alloy steel chain slings will not be used with loads in excess of the rated capacities. Slings will be used only in accordance with the manufacturer's recommendations.

**Safe Operating Temperatures**

Alloy steel chain slings will be permanently removed from service if they are heated above 1000° F. When exposed to service temperatures in excess of 600° F, maximum working load limits will be reduced in accordance with the chain or sling manufacturer's recommendations.

**Repairing and Reconditioning Alloy Steel Chain Slings**

- Worn or damaged alloy steel chain slings or attachments will not be used until repaired.
  When welding or heat testing is performed, slings will not be used unless repaired, reconditioned and proof tested by the sling manufacturer or an equivalent entity.
- Mechanical coupling links or low carbon steel repair links will not be used to repair broken lengths of chain.

**Effects of Wear**

If the chain size at any point of any link is less than minimum requirements, the sling will be removed from service.

**Deformed Attachments**

- Alloy steel chain slings with cracked or deformed master links, coupling links or other components will be removed from service.
- Slings will be removed from service if hooks are cracked, 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.

## WIRE ROPE SLINGS

**Sling Use**

Wire rope slings will not be used with loads in excess of the rated capacities. Slings will be used only in accordance with the manufacturer's recommendations.

**Minimum Sling Lengths**

- Cable laid and 6 x 19 and 6 x 37 slings will have a minimum clear length of wire rope 10 times the component rope diameter between splices, sleeves or end fittings.
- Braided slings will have a minimum clear length of wire rope 40 times the component rope diameter between the loops or end fittings.
- Cable laid grommets, strand laid grommets and endless slings will have a minimum circumferential length of 96 times their body diameter.

**Safe Operating Temperatures**

Fiber core wire rope slings of all grades will be permanently removed from service if they are exposed to temperatures in excess of 200° F. When non-fiber core wire rope slings of any grade are used at temperatures above 400° F or below minus 60° F, recommendations of the sling manufacturer regarding use at that temperature will be followed.

**End Attachments**

- Welding of end attachments, except covers to thimbles, will be performed prior to the assembly of the sling.
- All welded end attachments will not be used unless proof tested by the manufacturer or equivalent entity at twice their rated capacity prior to initial use. The employer will retain a certificate of the proof test, and make it available for examination.

**Removal from Service**

Wire rope slings will be immediately removed from service if any of the following conditions are present:

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

## METAL MESH SLINGS

**Sling Marking**

Each metal mesh sling will have permanently affixed to it a durable marking that states the rated capacity for vertical basket hitch and choker hitch loadings.

**Handles**

Handles will have a rated capacity at least equal to the metal fabric and exhibit no deformation after proof testing.

**Attachments of Handles to Fabric**

The fabric and handles will be joined so that:

- The rated capacity of the sling is not reduced.
- The load is evenly distributed across the width of the fabric.
- Sharp edges will not damage the fabric.

**Sling Coatings**

Coatings which diminish the rated capacity of a sling will not be applied.

**Sling Testing**

All new and repaired metal mesh slings, including handles, will not be used unless proof tested by the manufacturer or equivalent entity at a minimum of 1½ times their rated capacity. Elastomer impregnated slings will be proof tested before coating.

**Proper Use of Metal Mesh Slings**

Metal mesh slings will not be used to lift loads in excess of their rated capacities. Slings not included in this table will be used only in accordance with the manufacturer's recommendations.

**Safe Operating Temperatures**

Metal mesh slings which are not impregnated with elastomers may be used in a temperature range from minus 20° F to plus 550° F without decreasing the working load limit.

Metal mesh slings impregnated with polyvinyl chloride or neoprene may be used only in a temperature range from zero degrees to plus 200° F. For operations outside these temperature ranges or for metal mesh slings impregnated with other materials, the sling manufacturer's recommendations will be followed.

**Repairs**

- Metal mesh slings which are repaired will not be used unless repaired by a metal mesh sling manufacturer or an equivalent entity.
- Once repaired, each sling will be permanently marked or tagged, or a written record maintained, to indicate the date and nature of the repairs and the person or organization that performed the repairs.
- Records of repairs will be made available for examination.

**Removal from Service**

Metal mesh slings will be immediately removed from service if any of the following conditions are present:

- A broken weld or broken brazed joint along the sling edge.
- Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion.
- Lack of flexibility due to distortion of the fabric.
- Distortion of the female handle so that the depth of the slot is increased more than 10 percent.
- Distortion of either handle so that the width of the eye is decreased more than 10 percent.
- A 15 percent reduction of the original cross sectional area of metal at any point around the handle eye.
- Distortion of either handles out of its plane.

## NATURAL AND SYNTHETIC FIBER ROPE SLINGS

### Sling Use

- Fiber rope slings made from conventional three strand construction fiber rope will not be used with loads in excess of the rated capacities prescribed.
- Fiber rope slings will have a diameter of curvature meeting at least the minimums specified.
- Slings not included in these tables will be used only in accordance with the manufacturer's recommendations.

### Sling Operating Temperatures

Natural and synthetic fiber rope slings, except for wet frozen slings, may be used in a temperature range from minus 20° F to plus 180° F without decreasing the working load limit. For operations outside this temperature range and for wet frozen slings, the sling manufacturer's recommendations will be followed.

### Splicing

Spliced fiber rope slings will not be used unless they have been spliced in accordance with the following minimum requirements and in accordance with any additional recommendations of the manufacturer:

- In manila rope, eye splices will consist of at least three full tucks, and short splices will consist of at least six full tucks, three on each side of the splice center line.
- In synthetic fiber rope, eye splices will consist of at least four full tucks, and short splices will consist of at least eight full tucks, four on each side of the center line.
- Strand end tails will not be trimmed flush with the surface of the rope immediately adjacent to the full tucks. This applies to all types of fiber rope and both eye and short splices. For fiber rope under one inch in diameter, the tail will project at least six rope diameters beyond the last full tuck. For fiber rope one inch in diameter and larger, the tail will project at least six inches beyond the last full tuck. Where a projecting tail interferes with the use of the sling, the tail will be tapered and spliced into the body of the rope using at least two additional tucks (which will require a tail length of approximately six rope diameters beyond the last full tuck).
- Fiber rope slings will have a minimum clear length of rope between eye splices equal to 10 times the rope diameter.
- Knots will not be used in lieu of splices.
- Clamps not designed specifically for fiber ropes will not be used for splicing.
- For all eye splices, the eye will be of such size to provide an included angle of not greater than 60 degrees at the splice when the eye is placed over the load or support.

### End Attachments

Fiber rope slings will not be used if end attachments in contact with the rope have sharp edges or projections.

**Removal from Service**

Natural and synthetic fiber rope slings will be immediately removed from service if any of the following conditions are present:

- Abnormal wear.
- Powdered fiber between strands.
- Broken or cut fibers
- Variations in the size or roundness of strands.
- Discoloration or rotting.
- Distortion of hardware in the sling.

**Repairs**

Only fiber rope slings made from new rope will be used. Use of repaired or reconditioned fiber rope slings is prohibited.

## Synthetic Web Slings

**Sling Identification**

Each sling will be marked or coded to show the rated capacities for each type of hitch and type of synthetic web material.

**Webbing**

Synthetic webbing will be of uniform thickness and width and selvage edges will not be split from the webbing's width.

**Fittings**

Fittings will be:

- Of a minimum breaking strength equal to that of the sling.
- Free of all sharp edges that could in any way damage the webbing.

**Attachment of End Fittings to Webbing and Formation of Eyes**

Stitching will be the only method used to attach end fittings to webbing and to form eyes. The thread will be in an even pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling.

**Sling Use**

Synthetic web slings will not be used with loads in excess of the rated capacities. Slings not included in these tables will be used only in accordance with the manufacturer's recommendations.

**Environmental Conditions**

When synthetic web slings are used, the following precautions will be taken:

- Nylon web slings will not be used where fumes, vapors, sprays, mists or liquids of acids or phenolics are present.

- Polyester and polypropylene web slings will not be used where fumes, vapors, sprays, mists or liquids of caustics are present.
- Web slings with aluminum fittings will not be used where fumes, vapors, sprays, mists or liquids of caustics are present.

**Safe Operating Temperatures**

Synthetic web slings of polyester and nylon will not be used at temperatures in excess of 180° F. Polypropylene web slings will not be used at temperatures above 200° F.

**Repairs**

- Synthetic web slings which are repaired will not be used unless repaired by a sling manufacturer or an equivalent entity.
- Each repaired sling will be proof tested by the manufacturer or equivalent entity to twice the rated capacity prior to its return to service. The employer will retain a certificate of the proof test and make it available for examination.
- Slings, including webbing and fittings, which have been repaired in a temporary manner will not be used.

# Recommended Hand Signals For Controlling Crane Operations