

## SECTION 32

### RIGGING

**MAPP employees do not perform rigging duties. Any subcontractor that must perform this type of job function shall have a written program and training compliant with regulatory guidelines. Any situation where a policy does not exist all employees shall comply with the following general policy:**

#### 1. PURPOSE AND SCOPE

This POLICY provides the minimum procedures to be followed when performing rigging tasks and provides specifications for approved rigging equipment.

This POLICY applies to all employees and company subcontractors engaged in operations covered by the HSE Manual.

#### 2. RESPONSIBILITIES

##### 2.1. Site Manager

The Site Manager shall:

- Ensure competent rigging personnel are designated, listed on competent person list, and properly perform their duties.
- Ensure approved rigging equipment is furnished and used and rigging operations are properly supervised.
- Know the requirements of a critical lift and ensure that all critical lifts are done in accordance with applicable procedures and lift plans.

##### 2.2 Supervisor

Supervisors responsible for employees performing work covered by this POLICY must:

- Ensure that adequate lift plans are developed and used for all rigging operations.
- Ensure that riggers and other employees have been properly trained in rigging techniques and the requirements of this work instruction.
- Ensure that approved rigging equipment is furnished and used in accordance with this POLICY and manufacturer requirements.
- Know and understand the POLICYs and the equipment limitations related to the hoisting and lifting equipment used for the rigging operation, Mobile Cranes, Forklifts, and Chainfalls and Come-a-longs, as well as any appropriate manufacturer and site-specific requirements.
- Know the requirements of a critical lift and ensure that all critical lifts are made in accordance with applicable procedures and lift plans.
- Act as the designated competent person for rigging unless a rigger is assigned those duties.
- Assign qualified riggers, lifting equipment operators, signal, and tagline person(s) to handle rigging operations.

##### 2.3 Competent Person for Rigging

The competent person for rigging shall:

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- Complete all documented inspections of all rigging, slings and wire rope,
- Act as the person in charge of the lift when assigned as that person, and
- Decide whether a tag line creates an unsafe condition and should not be used.

#### **2.4 Employees Assigned Rigging Duties**

Employees assigned rigging duties (referred to as riggers) shall be competent in all aspects of rigging. Riggers shall:

- Read and understand their responsibilities set forth in this POLICY.
- Act as the designated competent person in charge of the lift, when so assigned.
- Inspect all rigging before use and remove any defective equipment from service.
- Know and follow the lift/rigging plan including the plan for accessing, connecting, and disconnecting the load.
- Know the requirements of a critical lift and ensure that all critical lifts are made in accordance with applicable procedures and lift plans.
- Know the safe working capacity and limitations of rigging and not exceed the limits.
- Determine the proper connection or hitch (vertical/basket/choked/etc.) for the load to be hoisted and ensure that it is properly applied.
- Know and understand manufacturer and site-specific requirements, equipment limitations, and company requirements related to the lifting/hoisting equipment used for the rigging operation, Mobile Cranes, Forklifts, and Chainfalls and Come-a-longs.
- Know the load, including knowing the weight of equipment and material being lifted, the center of gravity of the load, and the weight of the rigging to be used.
- Inform the crane operator, rigging crew, and signal and tagline person(s) of the weight of the load, the maximum radius the load will be lifted to, and the load path.
- Know and use the standard hand and radio crane signals.
- Keep the load line plumb above the load and rig above the center of gravity of the load or make appropriate accommodations to maintain a stable load.
- Keep the load under control at all times and prevent it from contacting people, the crane, and/or other equipment and structures. Do not swing a load over any person or occupied building or facility. See tagline use below.
- Act as the designated signal person or relay signals to designated signal person, when necessary.
- Safely land the load and stabilize it with blocks, chocks, or other means before disconnecting.
- Stay out from under suspended loads.

#### **2.5 Lifting/Hoisting Equipment Operator**

The lifting equipment operator shall:

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- Ensure that all components of the lifting equipment have up-to-date inspections and are in good working order. See also local regulations and National Hoisting Equipment Standards, such as the American Society of Mechanical Engineers..
- Know and discuss lift requirements including gross load weight, rigging plan, lifting equipment capacity limitations, maximum allowable radius, and load path with designated signal and tagline person(s) and rigger(s) prior to the lift.
- Ensure that lifting equipment never exceeds 95% of its capacity.
- Know the requirements of a critical lift and ensure that all critical lifts are made in accordance with applicable procedures and lift plans.
- Know the weight of the material or equipment being lifted.
- Keep the load within the equipment capacity or safe working radius (mobile cranes).
- Not leave the controls while the load is suspended.
- Follow signals of designated signal person.
- Instruct riggers on all aspects of mobilizing and demobilizing the lifting equipment e.g. cranes, derricks, material hoists, and forklifts.

#### 2.6 Designated Signal Person

The designated signal person shall:

- Know the load path
- Know the correct radio or hand signals
- Know the limitations of the lifting equipment and work within those limits
- Give the signals in a smooth and logical order to limit impact loads from sudden stops and direction changes
- Assure the load does not swing over any personnel, and
- Obtain assistance when the equipment operator cannot see both the lifting equipment and the load.

When the designated signal person has any doubt as to the safety of the lift or people in the work area, he/she shall stop the lift until safe working conditions have been assured and orders to proceed have been issued by the designated competent person.

#### 2.7 Tag Line Person

The tag line person shall:

- Tag the load in accordance with the “Tagging of Loads” section provided below,
- Keep the load from swinging over other personnel,
- Keep the tag line free of knots, fraying, and prevent it from catching on other objects, and
- Stay out from underneath the load as well as away from any position that

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the load could fall onto, if one end of the load should swing free or the lifting equipment fails

#### 2.8 Employee

Employees involved with rigging operations must receive general training on rigging techniques and perform all rigging activities according to training and instructions received

### 3 DEFINITIONS

Approved Cable Clamp	A drop forged cable clamp with its size marked on it and for which the manufacturer required torque values, number of clamps per slice, and distance between clamps or total amount of cable turn back are known.
Approved Shackle	A shackle that is permanently marked with its size, capacity, and the name or trademark of the manufacturer. The safety factor for the shackles shall be in accordance with ASME, CSA, British Standard and/or other government or local regulatory requirements.
Approved Wire Rope Sling	A sling made of 6 X 19 or 6 X 37 (non US 6 X 19 or 6 X 36) Extra Improve Plow Steel or Improved Plow Steel with a fiber core (FC) or independent wire rope core (IWRC) and braided Flemish eyes secured with a pressed-on mechanical ferrule/sleeve with an identification tag stating the capacity of sling
Approved Wire Rope Sling Capacity Chart	Refer to ASME 30.9 Wire Rope Sling Chart for Improved Plow Steel with a fiber core. (See <a href="#">Figure 2.</a> ) This chart may be used for the same style slings with independent wire rope core. Manufacturer charts for higher strength cables may be used if the material in the sling can be accurately identified and the slings meet the requirements of ASME B30.9 (or equivalent standards) and this POLICY.
Basket Hitch	A method of rigging a sling in which the sling is passed around the load and both eyes of the sling attached to the lifting device. D/d ratio must exceed 25.
Bird Caging	Damage to a wire rope creating a torsional imbalance on the rope such that the strands are separated and distorted such that they will no longer evenly distribute the load to the rope.

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	This may be caused by sudden stops, by being pulled through too small a sheave, etc.
Choker Hitch	A method of rigging a sling in which the sling is passed around the load, then through one loop eye, end fitting, or other device, e.g., a shackle, with the other loop eye or end fitting attached to the lifting device; reduces vertical capacity 20% – 25%.
D/d Ratio	The ratio of the diameter (D) of the item being picked or connector to the diameter (d) of the sling or rigging used to pick it. D/d minimum = 1 for wire rope slings to obtain the full single cable vertical capacity of the sling.
Hitch	Method of attaching a sling to a load, i.e., choke, basket, double wrap, etc.
Kink	Deformation of wire rope so severe that the wires or strands are pushed out of their original position permanently deforming the wire rope by freezing or locking wires and strands, thereby preventing them from sliding and adjusting to properly take the load. This represents irreparable damage and is cause for replacement of the wire rope.
Lifting/Hoisting Equipment	Means mobile cranes, derricks, tower cranes, overhead cranes, chain falls, air winches (tuggers), forklift, etc.
Rated Load	The maximum allowable working load established by the rigging hardware manufacturer. The terms “rated capacity”, capacity, safe working load (SWL), and “working load limit” are commonly used to describe rated load.
Rigger	The competent person designated to be responsible for safe rigging of a load.
Reeving	A rope system in which the rope travels around drums and/or sheaves.
Shackle	A U-shaped load bearing rigging connection device designed for use with a removable screw pin or bolt.
Side Loading	A load applied at an angle to the vertical plane of the boom/lift.
Signal Person(s)	Individual(s) assigned to signal the hoisting equipment during rigging and hoisting operations. Only one signal person at a

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	time will have authority to directly signal the lifting equipment operator.
Sling	An assembly used for lifting when connected to a lifting device or hoisting equipment. The upper portion is connected to the lifting device or hoisting equipment and the lower end supports the load made from materials, e.g., wire rope, synthetic materials like polyester and nylon webbing, and metal mesh.
Softener	An appropriately sized member used to protect the choker, load or cable from damage while making a lift and may also prevent the load from slipping
Sorting Hook	Hook with a long tip that is designed for sorting material. To be used only at ground level and only for sorting material, since they do not have a latch.
Synthetic Sling Shackle	A wide body shackle designed to be used with synthetic slings to prevent bunching or pinching of the sling material, which reduces the rated load and which could cause additional stress on the edges or center of the webbing.
Total Gross Load	The total weight of equipment or material being lifted applied to the crane or hoisting equipment, including the weight of load attaching equipment such as lower load block, spreader bars, shackles, slings, additional parts of load line cable, etc.

**4 PROCEDURE**

All rigging practices will be conducted in accordance with company HSE requirements and must either meet or exceed those standards. Approved rigging charts and manufacturer guidelines shall be used at all times to determine rigging equipment capacity.

The use of cranes, derricks, hoists, and rigging equipment is subject to certain hazards that cannot be eliminated without exercising skill and common sense. Trained competent supervision and craft personnel are to be used to reduce rigging hazards.

Rigging hazards include overloading, dropping, or slipping of the load caused by improper selection of rigging or attachment/hitches. Examples include using extreme sling angles, rigging below the center of gravity, obstruction to the free passage of the load, and using equipment for a purpose for which it was not intended or designed.

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All rigging operations are to be carefully planned and executed. When the lift is over 50% of the rigging capacity, as configured, there shall be a written lift plan, including, as a minimum, the hoisting equipment capacity, the rigging to be used, and the load weight.

Lift calculations shall be written on the JSA, on the Critical Lift Permit on a Load and Capacity Calculation Sheet or equal or, if required, and shall be approved by the rigger or competent person in charge of the lift prior to the lift.

Provided below are specific requirements for using various lifting equipment and rigging hardware in a safe manner.

#### 4.1 General Safety Rules for Lifting and Hoisting Equipment

- The rigger(s), designated signal person(s), hoisting equipment operator(s), and tagline person(s) shall know and discuss lift requirements including gross load weight, rigging plan, lifting equipment capacity limitations, maximum allowable radius, load path, and lift sequence with prior to the lift. (See Pre-lift Checklist, Figure 7,)
- The rigger(s), designated signal person(s) and hoisting equipment operator shall know and understand the POLICY's and equipment's limitations related to the lifting/hoisting equipment used for the rigging operation, for mobile cranes, Forklifts, and for Chainfalls and Come-a-longs, as well as any manufacturer and site-specific requirements.
- Keep all hoisting equipment, rigging, and the load at least 10 feet from power lines. Non US distance may be greater, such as minimum 10 meters in Europe. Consult local regulations. The most frequent killer in rigging is electrocution caused by contacting overhead power lines. Always maintain at least a ten-foot safe working distance from any power line.
- Hoisting equipment operators shall know exact locations of utilities, pipelines, sewers, and any other underground obstructions and avoid them with proper clearances.
- The hoisting equipment operator shall refuse to move a load if he/she is not satisfied with the rigging, does not know the weight of the load, does not like the load path, or perceives any other problem that will endanger people or property during the lift.
- Loads shall be lifted in a smooth controlled manner to prevent shock or impact loading to hoisting equipment and the rigging.
- The hook of the hoisting equipment and the rigging equipment shall be

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connected above the center of gravity of the material or equipment being lifted unless additional load control measures are employed.

- The hoisting equipment operator shall not swing loads over personnel.
- Hoisting equipment shall not be side-loaded.
- Do not lift equipment or piling that is embedded or secured to a base or the ground. Use jacks, wedges, or similar devices to break the bond between the ground, grout, or etc. prior to lifting.
- Only one signal person at a time shall have the authority to directly signal the lifting equipment operator except for situations where the signal person cannot see both the lifting equipment and the load.
- Any person, who sees a danger to the lifting operation, is authorized to signal the operator to make an emergency stop.
- Suspended loads shall not be left unattended by the hoisting equipment operator.
- Discontinue all lifting operations during thunderstorms

#### 4.2 General Safety Rules for Rigging & Rigging Equipment

- Lifting lugs or rigging attachment points shall be engineered or certified by the manufacturer to withstand its maximum calculated load plus an additional 125% of the load as a safety factor. A qualified engineer shall engineer the lifting lugs and rigging attachment points.
- On critical lifts, the welds of old and new lifting lugs shall be inspected using magnetic-particle tests (dye penetrant tests for stainless materials) to ensure soundness of the welds.
- Employees using rigging shall know the different types of slings and below-the-hook lifting devices available and use them correctly and efficiently.
- All rigging equipment shall be legibly marked with its rated capacity and be within its inspection period. See [Figure 6](#).
- All lifting/hoisting/rigging equipment shall be visually inspected before it is used to make certain it is in good condition and properly set-up.
- Report any lifting/hoisting/rigging equipment that appears to be unsafe and tag it do not use or destroy it.
- Use two slings when rigging bundles of materials like pipe, rebar, or lumber with a choker hitch.
- Rig vertical or sloping pipe or structural steel with a stop lug above the sling hitches or use a lift lug affixed to the material being lifted to prevent sling slippage and dropped loads.

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- Rigging equipment shall be used within manufacturer recommended temperature ranges. Use extreme caution when the temperature is below freezing or above 120 °F. Reduce capacities based on manufactures recommendations. Brittle fracture of the rigging equipment can occur at lower temperatures.
- .All lifting equipment shall be stored in proper racks or containers to prevent damage.
- A pre-lift checklist shall be used for all critical lifts see [Figure 7](#). This is recommended for all lifts.
- Report all accidents/incidents that cause damage to lifting equipment, operating equipment, the rigging equipment, the structure and/or injury to any person for proper investigation.

#### 4.3 Working On or Near Loads

Loads shall be stabilized prior to hooking or unhooking them. Use chocks, blocks, or other means to prevent movement of materials during these operations.

All loads shall be kept from swinging into the hoisting equipment or other structures. When lifting a load free from a previously anchored position, such as piping that has been in service, removing equipment from foundations, or dismantling structural members, attach a security device such as a come-a-long, chainfall, rope, etc., to prevent sudden movements.

All personnel shall be clear of the load before it is lifted. Barricade the work area when necessary to protect other workers. The load shall not be lifted or transported over or near people.

No one shall distract the equipment operator's attention while they are engaged in lifting operations.

No one shall work under a hoisted or + load.

All material transported on top of the load being lifted shall be secured.

Riding the load or headache ball is prohibited,

#### 4.4 Blocks & Hooks

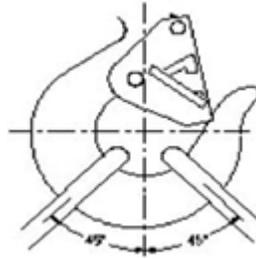
Select the proper size and style of hook, blocks, or attachments for the rigging application.

Use a shackle, with the shackle pin resting on the load hook. To connect two or more

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rope eyes to the lifting equipment hook if spread of slings is more than 90 degrees. This will prevent the spread of the sling legs from damaging the safety latch or coming off the hook



Use the correct size and weight lower block for vertical lifting to ensure that it is of sufficient weight to overhaul the hoist line from the highest hook position.

Size the sheaves correctly for the wire rope they are being used with.

Ensure the wire rope is properly seated in the sheaves if a slack rope condition occurs.

Use blocks with a pitch diameter 16 times the diameter of cable used for the hoisting lines.

Avoid tip-loading hooks, except for sorting/pipe hooks specifically designed for tip loading.

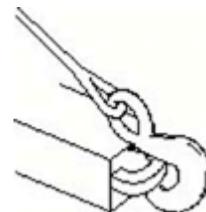
Sorting hooks shall not be used to place loads at elevation; they are to be used at ground level only.



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#### 4.5 Shackles

Use only approved shackles and inspect prior to use. (See definition for approved shackle.)

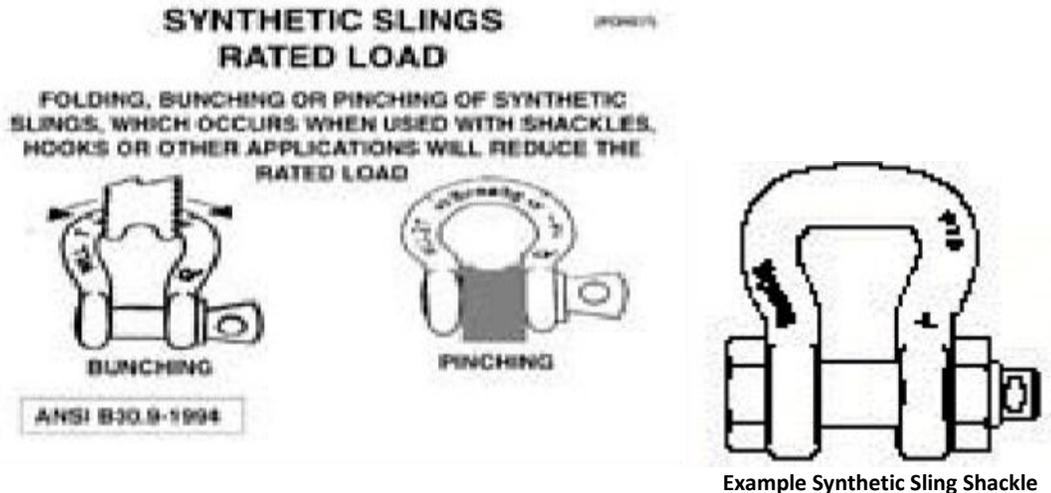
Use shackles of same diameter or larger than that of the sling on wire rope slings ( $D/d =$

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1)

Use only shackles designed for synthetic slings or shackles large enough to allow the webbing to lie flat in the shackle and not bunch up or over stress the outer edges or center of the web.



Ensure that the bolt in a screw pin shackle or nut on a bolt/anchor type shackle turns easily. Use oil on the threads. If the pin or nut is difficult to turn it should not be used. The pin is either bent due to overload or the threads have been damaged.

Hand tighten the shackle to prevent spreading of the bow during lifting. The shoulder of the pin and the nut (bolt type shackles) shall contact the shackle body or bow.

Bolt type shackles with cotter keys shall be used when there is any danger of the pin turning or when the shackle will be left in place for any length of time e.g. concrete bucket, guylines, etc.

Use the correct cotter pin if the shackle is designed for use with a cotter pin.

Place the pin of the shackle in the eye of the sling or the hook of the lifting equipment.

Decrease the capacity of the shackle if it is not being pulled directly in line (perpendicular to the pin of the shackle). De-rate the shackle to 70% capacity if it is being pulled at 45 degrees to in line and to 50% of capacity and if being pulled at 90 degrees to in line.

When using multiple slings do not exceed 120 degrees included angle loading on shackle body.

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Ensure that multiple sling loads are not applied to the pin or bolt of the shackle.

Screw pin shackles shall not be used in a manner that would cause the pin to unscrew during lifting.

#### 4.6 Wire Rope, Synthetic and Chain Slings

Chain slings are not to be used on construction sites without Senior HSE Manager and Operations manager approval.

Wear gloves while working with or inspecting wire rope, metal mesh, and chain slings.

Use a sling one size larger when work conditions may subject the sling to short term severe wear/abrasion or corrosive conditions.

Limit the capacity for four leg slings to the capacity of three legs because normal lifting practices may not distribute the load uniformly on all four legs.

Use synthetic slings in the presence of oils, greases, hydrocarbon and degreasing solutions to increase the friction of the hitch. Note these chemicals can degrade the sling material over time and the sling will need to be regularly cleaned or replaced.

Protect slings from sharp edges and cutting action during a lift by using softeners such as padding, blocks, or corner protectors. For synthetic slings the softener needs to be cut resistant enough to withstand the cutting force of the sharp edge as well as soft enough to prevent cutting of the sling. Cut resistant padding wrapped around metal mesh or nylon bar stock that attaches directly to the synthetic sling is highly recommended.

Inspect hoist hooks and fittings to make certain they are smooth and free of gouges and nicks that could damage synthetic slings.

Face the hook opening out and away from the pull of the sling when making choker hitches.

Balance the load in basket hitches and double wrap them to prevent slippage.

Keep hands and fingers from between the sling and the load while the sling is being tightened around the load.

Keep the sling straight by not twisting, knotting, or kinking it during use.

Block the load up off the sling and stand clear while a sling is being drawn from beneath a load. Hooks and slings may catch and suddenly fly free or tip the load. Also slings can be severely damaged if pulled from under loads while the load is resting on them.

Destroy any sling that has been over loaded.

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Use only lifting grade alloy chain for rigging. Common markings A, T or a version of the number 8 such as 80 or 800 indicates lifting grade alloy chain.

Avoid using chain when it is possible to use wire rope. The failure of a single link of chain results in the complete failure of the chain, whereas the wire rope is made up of many wires and strands and they may give more warning by showing individual wire damage before the rope breaks.

DO not use chain slings in construction situations.

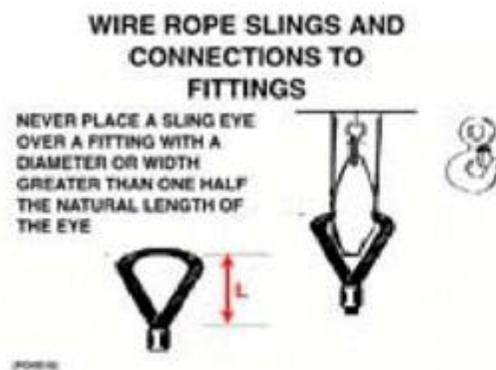
Chain links shall not be bolted together or tied in a knot in to shorten a chain sling, use appropriate shortening hooks.

Wire rope or chain slings should not be bent around sharp corners because they could kink and permanently weaken it. Use softeners to protect the sling and increase the D/d ratio.

Synthetic web slings shall not be used at temperatures above 194° F (90° C). See manufacturer recommendations.

The eyes of wire rope slings or wire rope bridles shall not be formed with wire rope clips or knots.

A sling eye shall not be placed over a fitting with a diameter or width greater than one half the natural length of the eye see figure below



#### 4.7 Metal Mesh Sling

Wire or metal mesh slings are used where the loads are abrasive, hot, or tend to cut other types of slings. They have smooth, flat bearing surfaces, they conform to irregular shapes and do not tangle or kink easily. In addition the requirements for sling use listed above:

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Metal mesh slings, which are not impregnated with elastomer, may be used without de-rating in a temperature range from - 20° F (- 29° C) to 550° F (288° C).

Elastomer coated slings may be used without de-rating between temperatures of 0° F (- 18° C) to 200° F (93° C).

#### **4.8 Capacity of Slings and Load Attachment Equipment Based on Sling Angle**

The sling angle causes the load in the sling or attachment equipment to increase and larger slings or equipment may be required to withstand the increased load see [Figure 1](#).

#### **4.9 Proper Use of Cable and Chain Hoists, Chainfalls and Come-A-Longs**

See POLICY 18.3 Chainfalls and Come-a-longs for their safety requirements.

The supporting structure or anchoring means shall have a capacity equal to or better than the hoist being used.

#### **4.10 Grip Hoists (Tirfor Type Hoist)**

A grip hoist is a versatile hoist that can be used to lift and pull loads with unlimited wire rope travel. The requirements for grip hoists are as follows:

- Ensure that you are trained to operate a hoist prior to using it.
- Follow all manufacturer requirements.
- Uncoil wire rope in a straight line to prevent loops, which might untwist the strands or form kinks when under tension.
- Use only the wire rope supplied by the manufacturer.
- Locate the hoist in such a position that it does not bind against the anchor point.
- Use only the telescopic handle supplied by the manufacturer.
- Never attempt to release the slip release or clutch under load. To change from forward to reverse (up or down) move the handle from the up lever to the down lever attachment point.
- Do not secure the end or tail of the lifting cable to prevent it from turning because it will kink it.

When grip hoists are used on suspended scaffolds, use safety devices such as a Bloc stop along with the hoist.

The hoists are generally protected from overload by a shear pin on the handle always use the correct pin.

#### **4.11 Jacks**

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The requirements for hydraulic and mechanical jacks are as follows:

- Firmly support the base of the jack so it does not shift under load. Use shims or restraints where required.
- Ensure that the recommended operating handle is used, properly seated in its socket and is free of slippery material or fluids.
- Remove operating handle when not in use to avoid dislocation of the jack or creating a tripping hazard.
- Maintain cribbing or blocking under the load as it is jacked up or down.
- Until proper cribbing or blocking has been put in place, do not go under the load. Jacks are subject to sudden failure.
- Use hydraulic jack fluid that is compatible with manufacturer specifications.

#### **4.12 Proper Use of Specialty Rigging Equipment**

A qualified person must approve all specialty rigging equipment such as spreader bars and beams, beam and plate clamps, eyebolts, pad eyes.

All specialty rigging equipment shall be used per manufacturer requirements.

The equipment must have their capacity and the manufacturer's name on them.

The safety factor for the equipment shall be per ASME, CSA, British Standard or other government or local regulatory requirements and the equipment shall be proof-tested to 125% of its capacity.

#### **4.13 Signaling of Lifting/Hoisting Equipment**

Use the signaling requirements for the hoisting equipment for Mobile Cranes.

When there is not a specific signaling system for the hoisting equipment used adapt the mobile crane system using variations agreed upon between the hoisting equipment operator and the rigger prior to the lift.

#### **4.14 Tagging of Loads**

Hands are to be kept off suspended loads whenever possible. Always use a tag line even for small lifts, unless their use creates an unsafe condition as determined by a competent person. Multiple tag lines may be needed based on the size of the load, wind speed, and interferences. It is easier to maintain control of the lift than to regain control when it is swinging or spinning.

Tag lines must be constructed of "dry" non-conductive material. Tag lines shall be a minimum of 5/8" diameter manila rope or equal to enhance grip on the tag line.

To prevent being caught in the tag line, do not wrap it around your hands, waist, or body. Ensure that the tag line is free of knots and fraying that could catch on objects or body

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parts and interfere with the lift or cause injury to the tagline person.

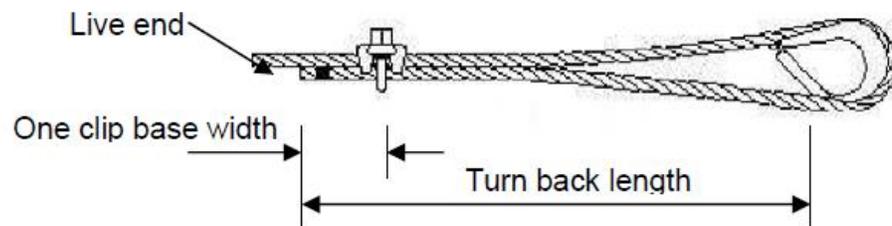
As a rule, it is recommended that a ratio of 2-to-1 (height-of-load to horizontal distance to the tag person) be maintained between tagline personal and suspended loads that are less than 50 feet off the ground or above employees on the structure. Thus for a 40-foot high load, a 20-foot horizontal distance to the edge of the load should be maintained. For loads above 50 feet in height, use the greater of a 30% ratio of load height to horizontal distance or 25 feet minimum. For special lifts, such as tall thin structures, greater distances should be utilized to ensure the safety of the person(s) working the tag line(s).

Under certain conditions, taglines may be released after lift pick and reacquired before the load is landed.

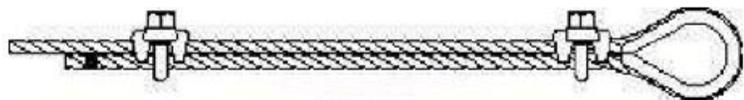
#### 4.15 Installing Wire Rope Clips/Cable Clamps and Wire Rope Splicing Procedure

The following is the correct procedure and sequence for installing U-bolt type cable clips:

- Turn back the amount of cable needed past the thimble or loop, see [Figure 3](#).
- Install the cable clip nearest the dead end of the cable and snug it up. Apply U-Bolt over the dead end of the wire rope and place the saddle on the live side (never saddle a dead horse). Tighten the nuts evenly, alternating from one nut to the other until reaching the recommended torque. See [Figure 3](#) for number, spacing, and required torque to install U-Bolt Wire Rope Clips for the US.



- Install the thimble and the second clip as near the loop or thimble as possible, turn nuts on second clip firmly, but do not tighten, and proceed to step 4.



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- When three or more clips are required, JSAce additional clips equally between first two, take up rope slack, tighten nuts on each U-Bolt evenly, alternating from one nut to the other until reaching recommended torque. If a pulley or sheave is used (larger diameter) add one additional clip.



- After stretching the cable with a load equal to the initial load, re-torque all the cable clips again. Where clamps are left in place for period of time the rope should be marked to act as an indicator of slippage and the torque checked on a regular basis.
- The preferred method for splicing two wire ropes is with interconnecting turn back eyes with the recommended number of cable clamps on each eye.



## 5 RIGGING COMPLIANCE CHECKLIST

Safety is a continuous process, requiring daily attention to every detail. It takes only an instant to become “unsafe”, and this very instant may cause an accident or injury.

The rigging checklist, see [Figure 7](#), is an important tool in your daily safety efforts and establishes the minimum requirements to be followed prior to making a lift.

The rigging checklist should be used on all lifts and is mandatory for Critical Lifts, see POLICY

## 6 RIGGING INSPECTION AND STORAGE

All rigging, slings and wire rope shall be inspected by a designated competent person prior to initial field usage (includes new/purchased equipment) and periodically thereafter in accordance with requirements shown below. To identify that the inspections have been done, see [Figure 6](#) for marking instructions.

The user prior to each use shall visually inspect all rigging.

A periodic documented inspection of all rigging equipment shall be made for all rigging

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equipment involved in a critical lift.

All slings, chainfalls, and come-a-longs must also be inspected quarterly by a designated competent person. Written records of these quarterly or periodic documented inspections shall be maintained. See [Figure 4](#), [Figure 5](#), and [inspection form](#). The records should show the number of slings inspected of the same size and location, a description of the slings by size (diameter or web size and length) and its condition on each inspection. The number taken out of service will be listed under comments on the inspection form. Chain slings require an additional annual written inspection by a qualified third party. Chain slings should not be used for construction operations. Based on frequency of use, severity of use, the nature of the lifts being made, or based on experience gained on the service life of the slings, the documented inspection period may need to be shortened.

A designated competent person shall inspect all rigging equipment, other than slings, chainfalls and come-a-longs, annually. Records of this annual inspection should be maintained in the Miscellaneous Rigging Periodic Inspection Report ([Figure 8](#).) The record should show a description of the rigging equipment and its condition on the annual inspection. Based on frequency of use, severity of use, the nature of the lifts being made, or based on experience gained on the service life of the slings, the documented inspection period may need to be shortened.

One of the difficult problems confronting the inspector is deciding just when rigging has reached the limit of its safe usage and when it must be discarded. Naturally, it is poor economy to discard expensive rigging before it is necessary. Likewise, it is dangerous, and may prove even more expensive, to continue its use beyond a certain stage. Know and use the following criteria for inspection of rigging equipment. Follow all manufacturer inspection requirements for specialty rigging equipment. Any signs of corrosion should be investigated internally as well as externally.

Damaged or defective rigging equipment shall be immediately removed from service

#### **6.1 Hooks and Blocks Inspection**

##### 6.1.1 Hook Inspection

Inspect hooks for the following:

- Cracks, nicks, bending, or excessive wear (10% wear is generally allowed and repair can be made per manufacturer recommendations. Hooks that are subject to frequent load cycles or pulsating loads should be periodically inspected by magnetic particle or dye penetrant testing),
- Swivel is secured properly and not coming loose,
- Distortion, such as bending, twisting, or increased throat opening (15% increase

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in throat opening and 10 degree in twist is allowed, but if any opening or twisting of the hook has taken place, the hook has been overloaded and should be replaced.),

- Latch engagement and damaged or malfunctioning latch,
- A hook with a latch that does not close the throat opening shall be removed from service until the latch is replace or repaired, and
- Self-locking hooks for proper operation and locking.

#### 6.1.2 Inspect blocks and sheaves for the following:

- Cable is properly seated within the sheave groove and is not cutting the sheave,
- The sheave(s) turn freely and are properly lubricated,
- The swivel is secured properly,
- Internal pins and locking systems for headache balls and blocks are checked, and
- Manufacturer supplied guards are in place.

#### 6.2 Shackle Inspection

Shackles shall be removed from service for the following reasons:

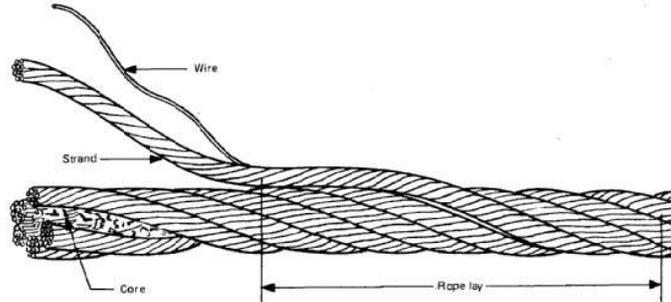
- Missing or illegible manufacturer's name or trademark and/or rated load identification,
- Indications of heat damage including weld JSAtter or arc strikes or unauthorized welding,
- Excessive pitting or corrosion,
- Bent, twisted, distorted, stretched, elongated, cracked or broken load bearing components,
- Excessive nicks or gouges,
- A 10% reduction of the original or catalog dimension at any point around the body or pin,
- Incomplete pin engagement such that the shoulder of the pin will not contact the bow of the shackle indicating thread damage,
- The bolt of a screw pin shackle does not extend to the end of the bow or more than one thread past the end of the bow (see the manufacturer allowable tolerances.), and
- Other conditions including visible damage that cause doubt as to the continued use of a shackle

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#### 6.3 Sling Inspections

##### 6.3.1 Wire Rope Sling Inspection Criteria



Elements of a Wire Rope

The type of wire, number of stands, wires, and type of core identifies a wire rope, e.g., IPS 6 X 19 w/ Fiber Core, means improved plow steel wire means 6 strands and 19 wires per strand with a fiber core.

The following are cause for rejection of a wire rope sling:

- Broken Wires: Ten or more randomly JSACed broken wires in one lay or five or more broken wires in one stand in one lay.
- Loss of rope diameter: abrasion, scrubbing, flattening, peening causing more than  $\frac{1}{8}$  loss in original diameter of the outside individual wires.
- Missing or illegible marking indicating the capacity of the wire rope sling. A qualified person may restore the marking on wire rope slings.
- Other types of wire rope damage: heat from electrical arc damage, bird caging (increased diameter), drum crushing or flattening, high stranding (individual lay standing out of wire rope), dog legs and kinks, corrosion, and cracked, worn or defective ferrules.

##### 6.3.2 Synthetic Slings

Synthetic web slings and round slings are available in two materials, nylon and polyester. Nylon is resistant to many alkalis and polyester is resistant to many acids. Polyester slings are usually preferred over nylon because they stretch only about half as much as nylon

Synthetic slings shall be removed from service if the following defects are detected:

- When the built-in wear indicator threads, usually red, start showing (indicator threads are not used by all manufacturers),
- Melting or charring from burns caused by heat, acid, or caustic,

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- Presence of holes, tears, cuts, and snags in the sling, (for round slings when these expose core yarns),
- Broken or worn stitching in load bearing splices,
- Missing marking indicating manufacturer's name, rated load capacity, and type of material used,
- Excessive abrasive wear or knots in any part of the sling, and
- Damaged fittings that are stretched, cracked, worn, pitted, or distorted in any way.
- When the above damage is found, the eyes of the sling should be cut apart and it should be discarded immediately.

#### 6.3.3 Chain Sling

Chain usually gives no warning when it is about to break. Clean a chain for inspection dirt and grease that may hide nicks and cracks. Chain slings require an annual written inspection by a qualified third party.

Chain slings shall be removed from service when the following defects are detected:

- Wear on any part of the chain equal to 15% or more (See manufacturer specific requirements.),
- Stretch of over 5% when compared to an equal length of new chain; watch for localized stretching due to overloading in a localized area; if links do not move freely inside each other, it is an indication of overloading.
- Twisted or gouged links, cracks in links, damage or distortion of master links and hooks,
- Damage to latches on hooks, discoloration due to excessive temperature, and
- Missing marking indicating the manufacturer, chain grade, number of legs, and rated load capacity.

#### 6.3.4 Metal Mesh Slings

Metal mesh slings shall be removed from service when the following defects are detected:

- A broken weld or broken brazed joint along the sling edge,
- A broken wire in any part of the mesh,
- Reduction in wire diameter of 25% due to abrasion or 15% due to corrosion,
- Lack of flexibility due to distortion of the mesh,
- Distortion of either end fitting so the width of the eye opening is decreased by more than 10%,

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- A 15% reduction of the original cross-sectional area of metal at any point around the hook opening of the end fitting,
- Visible distortion of either end fitting out of its plane, a cracked end fitting, and
- Missing marking with the manufacturer's name or trademark, rated capacity in the vertical, basket hitch, and choker hitch.

#### **6.4 Running Wire Rope (Hoist and Boom Cable) and Standing Ropes (Pendant Cables)**

Removal criteria for wire rope replacement shall be as follows:

- In standard cable running ropes, six randomly distributed wires in one lay or three broken wires in one strand in one lay.
- In rotation resistant ropes, two randomly distributed broken wires in six rope diameters or four randomly distributed broken wires in thirty rope diameters.
- In all running wire ropes one outer wire broken at the point of contact with the core of the rope that has worked its way out of the rope structure and protrudes or loops out from the rope structure is reason for additional inspection.
- In standing ropes, more than two broken wires in one lay in sections beyond end connections or more than one broken wire at an end connection.

Additional wear and damage criteria are the same as listed for wire rope slings above.

Additional wire rope damage criteria, loss of nominal rope diameter (for metrics take metric measurement and divide by 3):

- Rope diameters  $\frac{3}{8}$ " to  $\frac{1}{2}$ " up to  $\frac{1}{32}$ " reduction
- Rope diameters  $\frac{1}{2}$ " to  $\frac{3}{4}$ " up to  $\frac{3}{64}$ " reduction
- Rope diameters  $\frac{7}{8}$ " to  $1 \frac{1}{8}$ " up to  $\frac{1}{16}$ " reduction
- Rope diameters  $1 \frac{1}{4}$ " to  $1 \frac{1}{2}$ " up to  $\frac{3}{32}$ " reduction

Replacement rope shall have a strength rating at least as great as that furnished or recommended by the crane or hoist manufacturer. Any deviation from original size, grade, or construction shall be as specified by the rope manufacturer, the crane or hoist manufacturer, or a qualified person.

Monthly and annual inspections shall be done along with the inspection of the hoisting equipment on which the rope is used.

#### **6.5 Chain and Cable Hoists, Chainfalls, and Come-A-Longs**

Chainfalls and Come-a-longs for inspection criteria and inspection form for inspecting for inspecting chain hoists and chainfalls.

Inspect the cable on cable type hoists using the same criteria for running wire rope.

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Inspect the chains on chain hoists using the same criteria for inspecting chain slings.

#### **6.6 Specialty Rigging Equipment**

All specialty rigging equipment shall be inspected per manufacturer recommendations at intervals specified by the manufacturer or at required intervals shown above, whichever is less.

#### **6.7 Jacks**

Jacks shall be taken out of service and repaired if during inspection the following is found:

- Improper engagement or extreme wear of pawl and rack, chipped, cracked, or broken rack teeth,
- Cracked or damaged housing, excessive wear, bending or other damage to threads,
- Leaking hydraulic fluid, scored or damaged plunger, improperly functioning swivel heads and caps,
- Loose bolts or rivets, improperly assembled accessory equipment, and
- Other items as specified by manufacturer, which may affect operation.

#### **6.8 Maintenance**

All rigging equipment shall be kept clean of corrosive elements and chemicals.

All wire rope and metal rigging equipment shall be lubricated per manufacturer recommendations.

All repairs will be made with manufacturer recommended parts by qualified persons per manufacturer specifications.

#### **6.9 Storage Requirements**

It is essential that slings and other rigging equipment be properly stored out of the weather. Slings should be hung on a rack in a dry location. Synthetic slings should be stored out of direct sunlight and other UV exposure such as welding arc.

## **7 TRAINING**

All employees performing rigging operations shall be instructed in the proper techniques and the requirements set forth in this and re-trained annually.

## **8 REFERENCES**

ASME B30.1, Jacks; B30.5, Mobile and Locomotive Cranes; B30.9, Slings; B30.10, Hooks; B30.20, Below the Hook Lifting Devices; and B30.26 (Draft) Rigging Hardware

Crosby Catalog and Rigging Training

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29 CFR 1926.251, Rigging Equipment for Material Handling  
29 CFR 1910.184, Slings  
29 CFR 1910, Subpart N, 179 – 181, Cranes and Derricks, and 184, Slings  
29 CFR 1926.550, Cranes and Derricks

#### 9 FIGURES

[Sling Load Stress Multiplier Chart Based On Sling Angle](#)

[Wire Rope Sling Capacity Chart](#)

[Number, JSAcing, and Torque for U-Bolt Wire Rope Clips](#)

[Synthetic Web Sling Periodic Inspection Report](#)

[Wire Rope Sling Periodic Inspection Report](#)

[Color Code Schedule for Rigging Inspections](#)

[Pre-Lift Checklist](#)

[Miscellaneous Rigging Periodic Inspection Report](#)

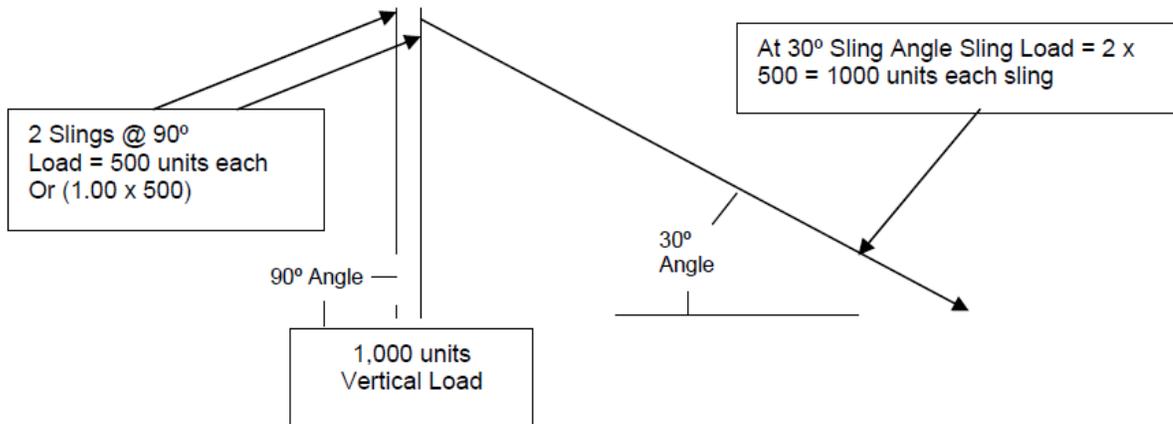
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To calculate sling load, multiply vertical load by sling factor for the angle at which the sling is being pulled. Sling angle is measured from the horizontal.

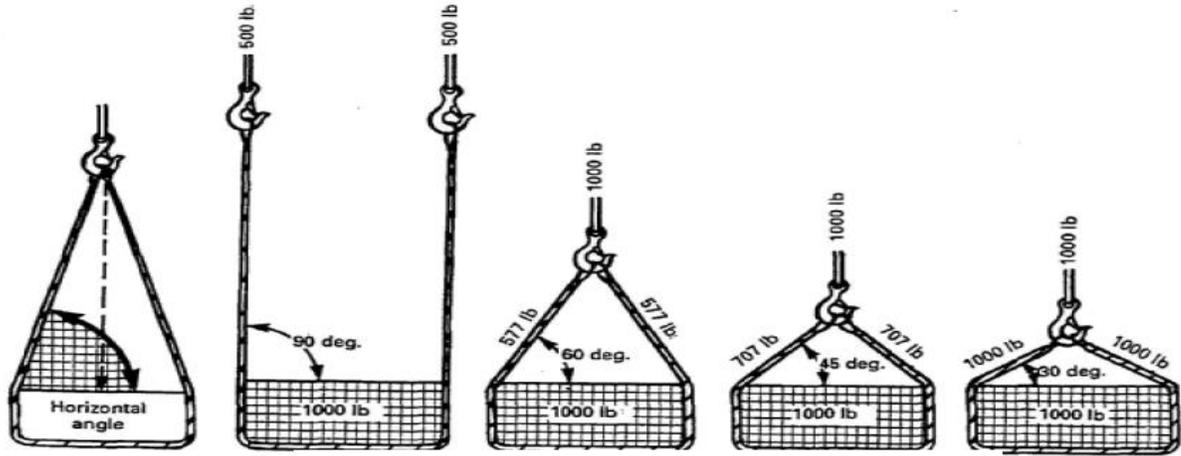
Sling Angle	Load Angle Multiplier
5°	11.49
10°	5.75
15°	3.86
20°	2.93
25°	2.37
30°	2.00
35°	1.75
40°	1.56
45°	1.42
50°	1.31
55°	1.23
60°	1.16
65°	1.11
70°	1.07
75°	1.04
80°	1.02
85°	1.01
90°	1.00

Example of use of sling load stress multiplier chart:



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Examples of Effect of Sling Angle on Sling Load

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**Figure 2**

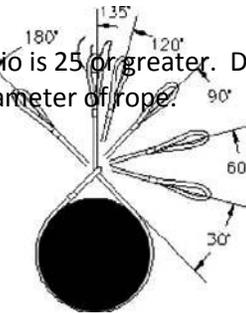
**Wire Rope Sling Capacity Chart**

Rated Loads for Single LG Slings 6 X 19 Or 6 X 37 Classification Improved Plow Steel Grade Rope With Fiber Core (FC) (See Definitions for Approved Sling			
Rated Loads <sup>1</sup> pounds (lb)			
Rope Diameter In.	Vertical	Choker	Vertical Basket
¼	1,020	760	2,000
5/16	1,580	1,200	3,200
¾	2,200	1,700	4,400
7/16	3,000	2,400	6,000
½	4,000	3,000	8,000
9/16	5,000	3,800	10,000
5/8	6,200	4,600	12,400
¾	8,800	6,600	17,600
7/8	12,000	9,000	24,000
1	15,400	11,800	30,000
1 1/8	19,000	14,800	38,000
1 ¼	24,000	18,000	48,000
1 3/8	28,000	22,000	56,000
1 ½	34,000	26,000	68,000
1 5/8	38,000	30,000	76,000
1 ¾	44,000	34,000	88,000
2	58,000	44,000	116,000

MS = Mechanical Splice

<sup>1</sup> The values in the chart are based on slings being vertical. If they are not vertical, the rated load shall be reduced. If two or more slings are used, the minimum horizontal angle between the slings shall also be considered.

<sup>2</sup> These values only apply when the D/d ratio is 25 or greater. D = Diameter of curvature around which the body of the sling is bent. d = Diameter of rope.





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**Figure 3**

<b>Number, JSacing, And Torque For U-Bolt Wire Rope Clips For USA**</b>			
Improved Plow Steel Wire Rope w/ Fiber Core or Wire Rope Center			
Size in inches	Number of Clips Drop Forged*	Amount of Rope to turn back minimum (Inches)	Required Torque* (ft-lbs)
3/8	2	6-1/2	45
7/16	2	7	65
1/2	3	11-1/2	65
5/8	3	12	95
3/4	4	18	130
7/8	4	19	225
1	5	26	225
1-1/8	6	34	225
1-1/4	7	44	360
1-3/8	7	44	360
1-1/2	8	54	360
1-5/8	8	58	430
1-3/4	8	61	590
2	8	71	750

\* Crosby Cable Clamps if other type clamps are used see manufacturer recommendations. Torque values are based on the threads being clean, dry, and free of lubrication. The efficiency ratings for the wire rope end terminations are based upon the breaking strength of the wire rope and are 80% for 1/8" through 7/8" diameter of cable and for 1" – 2" is 90%

\*\* For non-US location, check local regulation.





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✓ Good   X Bad

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**Figure 6**

The following tool or equipment marking color code shall be used for annual inspections. Repeat the sequence of color codes for subsequent years.

<b>Annual Inspections</b>			
2002 – Orange	2003 – Green	2004 – White	2005 – Red

Tools or equipment requiring a semi-annual inspection shall use the following color code for marking the tool or equipment to signify that it has been inspected.

<b>Semi-Annual Inspections</b>	
January Through June – White	July through December -- Red

Tools or equipment requiring a quarterly inspection shall use the following color code for marking the tool or equipment to signify that it has been inspected.

A monthly color code for those sites that perform monthly inspections has also been provided below.

<b>Monthly and Quarterly Inspections</b>	<b>Quarterly Color</b>	<b>Monthly Color</b>
January	White	White
February		White & Yellow
March		White & Blue
April	Green	Green
May		Green & Yellow
June		Green & Blue
July	Red	Red
August		Red & Yellow
September		Red & Blue
October	Orange	Orange
November		Orange & Yellow
December		Orange & Blue

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**Figure 7 Pre-Lift Checklist**

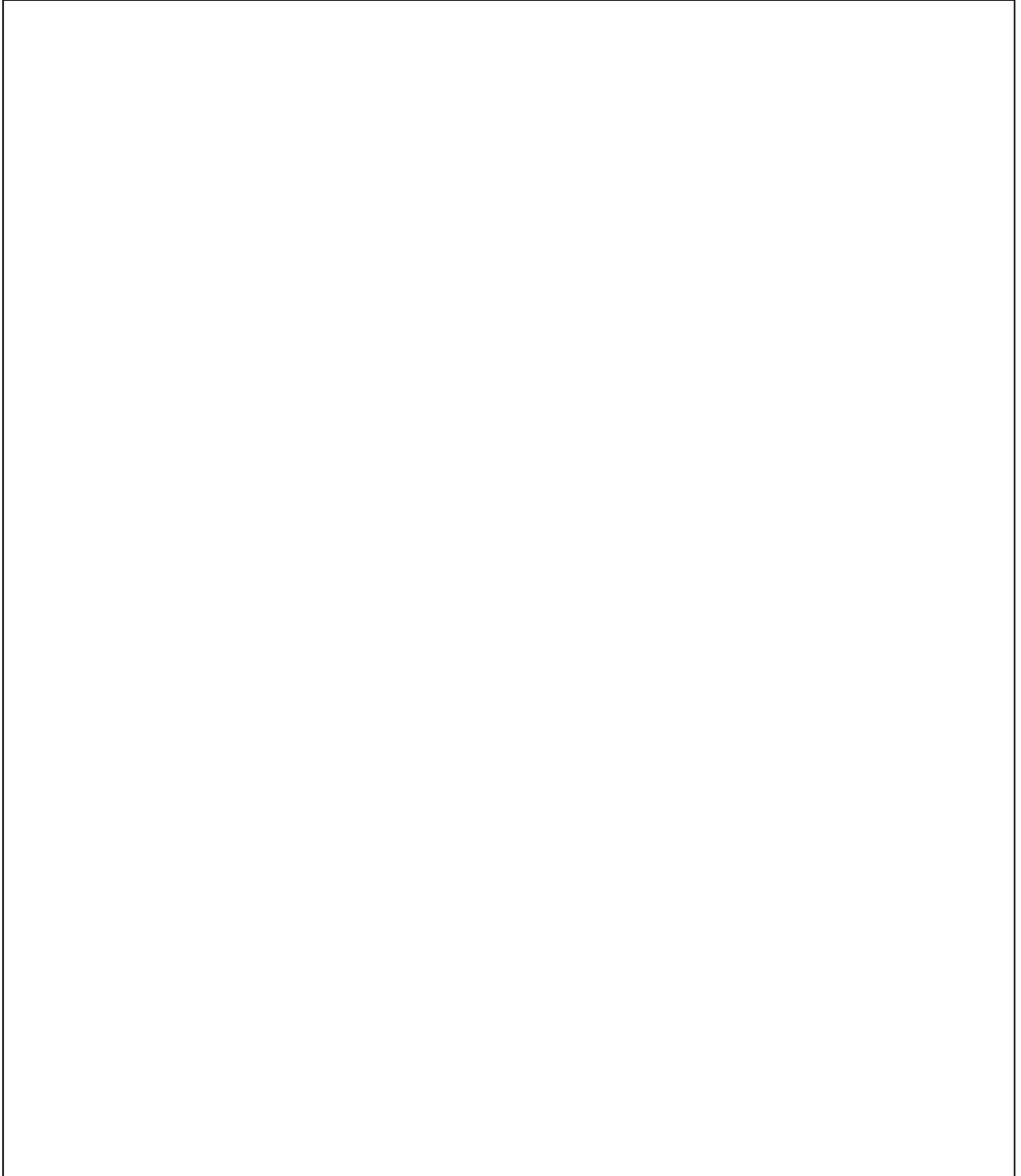
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Project: _____	Date: _____	
Lift Description:	Yes	No
1. Crane Operator meets company qualification requirements?	<input type="checkbox"/>	<input type="checkbox"/>
2. Lift calculations and rigging plan completed?	<input type="checkbox"/>	<input type="checkbox"/>
3. Are all required approvals/permits signed?	<input type="checkbox"/>	<input type="checkbox"/>
4. Crane inspections up to date (Annual/Monthly/Daily)?	<input type="checkbox"/>	<input type="checkbox"/>
5. Weather conditions and wind speed acceptable?	<input type="checkbox"/>	<input type="checkbox"/>
6. Has the stability of the ground been assured?	<input type="checkbox"/>	<input type="checkbox"/>
7. Matting and/or outrigger pads inspected and approved?	<input type="checkbox"/>	<input type="checkbox"/>
8. Electrical equipment and power lines at required distance?	<input type="checkbox"/>	<input type="checkbox"/>
9. Rigging Inspected for defects?	<input type="checkbox"/>	<input type="checkbox"/>
10. Engineered lifting lugs fabricated and installed correctly?	<input type="checkbox"/>	<input type="checkbox"/>
11. Connecting/disconnecting means been developed?	<input type="checkbox"/>	<input type="checkbox"/>
12. Have the safety precautions been reviewed?	<input type="checkbox"/>	<input type="checkbox"/>
13. Is survey equipment required?	<input type="checkbox"/>	<input type="checkbox"/>
14. The total lifted weight is below 95% of capacity?	<input type="checkbox"/>	<input type="checkbox"/>
15. Signal person(s) assigned?	<input type="checkbox"/>	<input type="checkbox"/>
16. Safe Plan of Action (JSA) Completed?	<input type="checkbox"/>	<input type="checkbox"/>
17. Pre-Lift Meeting/Task Safety Awareness Meeting (TSA) held?	<input type="checkbox"/>	<input type="checkbox"/>
18. Hoist area & load path cleared of non-essential personnel?	<input type="checkbox"/>	<input type="checkbox"/>
19. Crane set up per the lift plan (radius, configuration, etc)?	<input type="checkbox"/>	<input type="checkbox"/>
20. Rigging equipment and tag line(s) installed per plan?	<input type="checkbox"/>	<input type="checkbox"/>
Person Completing Check List: _____		
Signature: _____	Date: _____	

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Signature of Lead Inspector: