

Safety Manual Qualified Rigger for Hoisting Activities
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Qualified Rigger for Hoisting Activities

1.0 Rigging

1.1. General

A qualified rigger is needed during assembly/disassembly of cranes (29 CFR 1926.1404), when employees are engaged in hooking, unhooking, or guiding the load, or in the initial connection of a load to a component or structure and are within the fall zone (29CFR 1926.1425). A qualified rigger is defined as a qualified person who, by possession of a recognized degree, certificate or professional standing, or who by extensive knowledge, training and experience, successfully demonstrates the ability to solve/resolve problems relating to rigging.

1.2. Rigging Person Qualification

All qualified riggers shall be evaluated by a designated person and must demonstrate their qualifications in the following areas:

- The ability to identify the load's travel path
- The ability to identify load characteristics (i.e.; determine load weight; center of gravity)
- The ability to identify correct load attachment points
- The ability to recognize special load handling requirements (i.e.; unbalanced loads
- The ability to recognize and avoid unsafe rigging practices (i.e.; pinch points; need for softeners; shock loading; side loading; unsafe body positioning; electrical hazards)
- The ability to communicate hazards to others
- The ability to perform rigging equipment inspections and identify non-conforming equipment
- The ability to identify and select appropriate slings (i.e.; chain; wire rope; synthetic rope, synthetic web; and; synthetic round)
- The ability to identify and select appropriate rigging hardware (i.e.; shackles; adjustable hardware, such as spreader bars; links, rings and swivels; rigging blocks; hooks; hoists; dollies, skates, and rollers; trolleys; beam clamps; eyebolts; swivel hoist rings; jacks)
- The ability to protect rigging equipment and load from damage by the proper use of softeners
- Demonstrate the ability to select and tie knots/hitches required for various rigging tasks
- The ability to reference Rigger's Capacity Card

3.0 Basic Crane Terminology

Auxiliary Hoist: The supplemental hoisting unit, which is usually of lower load rating and higher speed than the main hoist.

Axis of Rotation: The vertical axis around which the crane's superstructure rotates.

Boom: In cranes and derricks usage, an inclined spar, strut, or other long member supporting the hoisting tackle. Also, defined as a structural member attached to the

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revolving superstructure used for guiding and acting as a support for the load.

Boom Angle Indicator: An accessory device that measures the angle of the boom base section centerline to horizontal.

Boom Stops: A device used to limit the angle of the boom at its highest position.

Brake: A device used for retarding or stopping motion by friction or power means.

Block: Sheaves or grooved pulleys in a frame provided with hook, eye, and strap.

Crane: A machine consisting of a rotating superstructure for lifting and lowering a load and moving it horizontally on either rubber tires or crawler treads.

Counterweight: Weights used for balancing loads and the weight of the crane in providing stability for lifting.

Deck: The revolving superstructure or turntable bed.

Drum: The spool or cylindrical member around which cables are wound for raising and lowering loads.

Gantry: A structural frame work (also known as an A Frame) mounted on the revolving superstructure of the crane to which the boom supporting cables are reeved.

Headache Ball: A heavy weight attached above the hook on a single line or whip line to provide sufficient weight to lower the hook when unloaded.

Holding Brake: A brake that automatically sets to prevent motion when power is off

Jib: An extension attached to the boom point to provide added boom length for lifting specified loads.

Load: The weight of the object being lifted or lowered, including load block, ropes, slings, shackles, and any other ancillary attachment.

Load Block: The assembly of the hook or shackles, swivel, sheaves, pins, and frame suspended from the boom point.

Main Hoist: Hoist system or boom used for raising and lowering loads up to maximum rated capacity.

Mechanical Load Brake: An automatic type of friction brake used for controlling loads in the lowering direction. This device requires torque from the motor to lower a load but does not impose additional loads on the motor when lifting a load.

Outriggers: Support members attached to the crane's carrier frame which are used to the crane and may be blocked up to increase stability.

Pawl: Also known as "dog". It is a gear locking device for positively holding the gears against movement.

Pendants: Stationary cables used to support the boom.

Radius: The horizontal distance from the axis of rotation of the crane's superstructure to the center of the suspended load.

Reeving: The path that a rope takes in adapting itself to all sheaves and drums of a piece of equipment.

Running Sheave: Sheaves that rotate as the hook is raised or lowered.

Superstructure: The rotating frame, gantry and boom or other operating equipment.

Test Load: Any load or force, expressed in pounds, used for testing or certifying the limitations within acceptable tolerances of the anticipated load.

Two-Block: The condition in which the lower load lock or hook assembly comes in contact with the upper load block or boom point sheave assembly.

Quadrant of Operation: The area of operation that the lift is being made in. Usually, divided into four quadrants, i.e. front, rear and side(s) - left side and right side.

Basic Crane Types

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Telescoping Carrier Crane



Telescoping Crawler Crane



Telescoping Rough Terrain Crane



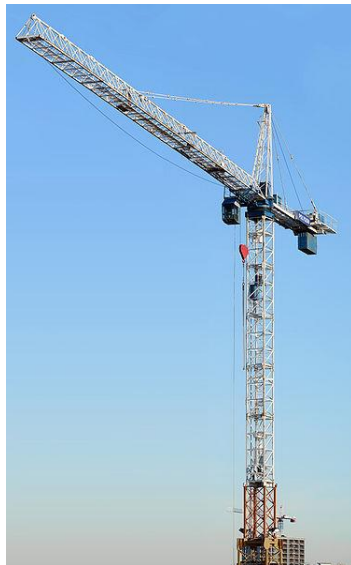
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Lattice Boom Crawler Mounted



Industrial Boom Crane



Tower Crane

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Overhead Crane



Jib Crane

4.0 Crane Safe Operating Practices & Procedures

Hoisting Procedures: Before and during hoisting operations, the person directing the lift must ensure:

- The crane is level and where necessary, blocked
- The load is secured and balanced in the sling or lifting device
- Both the lift and swing path are clear of obstructions and people
- All persons are clear of the swing radius

Avoiding Distractions:

- The operator should never be distracted while he is operating the crane. His safety and the safety of other workers depend on his constant attention on the job at hand.
- The operator must obey on signal given by the appointed signalperson with the exception of the STOP signal, which must be obeyed regardless who gives it. Hand signals must be in accordance with those specified in ASME B30.5

Leverage and Stability

- As the upper structure rotates, the crane's center of gravity moves closer to its tipping axis. The movement of the crane's center of gravity increases the load's leverage on the crane and results in the crane's capacity being lowered. This is why a rough terrain crane can become unstable, even to the point of overturning, when a load is lifted over the front and swung over the side. Be sure to consult the capacity chart before swinging to a less stable area.
- A mobile crane is stable when its leverage is greater than the load's leverage.

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- Most carrier mounted cranes have their greatest capacity over the rear. When the upper structure is rotated over the side, the capacity will be lower because the distance from the crane's center of gravity to the tipping axis is shortened. Most crane manufacturers do not allow loads to be lifted over the front unless the front stabilizer is extended and set.

Two-Blocking

- Two-blocking occurs when the hook block or headache ball makes contact with the sheaves at the main boom head, extension or jib tip. This can break the hoist rope and cause the headache ball to fall.
- Two-blocking occurs most commonly on telescoping boom cranes as a result of over hoisting or telescoping the boom without letting out the hoist line
- An anti-two-block device can stop an impending two-block condition and, if necessary, prevent further hoisting, boom extension and lowering of the boom.

Dangers of Tipping

- As a crane starts to tip, the load radius increases. As the center of gravity of the load moves away from the tipping axis, the center of gravity of the crane moves towards the tipping axis. This accelerates the rate of tipping and may leave the operator powerless to remedy the situation other than by dropping the load.
- Tipping on telescoping boom cranes may be even more rapid because of the greater weight of the boom.
- In the structural area of the load chart, crane capacities are based on the strength of its components. This means a crane may fail structurally before it tips.....so **never** use signs of tipping as an indication of a crane's ability to lift. When a crane starts to tip it is already overloaded and may incur structural damage.

Increase in Load Radius

- Reaching beyond the vertical extends the load radius and can pull the boom forward.
- A rapid swing with a load can cause the load radius to increase. The degree of swing-out may increase as the crane swings. This can also cause shock loading and twist the boom.
- Swinging a load from over the rear to over the side, or from over the front to over the side, can increase carrier deflection and extend load radius. This is especially noticeable when working on rubber.

Shock Loading

- Rapid hoist acceleration produces hook loads higher than the actual load weight.
- Sudden release of the load can cause the crane to tip backwards or even collapse.
- Pick and carry operations can subject the carrier and boom to shock loads.
- Extracting loads by jerking can overload the crane and cause shock loading.
- Shock loading can also be caused by the sudden snatching of a load or the sudden release of a frozen, caught or stuck load. Either condition can cause overloading or structural failure.

Side Loading

- Since booms are only designed to take minimal side loading, the load line should remain reasonably vertical when moving loads. Side loading can occur

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when the crane is out of level, or, during a rapid swing, or of the swing brake is applied suddenly.

- Dragging or pulling a load sideways is never permitted.

High Winds

- The force created by wind can have a devastating effect on the crane. Most crane manufactures require the load chart be reduced when operating in windy conditions. In most case crane operations should be stopped when the wind exceeds 30 mph.
- High winds can cause the operating radius to increase by swing the load forward.
- The effect of wind on the crane increased four times if the wind speed doubles.
- High winds can cause side loading.

Working near power lines

- Use extreme caution when working near power lines during windy conditions. Even slight winds can move power lines a significant distance, especially if there is a long span between power line supports.
- Whether hoisting, booming, swinging, or traveling, the crane must be operated slowly and with extreme caution.
- Maintain your distance from power lines. No part of the crane or load must ever enter the "prohibited zone". This zone must be expanded as the kV increases (see table below). Certain environmental conditions, such as fog, smoke or precipitation, may also require this distance to be increased.
- Consider erecting guard structures or barricades around power lines as a constant reminder to all personnel. Set the crane up as far as practically possible from the prohibited zone.

Required Clearance For Operations Near High Voltage Power Lines:	
to 50 kV	10 ft.
over 50 to 200 kV	15 ft.
over 200 to 350 kV	20 ft.
over 350 to 500 kV	25 ft.
over 500 to 700 kV	35 ft.
over 700 to 1000 kV	45 ft.

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6.0 Dedicated Spotter

- From the cab, it is difficult for the operator to judge distances accurately. Therefore, any time the crane is working within a boom's length of the prohibited zone, a dedicated spotter shall be appointed.
- To be considered a dedicated spotter, the requirements of 29 CFR 1926.1428 Signal Person qualifications must be met and this person's sole responsibility is to watch the separation between power line and the equipment, load line and load (including rigging and lifting accessories), and ensure through communication with the operator that the applicable minimum approach distance is not breached.

7.0 Situational Awareness

The qualified rigger must be familiar with the following site specific considerations.

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- Being involved with reviewing lift requirements with site supervisor, crane operator and crew. This will include the pre-lift safety meeting.
- The pre-lift safety meeting should include ensuring the area for the crane is adequately prepared. The preparation includes but not limited to the following:
 - 1) Access roads for the crane and associated equipment
 - 2) Sufficient room to assemble and disassemble crane
 - 3) An operating area that is suitable for the crane with respect to levelness, surface conditions, support capability, proximity to power lines, excavations, slopes, underground utilities, subsurface construction and obstructions to crane operation
 - 4) Traffic control necessary to restrict unauthorized access to the crane working area
- Ensuring that conditions which may adversely affect crane operations are addressed. Such conditions include but are not limited to the following:
 - 1) Poor soil conditions
 - 2) Wind velocity or gusting winds
 - 3) Heavy rain
 - 4) Fog
 - 5) Extreme cold
 - 6) Artificial lighting
- Know how to identify and avoid hazards and obstacles
- Understand the established emergency procedure

8.0 Main Cause of Crane Accidents

More than half of all mobile crane accidents (54.1%) were directly related to machine set-up.

Support Failure: 31.5%

- Ground giving way and subsiding beneath outrigger blocking
- Soft Footing with crawler crane
- Outrigger blocks fall off
- Crane slips off blocks

Failure To Use Outriggers: 22.6%

- Operator neglects when setting up
- Lifting boom without outriggers
- Changing boom and counterweights without outriggers

Operator Error: 33.1%

- Inexperience, i.e., violent control movements
- Boom out beyond safe working radius
- Overload
- Overturn while traveling
- Out of level
- Boom collapse backward

Machinery and Structural Failure: 11.2%

- Boom hoist failure
- Brake failure
- Booms
- Outriggers

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High Wind: 1.6%

- Wind force sufficient to topple boom or crane

9.0 Cause of Mobile Crane Fatalities

- Electrocution: 44%
- Rigging Mishap or Failure: 15%
- Load Handling (struck by or crushed): 14%
- Operator Error: 7%
- Overload: 7%
- Dismantling Boom: 5%
- Wire Rope Failure: 3%
- Struck by Crane: 3%
- Miscellaneous: 3%

10.0 Rigging Safety Rules

- Know the weight of the load
- Know the center of gravity of the load
- Make the load attachment directly above the center of gravity of the load
- Select the hitch that will hold and control the load
- Know the rated capacity of slings and hardware
- Select the best sling suited for the load
- Inspect all rigging before the lift
- Protect the sling from sharp surfaces
- Conduct sling loading calculation and understand the decreased sling capacity cause by sling angle
- Allow for D/d ratio on all wire rope slings
- Calculate reductions when using choker hitch
- Keep personnel clear from lift area
- Lift load a few inches then check rigging before lift
- Know the limitations of all components used for the lift
- Lift slowly and stop slowly
- Never replace a shackle pin with a bolt

11.0 Rigging Equipment

- Rigging equipment must be inspected by a Competent Person before each use and as necessary during its use to ensure it is safe
- Tag and remove defective equipment from service
- Custom design grabs, hooks, clamps, or other lifting accessories, for such units as modular panels, prefabricated structures and similar materials must be marked to indicate safe working load capacities and be proof tested to 125% of their rated load

Alloy Steel Chain & Welded Alloy Steel Chain Slings

- Must have permanently affixed durable identification tags stating; size, grade, rated capacity; and; sling manufacturer
- Job or shop hooks and links, or, makeshift fasteners, formed from bolts, rods, ect., or other such attachments shall not be used
- There are four grades of chain (Grade 28, 43,70 & 80). **ONLY Grade 80 alloy steel chain shall be used for overhead lifting**

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- Alloy steel chains must be inspected frequently by the user
- Inspection must be link by link including all attachments
- Competent Person inspections must be performed at least once a year or more frequent based on; frequency of use; severity of service conditions; nature of lifts being made; and; experience gained on the service life used in similar circumstances
- Competent Person inspections must be documented and available

Wire Rope Slings

- Protruding ends of strands in splices on slings and bridals shall be covered or blunted
- Wire rope shall not be secured by knots
- Except for eye splices in the ends of wires and for endless rope slings, each wire rope used in hoisting or lowering, or in pulling loads, shall consist of one continuous piece without knot or splice
- Wire rope slings shall not be shortened with knots, bolts or other makeshift devices
- Legs shall not be kinked
- Basket hitch shall have the loads balanced to prevent slippage
- Wire rope slings shall be padded or protected from sharp edges
- Hands and fingers shall never be placed between the sling and its load while the sling is being tightened around the load
- A sling shall never be pulled from under a load when the load is resting on the sling
- When U-bolt wire rope clips are used to form eyes, the U-bolt shall be applied so that the "U" section is in contact with the dead end of the rope – **"Never saddle a dead horse"!**

Synthetic Webbing (nylon, polyester, and polypropylene)

- The employer shall have each synthetic web sling marked or coded to show; name or trademark of manufacture; rated capacity for the type of hitch; and; type of material
- Webbing shall be removed from service immediately if there is evidence of; acid or caustic burns; melting or charring of any part of the sling surface; snags, punctures, tears or cuts; broken or worn stitches; distortion of fittings.

Shackles, Hooks and Eyebolts

- Inspect prior to use and immediately remove from service if there is any evidence of stretching or cracks
- Never attempt to straighten deformed shackles, hooks, or, eyebolts
- The use of "homemade" hooks, shackles, or, other makeshift fasteners is prohibited
- Shackle pins must fit freely, without binding, and seat properly
- Eyebolts used for hoisting must be fabricated from forged carbon steel or alloy steel
- Carbon steel eyebolts must have the manufacturers name or identification trademark forged in raised characters on the surface of the eyebolt
- Alloy steel eyebolts must have the symbol "A" (denoting alloy steel) and the manufacturers name or identification trademark forged in raised characters on the surface of the eyebolt