**Purpose:** Establish safety requirements for the movement of materials using slings, ropes, and chains with other material handling equipment for the movement of material by hoisting.

**Safe Sling Operating Practices:**

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

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

## Inspections:

Each day before use, the sling and all fastenings and attachments shall be inspected for damage by a competent person designated by management. Additional inspections shall be performed during use, where service conditions warrant.

All wire rope slings and hoist chains must have a documented inspection every 30 days. See (Exhibit1)

Damaged or defective slings shall be immediately removed from service.

## Slings and Sling Types:

Because cranes, derricks, and hoists rely upon slings to hold their suspended loads, slings are the most commonly used piece of material-handling apparatus.

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:

1. chain
2. wire rope
3. metal mesh

4. natural fiber rope
5. synthetic fiber rope
6. synthetic web

In general, use and inspection procedures tend to place these slings into three groups:

1. chain
2. wire rope and mesh
3. fiber rope web

Each type has its own particular advantages and disadvantages.

## Chains:

Chains are commonly used because of their strength and ability to adapt to the shape of the load. Alloy chain slings are subject to damage by sudden shocks.

Chain slings are the best choice for lifting materials that are very hot. They can be heated to temperatures of up to 1000oF. Such heat will not be found in our operations. However chains are found in

When inspecting alloy steel chain slings, pay special attention to any stretching, wear in excess of the allowances made by the manufacturer, and nicks and gouges. These are all indications that the sling may be unsafe and is to be removed from service.

## Wire Rope:

Wire rope is composed of individual wires that have been twisted to form strands. The 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.

### Rope Lay:

The lay of a wire rope can mean any of three things:

- One complete wrap of a strand around the core; or
- The direction the strands are wound around the core; either right lay or left lay.
- The direction the wires that make up a strand are wound in relation to the direction the strands are wound around the core. In regular lay ropes the wires in the strands are laid in one direction while the strands in the rope are laid in the opposite direction. In Lang lay rope, the wires are twisted in the same direction as the strands.

Lang lay ropes are more flexible and have greater wearing surface per wire 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 form 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 maximum load that will be applied. 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 a strength of 10,000 pounds and a total working load of 2,000 pounds has a design factor (multiplier) 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. Older slings must be more rigorously inspected to ensure that rope conditions adversely affecting the strength of the sling are considered in determining whether or not a wire rope sling should be allowed to continue in service.

### Fatigue:

A wire rope must have the ability to withstand repeated bending without the failure of the wires from fatigue.

Fatigue failure of the wires in a wire rope is the result of the development of small cracks under repeated applications of bending loads. It occurs when ropes make small radius bends.

## 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 smaller wires of the more flexible ropes.

## Abuse:

All other factors being equal, misuse or 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.

## 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.

## Wire Rope Sling Inspection:

Before each 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. End fittings and other components should also be inspected for any damage that could make the sling unsafe.

## Field Lubrication:

Although every rope sling is lubricated during manufacture, to lengthen its useful service life it must also be lubricated “in the field.”

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 will be required.

## Storage:

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

Records show that slings that are used frequently or continuously give useful service far longer than those that are idle.

## Discarding Wire Rope Slings:

Wire rope slings can provide a margin of safety by showing early signs of failure. Factors requiring that a wire sling be discarded include the following:

- Severe corrosion,
- Localized wear (shiny worn spots) on the outside,
- A one-third reduction in outer wire diameter,
- Damaged 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, or
- 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 are also the best choice for use on highly finished parts, fragile parts, and delicate equipment.

### Fiber Rope:

Fiber rope slings are preferred for some applications because they are pliant, they grip the load well and they do not mar the surface of the load. They should be used only on light loads, however, and must not be used on objects that have sharp edges capable of cutting the rope or in applications where the sling will be exposed to high temperatures, severe abrasion or acids.

When inspecting a fiber rope sling prior to using it, look first at its surface. Look for dry, brittle, scorched, or discolored fibers. 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 interior of the sling. It should be as clean as when the rope was new. A build-up of powder-like sawdust on the inside of the fiber rope indicates excessive internal wear and is an indication that the sling is unsafe.

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

### Synthetic Web:

Synthetic web slings offer a number of advantages for rigging purposes. The most commonly used synthetic web slings are made of nylon, Dacron, and polyester. They have the following properties in common:

- Strength — can handle loads of up to 300,000 lbs.
- 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 low initial cost plus long service life.
- Shock absorbency — can absorb heavy shocks without damage.
- Temperature resistance — are unaffected by temperatures up to 180F.

Each synthetic material has its own unique properties. Nylon must be used wherever alkaline or greasy conditions exist. It is also preferable when neutral conditions prevail and when resistance to chemicals and solvents is important.

Dacron must be used where high concentrations of acid solutions such as sulfuric, hydrochloric, nitric, and formic acids and where high-temperature bleach solutions are prevalent. (Nylon will deteriorate under these conditions.) Do not use Dacron in alkaline conditions because it will deteriorate; use nylon or polypropylene instead. Polyester must be used where acids or bleaching agents are present and is also ideal for applications where a minimum of stretching is important.

## Synthetic Web 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, or
- Distortion of fittings.

## Safe Lifting Practices:

The four primary factors to take into consideration when safely lifting a load are (1) the size, weight, and center of gravity of the load; (2) the number of legs and the angle the sling makes with the horizontal line; (3) the rated capacity of the sling; and (4) the history of the care and usage of the sling.

### 1. 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. In order to make a level lift, the crane hook must be directly above this point.

### 2. Number of Legs and Angle with the Horizontal

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.

### 3. 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.

### 4. History of Care and Usage

The mishandling and misuse of slings are the leading causes of accidents involving their use. The majority of injuries and accidents, however, can be avoided by becoming familiar with the essentials of proper sling care and usage.

**Good lifting techniques common to all slings:**

- Make sure that the load is not lagged, clamped, or bolted to the floor.
- Guard against shock loading by taking up the slack in the sling slowly. Apply power cautiously so as to prevent jerking at the beginning of the lift, and accelerate or decelerate slowly.
- 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 hood or load.
- 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.

**Never:**

- 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, or leave the load suspended in the air.
- 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.

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

## MAINTENANCE OF SLINGS:

Safe storage of all slings helps prolong their useful life. All slings should be hung in a space reserved for that alone.

### 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 it was when 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 is also an indication 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 smooth, measured with calipers, 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 discard it.

### Wire Rope:

Wire rope slings, like chain slings, must be cleaned prior to each inspection because they are also 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. Therefore, 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.

### Fiber Ropes and Synthetic Webs:

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

## INSPECTION OF HOIST HOOKS:

OSHA has interpreted 1910.179 to mean that all hooks are subject to visual inspection by the operator or other designated person(s) at daily to monthly intervals.

Hooks must have documented inspections every 30 days. (See Exhibit 1)

Hooks with deformation or cracks or having more than 15 percent in excess of normal throat opening or more than 10 degrees of twist from the plan of the unbent hook shall be discarded. Repairs are generally not recommended. If such repairs are attempted they shall only be done under competent supervision and the hook shall be tested to the load requirements.

Test loads shall not be more than 125 percent of the rated load unless otherwise recommended by the manufacturer. The test reports shall be placed on file where readily available to appointed personnel.