Moving materials: Crane and hoist safety

Introduction
Moving large, heavy loads is crucial to many manufacturing processes. While forklifts are excellent for moving materials around a facility — for stacking, loading, or unloading — there are many operations where the best piece of equipment to move heavy or oversized objects is a crane or hoist.

A crane is designed to lift and lower a load and move it horizontally. Whether fixed or mobile, cranes are driven manually or by a power source. Cranes come in all sizes, so the task of manipulating materials is made safer and easier. The safe use of a crane depends on several factors, including:

- Site evaluation — Evaluating the terrain, what is around and overhead, what is the load bearing capacity of the site, and what the hazards are in the area.
- Operator training — Operators must be trained in the operation, limitations, and emergency procedures for the cranes they operate. They also need to understand the load ratings and how to safely lift loads.
- Proper equipment selection for the job — Choosing the proper equipment is a factor in operating cranes safely. The crane should be matched to the job. Review the manufacturer’s specifications and recommendations to determine if a crane can be used in a particular application.
- Inspection — Inspections ensure that the equipment is functioning correctly.
- Good maintenance — Besides repairing the equipment, a crane program should include preventive maintenance. Well-maintained equipment will aid in preventing accidents involving mechanical failure.

Overhead and gantry cranes

Introduction
Overhead and gantry cranes have a horizontal bridge across which a trolley and hoist travels. A gantry crane has one or more legs running on fixed ground rails, wheels, or other runway systems. Gantry cranes can be portable, with load capacities generally ranging from one to 30 tons, width spanning from eight to 100 feet, and heights from six to 60 feet. These qualities make them ideal for use in warehouses, loading docks, and vehicle maintenance facilities. This type of crane, having trolleys and similar travel characteristics, also include semigantry, cantilever gantry, wall cranes, and storage bridge cranes.

Materials being moved by these cranes are attached to a hoisting mechanism on the trolley. These cranes are useful in general machine shops, fabricating assemblies, printing operations, and warehousing. They can be purchased “as is” or custom-built by the manufacturer. A variation, the jib crane, is useful for moving smaller, localized loads.

OSHA’s general requirements
OSHA’s Overhead and Gantry Crane rule, §1910.179, requires that cranes constructed after August 31, 1971 have to meet the design specifications of the ANSI/ASME standard Safety Code for Overhead and Gantry Cranes, ANSI B30.2.0-1967. The most recent revision of this standard is the 2001 edition.

The OSHA rule covers the safe operation of overhead- and gantry-type cranes by setting down manufacturer’s design criteria, as well as the safe procedures employers must follow pertaining to crane and rope inspections, equipment maintenance, load handling, and operator training. The following information summarizes the OSHA requirements, as well as safety points from the ANSI B30.2 standard and from crane manufacturers and users. For details, you should obtain a copy of the rule and/or the consensus standard, and the crane manufacturer’s operational manual.
Crane components

Cabs
The general arrangement of the cab and the location of control and protective equipment must be such that all operating handles are within the operator’s convenient reach when facing the area to be served by the load hook, or while facing the direction of travel of the cab. The arrangement needs to allow the operator a full view of the load hook in all positions. If there are positions where the view is blocked, other methods such as closed-circuit television, mirrors, radio, or a signal person may be used.

The cab needs to have sufficient light, either natural or artificial, so that the operator can see clearly. A portable fire extinguisher with a basic minimum rating of 10 BC must be kept in or near the cab area. Carbon tetrachloride fire extinguishers are prohibited in crane cabs. There should be an emergency exit method, such as two exits remote from each other, in cab-operated cranes. The crane should have a fixed ladder, stairs, or platform allowing access to the cab and/or bridge walkway. If sufficient headroom is available on cab-operated cranes, there will be a service platform (footwalk) with an anti-slip surface on the drive side along the entire length of the bridge.

Personal items must be stored safely so they won’t interfere with crane operation. Items related to operations such as tools, oil cans, waste, extra fuses, and other necessary articles must be stored in the tool box and not permitted to lie loose in the cab.

Bumpers and brakes
The bumper, which is attached to the bridge, trolley, or runway stop, reduces the force of impact when a moving crane reaches the end of its permitted travel distance. Cranes and trolleys, with few exceptions, must have bumpers or other automatic means to stop the bridge when traveling in either direction with power off at a speed of at least 40 percent of the rated load speed.

The bumper has to be designed and installed to minimize parts falling from the crane or trolley in case of breakage. When more than one trolley is operated on the same bridge, each must be equipped with bumpers or equivalents.

Rail sweeps
Crane bridges must be equipped with rail sweeps to clear the travel path. The rail sweep, a device located in front of the crane’s leading wheels, removes obstructions from the runway. If obstructions are not removed, they could damage the wheel or cause it to derail.

Guards
All exposed moving parts such as gears, set screws, projecting keys, chains, chain sprockets, and reciprocating components, which might constitute a hazard under normal operating conditions, must be guarded. The guard must be capable of supporting (without permanent distortion) the weight of a 200-pound person — unless the guard is located where it is impossible for someone to step on it. Hoisting ropes that run too close to other parts need to be guarded. Also, to prevent contact between bridge conductors and hoisting ropes, a guard may be needed.

Brakes
Brakes for trolleys and bridges may be applied by mechanical, electrical, pneumatic, hydraulic, or gravity methods. Foot-brake pedals must have a non-slip surface and automatically release when the operator releases pressure from the pedal. Each independent hoisting unit needs to be equipped with at least one self-setting holding brake, and with the exception of worm-gear hoists, a braking method to control the load during lowering and prevent overspeeding. Holding brakes on hoists must be applied automatically when power is removed.

Electrical equipment
Electrical equipment must be located or enclosed so that live parts will not be exposed to accidental contact under normal operating conditions. Clearly marked control boxes must be installed to prevent electrical shock and display warnings such as “Lockout disconnecting means before removing cover or servicing equipment” or “Do not operate without cover in place.” Protect electrical equipment from dirt, grease, oil, and moisture. The controls for the bridge and trolley travel must be located so that the operator can generally face the direction of travel and be within easy reach. Controls must automatically return to the “off” position when released by the operator and all master switches have to be appropriately labeled. If a service receptacle is provided in the cab or on the bridge of cab-operated cranes, it has to be a grounded three-prong type permanent receptacle, not exceeding 300 volts.
Markings and warnings
The rated load of the crane must be plainly marked on each side. If the crane has more than one hoisting unit, the rated load will be marked on each hoist or its load block. The markings have to be large enough so they are clearly legible from the ground level. The rated load marking must contain at least the following information:

- Name and address of the manufacturer;
- Manufacturer’s model or serial number; and
- Voltage of AC or DC power supply and phase and frequency of AC power supply.

Floor- and remote-operated cranes
Floor-operated and remote-operated cranes must have safety labels that include precautionary warnings such as:

- Do not lift more than the crane’s rated load;
- Do not operate the hoist with kinked or damaged chain or rope; and
- Never lift loads over pedestrians.

Cab-operated cranes
Cab-operated cranes must also have safety labels that caution against operations such as:

- Operating the hoist when the load is not centered;
- Lifting personnel; and
- Operating a rope hoist when the rope is not properly seated in the groove.

Manufacturer’s precautions
Most manufacturers prepare warning labels for their equipment. If the labels and other markings are not on the crane, they may be shipped with it and the purchaser will be instructed to apply the labels when the equipment is assembled.

A manufacturer’s warning labels may include statements such as “Caution: Lock wheels when in use” or “Caution: Do not move gantry while loaded.” If warning labels are missing, contact the manufacturer for replacements.

Loading components
Proper loading is essential to crane safety. Never use a crane and/or its accessories to lift more than their rated load capacity. A crane’s load rate capacity is based on new equipment. When rating a load to be lifted, consider the age of the crane and daily wear, both of which reduce the operating capacity of the crane. Never use two pieces of equipment to lift a load greater than the rated capacity of a single piece of equipment. If a gantry crane is used with an electric hoist or other electrical accessories, make sure the electrical ground wires are installed according to the National Electrical Code and all wires are connected when the equipment is used. You may want to consult your local electrical code for requirements concerning connecting and operating electrical equipment. According to OSHA, the minimum clearance for obstructions must be three inches overhead and two inches laterally between the crane and all obstructions.

Running sheaves
Maintain sheave grooves on hoisting equipment so they are smooth and free from surface defects which could cause rope damage. All running sheaves must be lubricated. Permanently lubricated, sealed and/or shielded bearings meet this requirement.

Ropes
Follow the crane manufacturer’s recommendation when using hoisting ropes. The rated load, divided by the number of parts of rope, may not exceed 20 percent of the nominal breaking strength of the rope.
Rope must be secured to the drum with no less than two wraps of rope remaining on the drum when the hook is in its extreme low position. The rope end has to be anchored by a clamp securely attached to the drum, or by a socket arrangement approved by the crane or rope manufacturer.

Replacement rope should be the same size, grade, and construction as the original rope, unless otherwise recommended by a wire rope manufacturer, due to actual working condition requirements. If a load is supported by more than one part of rope, the tension in the parts must be equalized.

**Hooks**

Hooks must meet the manufacturer’s recommendations and not be overloaded. Swivel-type hooks should rotate freely.

**Warning alarms**

Except for floor-operated cranes, a manually-operated gong; power-operated bell, siren, or horn; rotating beacon; or strobe light must be used for each crane equipped with a power traveling mechanism.

Outdoor storage bridges need to have a wind-indicating device which gives a visible or audible alarm to the bridge operator at a predetermined wind velocity.

**Load handling**

Never load a crane beyond its rated capacity. When attaching the load, be sure the hoist chain or hoist rope is free from kinks or twists and does not wrap around the load.

The load should be moved from one point to another by moving the trolley back and forth along the bridge, while the crane itself is stationary. When moving the load, be sure that it is well secured and properly balanced before it is lifted more than a few inches. Before starting to hoist, inspect for the following conditions:

- Hoist rope is not kinked.
- Multiple-part lines are not twisted around each other.
- The hook is positioned above the center of gravity of the load in such a way as to minimize swinging when the load is lifted.
- If there is a slack-rope condition, be sure that the rope is properly seated on the drum and in the sheaves.
- All personnel, including the qualified rigger, must be clear of the load.

The only purpose of the hoist is to move the load straight up and down and to suspend the load. Do not operate the hoist to move in any direction other than straight up and down. During hoisting, ensure that:

- The load is lifted slowly until it clears the ground or other support to minimize swinging.
- There is no sudden acceleration or deceleration of the moving load.
- The load does not contact any obstructions. Conduct a dry run in areas where clearance is limited.

**Loading precautions**

While any employee is on the load or hook, do not allow hoisting, lowering, or traveling. The operator should never carry loads over people nor leave the control position while the load is suspended. When starting the bridge and when the load or hook approaches near or over personnel, the warning signal must be sounded.

The operator must test the brakes each time a load approaching the rated load is handled. Test the brakes by raising the load a few inches and applying the brakes. Do not lower the load below the point where less than two full wraps of rope remain on the hoisting drum.
When two or more cranes are used to lift a load, one qualified responsible person must be in charge of the operation. This person will analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made.

**Pre-start-up testing**
At the beginning of each operator’s shift, test the upper limit switch of each hoist under no load conditions. Practice extreme care — the block should be “inched” into the limit or run in at slow speed. If the switch does not operate properly, immediately notify the appropriate person. Never use the hoist limit switch, which controls the upper limit of travel of the load block, as an operating control.

**Crane inspections**

**Initial inspection**
All new and altered cranes must be inspected prior to initial use. Inspection procedures for cranes in regular service are divided into two general classifications, based on the intervals at which inspection should be performed. The intervals — frequent and periodic — depend on the nature of the crane’s critical components and the degree of their exposure to wear, deterioration, or malfunction.

- **Frequent inspection** — daily to monthly intervals.
- **Periodic inspection** — one to 12 month intervals.

**In-service inspection criteria**
The Department of Energy’s *Hoisting and Rigging Standard* DOE-STD-1090-2001 defines crane service as:

- **Normal service** — operating at less than 85 percent of rated load and not more than 10 lift cycles/hr. except for isolated instances.
- **Heavy service** — operating at 85 to 100 percent of rated load or in excess of 10 lift cycles/hr. as a regular specified procedure.
- **Severe service** — operating at normal or heavy service under abnormal operating conditions (i.e., extreme temperatures or corrosive atmospheres).

Inspections should be based on the following criteria:

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<td>Heavy service</td>
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<td>Severe service</td>
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*Period inspections:*

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**Frequent inspections**
The following items must be inspected for defects in the “frequent” range, or as specifically indicated, including observation during operation for any defects which might appear between regular inspections. Carefully examine all deficiencies, including the following, and decide if they constitute a safety hazard.

**Daily**

- All controls and operating mechanisms for proper operation.
- Deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of air or hydraulic systems.

**Visual inspection daily**
Monthly inspection with documentation

- Hooks with deformation or cracks.

- Written certification must include the date of inspection; the signature of the person who performed the inspection; and the serial number, or other identifier of the hook inspected.

**Note:** For hooks with cracks or having more than 15 percent in excess of normal throat opening or more than 10º twist from the plane of the unbent hook, refer to §1910.179(l)(3)(iii)(a).

- Hoist chains, including end connections, for excessive wear, twisted, distorted links interfering with proper function, or stretched beyond manufacturer’s recommendations.

Written certification must include the date of inspection, the signature of the person who performed the inspection, and an identifier of the chain which was inspected.

- All functional operating mechanisms for excessive wear of components.

- Rope reeving for noncompliance with manufacturer’s recommendations.

**Periodic inspections**

The following items must be inspected for defects in the “periodic” range, depending on the crane’s activity, severity of service, and environment. “Periodic” is defined as one to 12 month intervals. These inspections are in addition to those required by the “frequent” section. Any listed deficiencies must be carefully examined as to whether they constitute a safety hazard.

- Deformed, cracked, or corroded members.

- Loose bolts or rivets.

- Cracked or worn sheaves and drums.

- Worn, cracked or distorted parts such as pins, bearings, shafts, gears, rollers, locking and clamping devices.

- Excessive wear on brake system parts, linings, pawls, and ratchets.

- Load, wind, and other indicators over their full range, for any significant inaccuracies.

- Gasoline, diesel, electric, or other power plants for improper performance or noncompliance with applicable safety requirements.

- Excessive wear of chain drive sprockets and excessive chain stretch.

- Electrical apparatus, for signs of pitting or any deterioration of controller contactors, limit switches and push button stations.

**Cranes not in regular use**

**One through five months**

A crane which has been idle for one or more months, but less than six months, due to shutdown or storage, must have a frequent inspection plus a rope inspection before it can be put in service.

Appoint someone to inspect the rope for all types of deterioration. This person must approve and verify the condition of the rope prior to use by a certification that includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the rope which was inspected.

**Over six months**

A crane which has been idle for over six months must be given a complete inspection covering the requirements for both frequent and periodic inspections plus a rope inspection before it can be put in service.
Appoint someone to inspect the rope for all types of deterioration. This person must approve and verify the condition of the rope prior to use by a certification that includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the rope which was inspected.

**Standby cranes**

Standby cranes must be inspected at least semi-annually. The crane must have a frequent inspection plus a rope inspection before it can be put in service.

Appoint someone to inspect the rope for all types of deterioration. This person must approve and verify the condition of the rope prior to use by a certification that includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the rope which was inspected.

**Operational tests**

Prior to initial use, all new, reinstalled, repaired, or modified cranes must be tested by a designated person on the following functions:

- Hoisting and lowering,
- Trolley travel,
- Bridge travel, and
- Limit switches, locking, and safety devices.

Determine the trip setting of hoist switches by tests with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the limit switch must be located so that it will trip the switch, under all conditions, in sufficient time to prevent contact of the hook or hook block with any part of the trolley.

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

**Rope inspections**

**Running ropes**

A thorough inspection of all ropes must be made at least once a month. A certification record which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the ropes which were inspected must be kept on file where readily available to appointed personnel.

Any deterioration that results in appreciable loss of original strength must be carefully observed and determination made as to whether further use of the rope would constitute a safety hazard. Some of the conditions that could result in an "appreciable" loss of strength include:

- Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires;
- A number of broken outside wires and the degree of distribution or concentration of such broken wires;
- Worn outside wires;
- Corroded or broken wires at end connections;
- Corroded, cracked, bent, worn, or improperly applied end connections; and
- Severe kinking, crushing, cutting, or unstranding.

When an inspection determines that the rope has met one of the removal criteria, it must be replaced. Based on the judgment of a qualified person, it may be replaced at the end of a workshift, end of the work day, or prior to it being used again.
Other ropes
All rope which has been idle for a month or more due to crane shutdown or storage must be given a thorough inspection before it is used. Inspect for all types of deterioration. The inspection will be performed by an appointed person whose approval is required before the rope may be used.

A record certifying the inspection must be available which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the rope which was inspected.

Maintenance
Keeping a crane in good operating condition requires preventive maintenance as well as timely repairs. Establish a preventive maintenance program based on the crane manufacturer’s recommendations. A qualified person can be helpful in setting up this program. Be sure to record maintenance procedures, the date, and file them for future reference. Retain your maintenance history throughout the life cycle of the crane.

Your maintenance program should also include a lockout/tagout policy and procedures for worker safety when work is being done on a crane.

What is considered a “normal” operating condition?
Whenever a crane is used in its regular production activities such as materials handling and loading, and is under the control of its operator rather than under the control of a maintenance worker, it is considered to be used in a normal operating condition. However, normal operating conditions do not cover when a crane is taken out of production for maintenance work and is under the control of the maintenance person.

Routine maintenance procedures
Prior to maintenance work
Before adjustments and repairs are started on a crane, take the following lockout precautions:

- Move the crane to be repaired to a location where it will cause the least interference with other cranes and operations in the area.
- Place all controllers in the “off” position.
- Open and lock the emergency switch (or main switch) in the “open” position.
- Place “Warning” or “Out of order” signs on the crane, and also on the floor beneath — or on the hook — where visible from the floor.
- Where other cranes are in operation on the same runway, provide rail stops or other suitable methods to prevent interference with the idle crane.

Following maintenance work
After adjustments and repairs have been made, do not operate the crane until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.

Adjustments and repairs
Any unsafe conditions discovered during the inspection must be corrected before crane operation is resumed. Adjustments and repairs may be done only by designated personnel.

Adjustments
Examples of adjustments that must be maintained to assure correct functioning of crane components include:

- All functional operating mechanisms,
- Limit switches,
- Control systems,
- Brakes,
Power plants.

**Repairs**

For safe operation, make all repairs or replacements promptly. Include the following crane components in the repair process:

- Defective crane hooks. Generally, do not attempt to repair crane hooks by welding or reshaping. The best procedure is to discard defective hooks. If repairs are attempted, they may only be done under competent supervision. Following a repair, test the hook according to the load requirements of not more than 125 percent of the rated load, unless otherwise recommended by the manufacturer before further use.

- Load attachment chains and rope slings showing defects, including hoist chains and end connections, for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer’s recommendations.

- All critical parts which are cracked, broken, bent, or excessively worn.

- Pendant control stations need to be kept clean and function labels kept legible.

**Lubrication**

Follow the manufacturer’s recommendation for routinely lubricating the crane’s moving parts. The manufacturer will recommend the points of lubrication, frequency, and the type of lubricant to use. Unless equipped for automatic lubrication, cranes must be stationary when lubricants are applied.

**Operator training**

OSHA requires that only thoroughly trained and competent personnel be permitted to operate overhead and gantry cranes. It also requires that operators and maintenance personnel are familiar with the operation and care of fire extinguishers provided in the cab.

For safety sake, train employees who are using ladders to avoid carrying objects that could cause them to lose their grip on the ladder. Articles that are too large to be carried in pockets or belts should be lifted and lowered by hand line.

**ASME B30.2 physical criteria**

The ASME B30.2 Safety Code for Overhead and Gantry Cranes contains specific criteria for operators’ physical fitness as well as training criteria. It requires that potential operators pass a written or oral exam and practical operating examination.

Some additional physical criteria includes:

- The ability to distinguish colors and to hear with or without a hearing aid;
- To have strength, endurance, agility, coordination, and reaction speed to meet the rigors of crane operation; and
- To have normal depth perception and vision field.
- A potential operator may be disqualified based on certain physical conditions. For a complete list of physical requirements, see the B30.2 standard.

**Operational requirements**

Workers who are physically capable of performing the job must, among other things, understand hand signals and the appropriate responses; be responsible for their lifts; activate warning devices when necessary; know procedures to take when leaving the cab; understand their equipment and its care; and obey stop signals, no matter who gives them. Be sure training covers:

- Handling the load;
- Attaching the load;
- Moving the load;
• Hoist-limit devices; and
• Hand and special signals.

Manufacturer’s guidelines
The crane manufacturer is required to furnish a user’s manual containing general and specific operating instructions and information about installation, inspection, testing, lubrication, and maintenance of the crane. Employees with crane responsibilities should be familiar with the information in the manual.

Crane operator training tips
To reduce the chance of an injury, include training on the following precautions:

1. Require workers to always check the crane’s load chart to ensure that the crane will not be overloaded by operating conditions.
2. Instruct workers to plan lifts before starting them to ensure that they are safe.
3. Tell workers to take additional precautions and exercise extra care when operating around power lines.
4. Direct workers to always keep hoisting chains and ropes free of kinks or twists and never wrapped around a load.
5. Train workers to attach loads to the load hook by slings, fixtures, and other devices that have the capacity to support the load on the hook.
6. Instruct workers to pad sharp edges of loads to prevent cutting slings.
7. Teach workers to maintain proper sling angles so that slings are not loaded in excess of their capacity.

Glossary of terms for overhead and gantry cranes
A crane is a machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism an integral part of the machine. Cranes whether fixed or mobile are driven manually or by power.

An automatic crane is a crane which when activated operates through a preset cycle or cycles.

A cab-operated crane is a crane controlled by an operator in a cab located on the bridge or trolley.

Cantilever gantry crane means a gantry or semigantry crane in which the bridge girders or trusses extend transversely beyond the crane runway on one or both sides.

Floor-operated crane means a crane which is pendant or nonconductive rope controlled by an operator on the floor or an independent platform.

Gantry crane means a crane similar to an overhead crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two or more legs running on fixed rails or other runway.

Hot metal handling crane means an overhead crane used for transporting or pouring molten material.

Overhead crane means a crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure.

Power-operated crane means a crane whose mechanism is driven by electric, air, hydraulic, or internal combustion means.
A pulpit-operated crane is a crane operated from a fixed operator station not attached to the crane.

A remote-operated crane is a crane controlled by an operator not in a pulpit or in the cab attached to the crane, by any method other than pendant or rope control.

A semigantry crane is a gantry crane with one end of the bridge rigidly supported on one or more legs that run on a fixed rail or runway, the other end of the bridge being supported by a truck running on an elevated rail or runway.

Storage bridge crane means a gantry type crane of long span usually used for bulk storage of material; the bridge girders or trusses are rigidly or nonrigidly supported on one or more legs. It may have one or more fixed or hinged cantilever ends.

Wall crane means a crane having a jib with or without trolley and supported from a side wall or line of columns of a building. It is a traveling type and operates on a runway attached to the side wall or columns.

An auxiliary hoist is a supplemental hoisting unit of lighter capacity and usually higher speed than provided for the main hoist.

A brake is a device used for retarding or stopping motion by friction or power means.

A drag brake is a brake which provides retarding force without external control.

A holding brake is a brake that automatically prevents motion when power is off.

Bridge means that part of a crane consisting of girders, trucks, end ties, footwalks, and drive mechanism which carries the trolley or trolleys.

Bridge travel means the crane movement in a direction parallel to the crane runway.

A bumper (buffer) is an energy absorbing device for reducing impact when a moving crane or trolley reaches the end of its permitted travel; or when two moving cranes or trolleys come in contact.

The cab is the operator’s compartment on a crane.

Conductors, bridge are the electrical conductors located along the bridge structure of a crane to provide power to the trolley.

Conductors, runway (main) are the electrical conductors located along a crane runway to provide power to the crane.

The control braking means is a method of controlling crane motor speed when in an overhauling condition.

Countertorque means a method of control by which the power to the motor is reversed to develop torque in the opposite direction.

Dynamic means a method of controlling crane motor speeds when in the overhauling condition to provide a retarding force.

Regenerative means a form of dynamic braking in which the electrical energy generated is fed back into the power system.

Mechanical means a method of control by friction.

Controller, spring return means a controller which when released will return automatically to a neutral position.
Designated means selected or assigned by the employer or the employer’s representative as being qualified to perform specific duties.

A drift point means a point on a travel motion controller which releases the brake while the motor is not energized. This allows for coasting before the brake is set.

The drum is the cylindrical member around which the ropes are wound for raising or lowering the load.

An equalizer is a device which compensates for unequal length or stretch of a rope.

Fail-safe means a provision designed to automatically stop or safely control any motion in which a malfunction occurs.

Footwalk means the walkway with handrail, attached to the bridge or trolley for access purposes.

A hoist is an apparatus which may be a part of a crane, exerting a force for lifting or lowering.

Hoist chain means the load bearing chain in a hoist.

Hoist motion means that motion of a crane which raises and lowers a load.

Load means the total superimposed weight on the load block or hook.

The load block is the assembly of hook or shackle, swivel, bearing, sheaves, pins, and frame suspended by the hoisting rope.

Main hoist means the hoist mechanism provided for lifting the maximum rated load.

A man trolley is a trolley having an operator’s cab attached thereto.

Rated load means the maximum load for which a crane or individual hoist is designed and built by the manufacturer and shown on the equipment nameplate(s).

Rope refers to wire rope, unless otherwise specified.

Running sheave means a sheave which rotates as the load block is raised or lowered.
Crawler, locomotive, and truck cranes

Introduction
Crawler cranes, locomotive cranes, both truck and self-propelled wheel-mounted cranes, and any variations which have the same basic characteristics are covered by OSHA’s §1910.180 crane standard.

These types of cranes are powered by internal combustion engines or electric motors and utilize drums and ropes. Simple definitions of these cranes follow.

Crawler crane
A crawler crane consists of a rotating superstructure with power plant, operating machinery, and boom, mounted on a base, equipped with crawler treads for travel. Its function is to hoist, swing, and lower loads at various radii.

Locomotive crane
A locomotive crane consists of a rotating superstructure with power plant, operating machinery and boom, mounted on a base or car equipped for travel on railroad track. It may be self-propelled or propelled by an outside source. Its function is to hoist, swing, and lower loads at various radii.

Truck crane
A truck crane consists of a rotating superstructure with power plant, operating machinery and boom, one or more operator’s stations mounted on an automotive truck equipped with a power plant for travel. Its function is to hoist, swing, and lower loads at various radii.

Wheel-mounted crane
A wheel-mounted crane (wagon crane) consists of a rotating superstructure with power plant, operating machinery, boom, and operator’s station mounted on a base or platform equipped with axles and rubber-tired wheels for travel. The base is usually propelled by the engine in the superstructure, but it may be equipped with a separate engine controlled from the superstructure. Its function is to hoist, swing, and lower loads at various radii.

Only machines used as lifting cranes are covered by both the OSHA standard and the ASME B30.5 standard for mobile and locomotive cranes. Neither standard applies to cranes designed for railway and automobile wreck clearances.

OSHA’s general requirements
OSHA regulations require that all crawler, locomotive, and truck cranes constructed after August 31, 1971 have to meet the design specifications of the ANSI/ASME B30.5-1968, Safety Code for Crawler, Locomotive, and Truck Cranes. The most recent revision of the ASME standard is the 2000 edition.

The OSHA rule covers the safe operation of crawler, locomotive, and truck type cranes by setting down the safe procedures employers must follow pertaining to crane and rope inspections, equipment testing and maintenance, load handling, and operator training. The following information summarizes the OSHA requirements, as well as safety points from the ANSI B30.5 standard and from crane manufacturers and users. For details, you should obtain a copy of the rule and/or the consensus standard, and the crane manufacturer’s operational manual.

Crane cabs
Crane cabs have windows on the front and sides for easy viewing. The front window should have a windshield wiper to ensure the operator’s visibility. The cab door adjacent to the operator either swings outward or slides to the rear for easy exit. If the cab has a platform, the platform will have a guardrail or handholds and a slip-resistant walking surface. Single-control station wheel-mounted cranes are required to be equipped with seat belts for use during travel.

Cab controls
The basic controls for operating the crane are located within the operator’s easy reach. Remote-operated cranes have an emergency stop in case there is a malfunction. Controls include the means to start and stop the equipment, control engine speed, emergency stop, and select transmissions.
Cab storage
The crane operator’s extra clothing and personal belongings have to be stored so that they won’t interfere with the crane’s operation. Store tools, oil cans, waste, extra fuses, and other necessary articles in the toolbox which is attached directly to the crane. Items lying loose in or about the cab create a safety hazard.

Fire extinguishers
A carbon dioxide, dry chemical, or equivalent fire extinguisher must be kept in the cab or vicinity of the crane. Crane operators and maintenance personnel need to be trained in the use and care of the fire extinguishers.

Fueling
Refueling with small portable containers may be done using an approved safety can equipped with an automatic closing cap and flame arrester. Never refuel when the engine is running. Never allow smoking or open flames in a refueling area.

The fuel tank filler pipe should be protected to prevent fuel from spilling or overflowing onto the engine, exhaust, or electrical equipment.

Engine exhaust gases must be pumped to the outside and away from the operator. For safety, exhaust pipes need to be guarded or insulated to prevent contact.

Markings and warnings
Load rating chart
A substantial and durable rating chart with clearly legible letters and figures must be provided by the manufacturer with each crane. The chart needs to be securely fixed to the crane cab in a location easily visible to the operator while seated at the control station.

The rated load of the crane must be plainly marked on each side. If the crane has more than one hoisting unit, the rated load will be marked on each hoist or its load block. The markings have to be large enough so they are clearly legible from the ground level. The rated load marking must contain at least the following information:

- Crane load ratings at all operating radii, boom angles, work areas, jib lengths, and alternate ratings for optional equipment;
- Work area chart for specific listed capacities;
- Limitations such as structural or hydraulic;
- Areas where no load is to be handled; and
- Recommended reeving for hoist lines.

In addition, the following information, where applicable for a particular crane, must be included either on the rating chart or in the user’s manual:

- Recommended parts of hoist reeving, size and type of rope;
- Boom hoist reeving diagram;
- Tire pressure;
- Precautions for equipment and operating limitations;
- Gantry positioning and boom suspension;
- Instructions for boom erection, boom/jib raising and lowering;
- Specific hoist-holding mechanism details;
- Specific details regarding telescopic booms; and
- Hydraulic relief valve settings.

**Audible warning**
All cranes have to be equipped with an audible signal device that is controlled by the operator. Audible travel signals that an operator may use equate to:

- One blast = stop,
- Two blasts = go ahead, and
- Three blasts = back up.

**Communication**
Crane operators may use standard hand signals to communicate during operations, unless reliable voice equipment such as telephones, radios, or similar equipment is used.

**Electrical warning**
A sign warning about electrocution or serious injury has to be installed in a location clearly visible from the operator’s station. The sign will specify that a minimum clearance of 10 feet must be maintained between the crane or load and energized power lines up to 50 kV, and that greater clearances are required for higher voltages.

**Traveling**
On all single-control station cranes, the travel controls are located in the operator’s station. Wheel-mounted multiple control station cranes will have these controls located in the carrier cab. When an operator is in a traveling crane, communication between cabs is required.

**Guarding moving parts**
Moving parts on cranes are usually guarded when the equipment is manufactured. Employers must ensure that guards cover all moving parts which may present a hazard and remain in place, such as on gears, set screws, projecting keys, chains and sprockets, and reciprocating or rotating parts.

Protect dry friction brakes and clutches against rain and other liquids such as oil and lubricants. Further, provide protection for hydraulic and pneumatic lines as practical.

**Lifting personnel**
OSHA’s §1910.180(h)(3)(v) covers the use of suspended personnel platforms in general industry. The standard prohibits hoisting, lowering, swinging, or traveling while anyone is on the load or hook. When the use of a conventional means of access to any elevated worksite would be impossible or more hazardous, however, OSHA will treat a violation of §1910.180(h)(3)(v) as de minimis — in effect, disregarded — if the employer has complied with the provisions in the construction industry regulations at §1926.550(g)(3-8).

Because using cranes or derricks to hoist personnel poses a serious risk to the employees being lifted, any cranes and derricks that hoist personnel must conform to the following:

- Be placed on a firm foundation;
- Be uniformly level within one percent of level grade;
- Have a minimum safety factor of seven for the load line (wire rope) of the crane or derrick (this means it must be capable of supporting seven times the maximum intended load);
- Move the personnel platform slowly and cautiously without any sudden jerking of the crane, derrick, or platform;
- Have rotation-resistant rope with a minimum safety factor of 10; and
- Have all brakes and locking devices on the crane or derrick set when the occupied personnel platform is in a stationary working position.
In addition, the combined weight of the loaded personnel platform and its rigging must not exceed 50 percent of the rated capacity of the crane or derrick for the radius and configuration of the crane or derrick.

**Note:** The crane operator must always be at the controls when the crane engine is running and the personnel platform is occupied. The crane operator also must have full control over the movement of the personnel platform. For more information, see the construction industry requirements.

**Loading/unloading**

Proper loading is essential for all types of cranes. Never use a crane and/or its accessories to lift more than the rated load capacity. A crane’s load rate capacity is based on new equipment. When rating a load to be lifted, consider the age of the crane and daily wear, both of which reduce the operating capacity of the crane.

When loading or unloading with a locomotive crane, take precautions to ensure that it is not swung into a position where railway cars on an adjacent track might strike it. Be certain that cars are not being moved on the adjacent track and proper flag protection has been established prior to swinging the load.

**Load ratings**

**Where stability governs lifting performance**

The margin of stability for determining load ratings, with booms of stipulated lengths at stipulated working radii for the various types of crane mountings, is established by taking a percentage of the loads which will produce a condition of tipping or balance with the boom in the least stable direction, relative to the mounting.

The load ratings cannot exceed the following percents with the indicated types of mounting under conditions stipulated in §1910.180(c)(1)(ii) and (iii):

<table>
<thead>
<tr>
<th>Type of crane mounting</th>
<th>Maximum load ratings (percent of tipping loads)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotive, without outriggers: Booms 60 feet or less</td>
<td>85¹</td>
</tr>
<tr>
<td>Booms over 60 feet</td>
<td>85¹</td>
</tr>
<tr>
<td>Locomotive, using outriggers fully extended</td>
<td>80</td>
</tr>
<tr>
<td>Crawler, without outriggers</td>
<td>75</td>
</tr>
<tr>
<td>Crawler, using outriggers fully extended</td>
<td>85</td>
</tr>
<tr>
<td>Truck and wheel mounted without outriggers or using outriggers fully extended</td>
<td>85</td>
</tr>
</tbody>
</table>

¹Unless this results in less than 30,000 pound-feet net stabilizing moment about the rail, which shall be minimum with such booms.

**Locomotive cranes**

Use the following stipulations when applying the load values for locomotive cranes:

- Tipping with or without the use of outriggers occurs when half of the wheels farthest from the load leave the rail.
- The crane must be standing on track which is level within one percent grade.
- Radius of the load is the horizontal distance from a projection of the axis of rotation to the rail support surface, before loading, to the center of vertical hoist line or tackle with load applied.
- Tipping loads from which ratings are determined must be applied under static conditions only, (i.e., without dynamic effect of hoisting, lowering, or swinging).
- The weight of all auxiliary handling devices such as hoist blocks, hooks, and slings must be considered a part of the load rating.
Crawler, truck, and wheel-mounted cranes

Stipulations for applying the values for crawler, truck, and wheel-mounted cranes must comply with ANSI/SAE J765 Crane Load-Stability Test Code, Society of Automotive Engineers. The effectiveness of stability will also be influenced by other factors. Be sure to take the following additional factors into consideration:

- Freely suspended loads,
- Track,
- Wind,
- Ground conditions,
- Condition and inflation of rubber tires,
- Boom lengths,
- Proper operating speeds for existing conditions, and
- Careful and competent operation.

Also take into account the effect of lights, pile lead adaptors, and other nonstandard attachments to the boom such as jibs and whip lines.

**Where structural competence governs lifting performance**

While some load ratings are limited by a crane’s stability, other factors may also play a role in a crane’s operating range. Some additional factors to consider include unstable loads that may increase tipping and loads that are nonsymmetrical. Ratings for these loads may be governed by structural competence of the equipment rather than stability.

**Load handling**

A crane’s load hoist mechanism generally consists of a drum or hydraulic cylinder with the necessary rope reeving sufficient to safely lift and lower a load. When a load is in the lowest position, there must be at least two full wraps of rope remaining on the drum.

All cranes have some type of braking system that will control and stop the load from falling. Always take extreme caution when operating a crane near electric power lines.

**Stability**

During work operations, brakes or other locking devices must be applied to hold the crane stationary. Rail clamps may not be used as a method for restraining tipping locomotive cranes.

Never operate a crane without the full amount of any ballast or counterweight in place, as specified by the manufacturer. Exceptions to this requirement are truck cranes that have dropped the ballast or counterweight. They may be operated temporarily with special care and only for light loads without the full ballast or counterweight in place. The ballast or counterweight specified by the manufacturer may not be exceeded.

**Load size**

Do not load a crane beyond its rated load capacity. When loads which are limited by structural competence rather than by stability are to be handled, ensure that the weight of the load has been determined within plus or minus 10 percent before it is lifted.

**Attaching the load**

Never wrap the hoist rope around the load. The load must be attached to the hook by a sling or other device having adequate capacity.

**Holding the load**

Most importantly, the operator must never leave the controls when the load is lifted, nor may anyone be allowed to walk under or stand by a suspended load.
Prior to lifting a load, ensure that:

- The crane is level and where necessary blocked properly.
- The load is well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches.

Before starting to hoist, ensure that:

- Hoist rope is not kinked.
- Multiple part lines are not twisted around each other.
- The hook is brought over the load in such a manner as to prevent swinging.

During the hoist, ensure that:

- There is no sudden acceleration or deceleration of the moving load.
- The load does not contact any obstructions.

Moving the load

Before beginning a lift, be sure to consider the effects of the wind on the crane’s stability. Then ensure that the load is secure and balanced before it is lifted more than a few inches.

Check all ropes for kinking prior to the lift. Slowly and smoothly raise and move the load. Test the brakes each time a load approaching the rated load is handled by raising it a few inches and applying the brakes.

Side loading of booms must be limited to freely suspended loads. Cranes can never be used for dragging loads sideways. On truck-mounted cranes, no loads may be lifted over the front area except as approved by the crane manufacturer.

The operator should avoid carrying loads over people. No hoisting, lowering, swinging, or traveling may be done while anyone is on the load or hook (see exception when construction industry requirements are met).

Use outriggers when the load to be handled at that particular radius exceeds the rated load without outriggers as given by the manufacturer for that crane. Where floats are used, they must be securely attached to the outriggers.

Wood blocks used to support outriggers must:

- Be strong enough to prevent crushing,
- Be free from defects, and
- Be of sufficient width and length to prevent shifting or toppling under load.

When two or more cranes are used to lift one load, one designated person must be responsible for the operation. This person has to analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made.

When rotating the crane, avoid sudden starts and stops. Maintain rotational speed at a rate where the load does not swing out beyond the radii at which it can be controlled. Use a tag or restraint line when load rotation is hazardous. If a crane is to be operated at a fixed radius, engage the boom-hoist pawl or other positive locking device.

Never lower the load or the boom below the point where less than two full wraps of rope remain on their respective drums. Ropes must not be handled on a winch head without the knowledge of the operator. While a winch head is being used, the operator must remain within convenient reach of the power unit control lever.
Before lifting loads with locomotive cranes without using outriggers, apply a method to prevent the load from being carried by the truck springs.

**Traveling with a load**

Before traveling a loaded crane, designate a person to be responsible for determining and controlling safety. This designated person will decide the position of load, boom location, ground support, travel route, and speed of movement. When in transit, take the following additional precautions:

- Carry the boom in line with the direction of motion.
- Secure the superstructure against rotation, except when negotiating turns when there is an operator in the cab or the boom is supported on a dolly.
- Lash or restrain an empty hook so that it cannot swing freely.
- A crane with or without load cannot be traveled with the boom so high that it may bounce back over the cab.

**Crane inspections**

**Initial inspections**

Prior to initial use, all new and altered cranes have to be inspected by a qualified person. Inspection procedures for cranes in regular service are divided into two general classifications based on the intervals at which inspections should be performed. The intervals, frequent and periodic, are dependent on the nature of the critical components of the crane and the degree of their exposure to wear, deterioration, or malfunction.

- Frequent inspection — daily to monthly intervals.
- Periodic inspection — one to 12 month intervals, or as specifically recommended by the manufacturer.

**In-service inspection criteria**

The Department of Energy’s *Hoisting and Rigging Standard* DOE-STD-1090-2001 defines crane service as:

- **Normal service** — operating at less than 85 percent of rated load and not more than 10 lift cycles/hr. except for isolated instances.
- **Heavy service** — operating at 85 to 100 percent of rated load or in excess of 10 lift cycles/hr. as a regular specified procedure.
- **Severe service** — operating at normal or heavy service under abnormal operating conditions (i.e., extreme temperatures or corrosive atmospheres).

Inspections should be based on the following criteria:

**Frequent inspections:**

- Normal service — monthly
- Heavy service — weekly to monthly
- Severe service — daily to weekly

**Periodic inspections:**

- Normal service — yearly
- Heavy service — semi-annually
- Severe service — quarterly
Frequent inspections

The following items must be inspected for defects at “frequent” intervals, or as indicated, including observation during operation for any defects which might appear between regular inspections. Carefully examine any deficiencies, such as those listed below, and decide if they present a safety hazard.

Daily

- All control mechanisms for maladjustment interfering with proper operation.
- Deterioration or leakage in air or hydraulic systems.

Daily to monthly

- All control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter.
- All safety devices for malfunction.
- Crane hooks with deformations or cracks. For hooks with cracks or having more than 15 percent in excess of normal throat opening or more than 10º twist from the plane of the unbent hook.
- Rope reeving for noncompliance with manufacturer’s recommendations.
- Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.
- Tires for recommended inflation pressure.

Periodic inspections

Perform a complete crane inspection periodically, that is, between a one to 12 month interval, or as recommended by the manufacturer. The interval is dependent on the crane’s activity, severity of service, and environment, or as specifically indicated below.

These items to be inspected on the following list are in addition to those required on the “frequent” list. Any deficiencies discovered must be carefully examined and a determination made as to whether they constitute a safety hazard.

- Deformed, cracked, or corroded members in the crane structure and boom.
- Loose bolts or rivets.
- Cracked or worn sheaves and drums.
- Worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers, and locking devices.
- Excessive wear on brake and clutch system parts, linings, pawls, and ratchets.
- Load, boom angle and other indicators over their full range, for any significant inaccuracies.
- Gasoline, diesel, electric, or other power plants for improper performance or noncompliance with safety requirements.
- Excessive wear of chain-drive sprockets and excessive chain stretch.
- Crane hooks for cracking.
- Travel steering, braking, and locking devices for malfunction.
- Excessively worn or damaged tires.
- Hydraulic and pneumatic hose, fittings, tubing, pumps, motors, cylinders, and filters.

**Cranes not in regular use**

**One through five months**
A crane which has been idle for one month or more, but less than six months, must have an inspection covering at least the items listed for a “frequent” inspection plus a rope inspection before it can be put in service.

All rope which has been idle for a period of a month or more due to shutdown or storage of the crane must have a thorough inspection before it is used. An appointed or authorized person whose approval is required for further use of the rope must inspect for all types of deterioration.

A certificate which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the rope which was inspected must be prepared and kept readily available.

**Over six months**
A crane which has been idle for six months must be given a complete inspection covering the requirements for both frequent and periodic inspections plus a rope inspection before it can be put into service.

All rope which has been idle for a period of a month or more due to crane shutdown or storage must have a thorough inspection before it is used. An appointed or authorized person whose approval is required for further use of the rope must inspect for all types of deterioration.

A certificate which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the rope which was inspected must be prepared and kept readily available.

**Standby cranes**
Standby cranes must be inspected at least semi-annually. The inspection must cover the items listed for a frequent inspection and a rope inspection. Cranes which are exposed to adverse environment should be inspected more frequently.

All rope which has been idle for a period of a month or more due to crane shutdown or storage must have a thorough inspection before it is used. An appointed or authorized person whose approval is required for further use of the rope must inspect for all types of deterioration.

A certificate which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the rope which was inspected must be prepared and kept readily available.

**Inspection records**
Inspection of critical items such as brakes, crane hooks, ropes, hydraulic and pneumatic cylinders, and relief pressure valves must be made monthly. Certification records must include:

- Date of inspection,
- Signature of the person who performed the inspection,
- Serial number or other identifier.
- Keep this certification record on file and readily available.

**Testing**

**Manufacturer’s tests**
All newly-produced cranes must be tested by the manufacturer for proper operation of:

- Load hoisting and lowering mechanisms,
- Boom hoisting and lowering mechanisms,
Swinging mechanism,
Travel mechanism, and
Safety devices.

When the complete crane is not supplied by one manufacturer, the tests have to be conducted at final assembly and the certified results made available.

**On-the-job operational tests**

Prior to daily use on the job, the crane’s accessories that facilitate operation must be checked following the crane manufacturer’s recommended procedures to ensure proper functioning. If any accessories are not functioning correctly, follow the manufacturer’s directions until the problems are corrected.

If the crane or one of its elements is not functioning properly, first try to find a solution in the operating manual. If the manual does not contain a recommendation, consult the manufacturer.

**Rated load tests**

Prior to initial use, cranes that have had load sustaining parts altered, replaced, or repaired (except ropes) should be loaded-tested by a qualified person. A functional test made using a normal operating load should be made prior to putting the crane back in service. Written reports must be available showing test procedures and confirming that repairs or alterations are adequate.

Test loads may not exceed 110 percent of the rated load at any selected working radius. Where rerating is necessary:

- Test crawler, truck, and wheel-mounted cranes according to SAE Recommended Practice, Crane Load Stability Test Code J765 (April 1961).
- Test locomotive cranes according to §1910.180(c)(1) (i) and (ii).
- Make rerating test report readily available.

No cranes may be rerated in excess of the original load ratings, unless the rating changes are approved by the crane manufacturer or final assembler.

**Rope inspections**

The ropes used on cranes must be of a type recommended by either the crane manufacturer or by a qualified person. Never use rotation resistant ropes or fiber core ropes for boom hoisting reeving. Ropes that are exposed to temperatures greater than 180° F must have an independent wire-rope, wire-strand core, or similar temperature damage-resistant core.

Sheave grooves must be kept free from surface defects that could damage the rope. Be sure that sheave bearings are adequately lubricated. Hook and ball assemblies and load blocks must be marked with their rated capacity and weight. Hooks must have latches, unless impractical.

**Running ropes**

Setting up a long-range inspection program for crane ropes will ensure that damaged or deteriorating ropes will be spotted and replaced and a potentially serious incident avoided. After several years of recording inspection results, you will begin to see a pattern of wear and rope conditions associated with use. This will enable you to judge when replacements are necessary.

OSHA requires that a thorough inspection of all running ropes in use be made at least once a month, and the ANSI B30.5 standard recommends that all running ropes be visually inspected frequently, that is once each working day. Both OSHA and ASME require that the inspections be performed by qualified/authorized personnel.

When ropes are inspected, OSHA further requires documentation of the inspection which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the ropes. Keep the inspection report on file where it is readily available.
Any deterioration resulting in appreciable loss of original strength must be carefully observed and determination made as to whether further use of the rope would constitute a safety hazard. Some of the conditions that could result in an “appreciable” loss of strength include:

- Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.
- A number of broken outside wires and the degree of distribution of concentration of broken wires.
- Worn outside wires.
- Corroded or broken wires at end connections.
- Corroded, cracked, bent, worn, or improperly applied end connections.
- Severe kinking, crushing, cutting, or unstranding.

When an inspection determines that the rope has met one of the removal criteria, it must be replaced. Based on the judgment of a qualified person, it may be replaced at the end of a workshift, end of the work day, or prior to it being used again.

Other ropes

Heavy wear and/or broken wires may occur in sections in contact with equalizer sheaves or other sheaves where rope travel is limited, or with saddles. Particular care has to be taken to inspect rope at these locations, as well as nonrotating rope in any location.

All rope which has been idle for a month or more due to shutdown or storage of a crane on which it is installed must be given a thorough inspection for all types of deterioration before it is used. The inspection must be performed by an appointed or authorized person whose approval is required for further use of the rope. A certification record which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the rope which was inspected must be prepared and kept readily available.

Maintenance

It’s a good idea to implement a preventive maintenance program based on the manufacturer’s recommendations and to keep detailed records of maintenance done to the equipment. Use replacement parts from the crane’s manufacturer whenever possible.

All moving parts that require lubrication should be lubricated on a routine basis. In most instances, the crane must be stationary while lubricants are being applied. Check lubricating systems to ensure the lubricant is being properly delivered.

Routine maintenance procedures

Prior to any maintenance procedure, take the following precautionary steps to lockout the equipment and render it inoperable:

- Move the crane to a place where it will not interfere with other equipment or operations;
- Set all controls in the “off” position and secure all operating features;
- Secure the starting control to make it inoperative;
- Stop or disconnect the power plant;
- Lower the boom and load block to the ground or secure them from dropping; and
- Relieve hydraulic oil pressure.

After these steps have been taken and before maintenance work begins, post “Warning” or “Out of order” signs on the crane controls. For locomotive cranes, follow the “blue flag protection” procedure. Only authorized persons may remove the postings and/or flags when the work is completed.
After adjustments and repairs have been made, the crane may not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.

Adjustments and repairs
When an inspection uncovers a hazard, it must be corrected before the crane may be operated. Adjustments and repairs, done only by designated personnel, must be made within the manufacturer’s specified tolerances.

Replacement parts must have at least the original design factor.

Adjustments
Examples of adjustments that must be maintained to assure correct functioning of crane components include:

- All functional operating mechanisms,
- Accessories and limit switches,
- Control systems,
- Brakes, and
- Power plants.

Repairs
Following are examples of repairs and replacements:

- Operating mechanism’s critical parts that are cracked, bent or broken, corroded, or worn;
- Structural parts that are cracked, bent, broken, or corroded; and
- Damaged or worn hooks (repair by welding or reshaping is not recommended).

After adjustments and repairs have been made, the crane may not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.

Rope maintenance procedures
Rope should be stored in a way that prevents damage or deterioration. When rope is uncoiled, use care to avoid kinking or twisting. Avoid dragging rope through dirt or in material that may scrape, crush, or bend the strands. Lubrication reduces internal friction and prevents corrosion. Lubricate ropes routinely, as part of your overall maintenance program.

Operator training
Crane operators have to be trained before initial assignment and regularly thereafter. However, they are not the only personnel involved in crane operations that should receive training. Include the signal and ground persons, lift directors, and riggers in any training. That way, the whole crew will understand all crane operations and how their role relates to the other members of the crew.

When operating any type of equipment, it is essential for the operator to remain focused on the task at hand and not take unnecessary risks or short cuts. Because of the potential hazards inherent to heavy equipment such as cranes, this is particularly true for crane operators. These workers must be both emotionally stable and physically fit to conduct themselves responsibly on the job.

OSHA requires that only designated personnel be permitted to operate locomotive and truck cranes. It goes no further to explain what “designated” encompasses. However, the ASME B30.5 standard has quite specific criteria, some of which is covered in the following section. For the full list of criteria, see the ANSI/ASME B30.5 standard.

Operational requirements
As specified in the ASME B30.5 Safety Code for Crawler, Locomotive, and Truck Cranes, operators have to be trained for the type of crane they will be operating. Only qualified, designated persons,
trainees having direct supervision, and maintenance and test personnel may enter the crane cab. Potential operators must pass a written or oral exam and practical operating examination.

Operators who are physically capable of performing the job must, among other things, demonstrate proficiency in handling the specific type of crane, including:

- Pre-start and post-start inspections,
- Maneuvering skills,
- Shutdown, and
- Securing procedures.

Requalification may be done if deemed necessary by a supervisor.

**Physical requirements**

According to ASME B30.5, potential operators must be physically fit, including having the:

- Ability to distinguish colors;
- Ability to hear with or without a hearing aid;
- Strength, endurance, agility, coordination, and reaction speed to meet the rigors of crane operation; and
- Having normal depth perception and field of vision.

Crane operators must have a physical examination at least every three years. A potential operator may be disqualified based on certain physical conditions or failing a drug test. For a complete list of physical requirements, see the B30.5 standard.

**Manufacturer’s guidelines**

The crane manufacturer is required to furnish a user’s manual containing general and specific operating instructions and information about installation, inspection, testing, lubrication, and maintenance of the crane. Employees with crane responsibilities should be familiar with the information in the manual.

**Fire extinguishers**

Because a carbon dioxide, dry chemical, or equivalent fire extinguisher must be kept in the cab or vicinity of the crane, operators and maintenance personnel have to be trained in the use and care of the extinguishers.

**Safety measures**

Only thoroughly trained and competent workers should operate cranes. Operators need to know what they are lifting and what it weighs.

For example, the rated capacity of mobile cranes varies with the length of the boom and the boom radius. When a crane has a telescoping boom, a load may be safe to lift at a short boom length or a short boom radius, but may overload the crane when the boom is extended and the radius increases.

**Crane operator’s basic safety rules**

1. Know the equipment you’re working with.
2. Know the load and the radius.
3. Understand and interpret load charts.
4. Use proper rigging practices.
5. Inspect and monitor all critical equipment regularly.
6. Stay clear of electrical power lines.
7. Be aware of all surrounding hazards and obstructions.
8. Never walk under a raised load.
9. Secure and restrict access to the lift area.
10. When you’re unsure or just don’t know, stop and ask.

**Glossary of terms for crawler, locomotive, and truck cranes**

An accessory is a secondary part or assembly of parts which contributes to the overall function and usefulness of a machine.

An angle indicator (boom) is an accessory which measures the angle of the boom to the horizontal.

The axis of rotation is the vertical axis around which the crane superstructure rotates.
Axle means the shaft or spindle with which or about which a wheel rotates. On truck- and wheel-mounted cranes it refers to an automotive type of axle assembly including housings, gearing, differential, bearings, and mounting appurtenances.

Axle (bogie) means two or more automotive-type axles mounted in tandem in a frame so as to divide the load between the axles and permit vertical oscillation of the wheels.

The base (mounting) is the traveling base or carrier on which the rotating superstructure is mounted such as a car, truck, crawlers, or wheel platform.

The boom (crane) is a member hinged to the front of the rotating superstructure with the outer end supported by ropes leading to a gantry or A-frame and used for supporting the hoisting tackle.

The boom angle is the angle between the longitudinal centerline of the boom and the horizontal. The boom longitudinal centerline is a straight line between the boom foot pin (heel pin) centerline and boom point sheave pin centerline.

The boom hoist is a hoist drum and rope reeving system used to raise and lower the boom. The rope system may be all live reeving or a combination of live reeving and pendants.

The boom stop is a device used to limit the angle of the boom at the highest position.

A brake is a device used for retarding or stopping motion by friction or power means.

A cab is a housing which covers the rotating superstructure machinery and/or operator’s station. On truck-crane trucks a separate cab covers the driver’s station.

The clutch is a friction, electromagnetic, hydraulic, pneumatic, or positive mechanical device for engagement or disengagement of power.

The counterweight is a weight used to supplement the weight of the machine in providing stability for lifting working loads.

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

The drum is the cylindrical members around which ropes are wound for raising and lowering the load or boom.

Dynamic (loading) means loads introduced into the machine or its components by forces in motion.

The gantry (A-frame) is a structural frame, extending above the superstructure, to which the boom support ropes are reeved.

A jib is an extension attached to the boom point to provide added boom length for lifting specified loads. The jib may be in line with the boom or offset to various angles.
Load (working) means the external load, in pounds, applied to the crane, including the weight of load-attaching equipment such as load blocks, shackles, and slings.

Load block (upper) means the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended from the boom point.

Load block (lower) means the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended by the hoisting ropes.

A load hoist is a hoist drum and rope reeving system used for hoisting and lowering loads.

Load ratings are crane ratings in pounds established by the manufacturer in accordance with paragraph (c) of this section.

Outriggers are extendable or fixed metal arms, attached to the mounting base, which rest on supports at the outer ends.

Rail clamp means a tong-like metal device, mounted on a locomotive crane car, which can be connected to the track.

Reeving means a rope system in which the rope travels around drums and sheaves.

Side loading means a load applied at an angle to the vertical plane of the boom.

A standby crane is a crane which is not in regular service but which is used occasionally or intermittently as required.

A standing (guy) rope is a supporting rope which maintains a constant distance between the points of attachment to the two components connected by the rope.

Structural competence means the ability of the machine and its components to withstand the stresses imposed by applied loads.

Superstructure means the rotating upper frame structure of the machine and the operating machinery mounted thereon.

Swing means the rotation of the superstructure for movement of loads in a horizontal direction about the axis of rotation.

Swing mechanism means the machinery involved in providing rotation of the superstructure.

Tackle is an assembly of ropes and sheaves arranged for hoisting and pulling.

Transit means the moving or transporting of a crane from one jobsite to another.

The travel mechanism is the machinery involved in providing travel.

Wheelbase means the distance between centers of front and rear axles. For a multiple axle assembly the axle center for wheelbase measurement is taken as the midpoint of the assembly.

The whipline (auxiliary hoist) is a separate hoist rope system of lighter load capacity and higher speed than provided by the main hoist.

A winch head is a power driven spool for handling of loads by means of friction between fiber or wire rope and spool.
Derricks

Introduction
A derrick is a lifting apparatus consisting of a mast held at the head by guys or braces, with or without a boom, for use with a hoisting mechanism and operating ropes. Derricks may be installed for temporary use, as in construction work.

Different types of derricks covered by OSHA’s Derrick standard at §1910.181 include guy, stiffleg, basket, breast, gin pole, Chicago boom, and A-frame derricks of the stationary type. These derricks are capable of handling loads at variable reaches and powered by hoists through systems of rope reeving. They are used to perform lifting hook work, single or multiple line bucket work, grab, grapple, and magnet work. The OSHA standard also applies to any modification of these types which retain their fundamental features, except for floating derricks.

All new derricks constructed and installed after August 31, 1971, have to meet the design specifications of the ANSI standard for derricks, ANSI B30.6-1969.

Derrick cabs or operating enclosures

Storage
Necessary clothing and personal belongings must be stored so they don’t interfere with access or operation. Tools, oil cans, waste, extra fuses, and other articles must be stored in the toolbox. Never leave these articles loose in the cab or operating enclosure.

Fire extinguishers
A carbon dioxide, dry chemical, or equivalent fire extinguisher must be kept in the immediate vicinity of the derrick. Operating and maintenance personnel must be trained in the use and care of the fire extinguishers provided.

Refueling
Refueling using portable containers may be done with approved safety type cans equipped with an automatic closing cap and a flame arrester. Machines may not be refueled with the engine running.

Markings and warnings

Load ratings for permanent installations
For permanently installed derricks with fixed lengths of boom, guy, and mast, a substantial, durable, and clearly legible rating chart must be provided. The rating chart has to be securely mounted where it is visible to personnel responsible for the safe operation of the equipment. The chart must include the following data:

- Manufacturer’s approved load ratings at corresponding ranges of boom angle or operating radii;
- Specific lengths of components on which the load ratings are based; and
- Required parts for hoist reeving. Rope size and construction may be shown either on the rating chart or in the operating manual.

Load ratings for temporary installations
For nonpermanent installations, the manufacturer must provide sufficient information from which capacity charts can be prepared for the particular installation. The capacity charts have to be kept at the derricks or the jobsite office.

Guarding moving parts
Exposed moving parts, such as gears, ropes, setscrews, projecting keys, chains, chain sprockets, and reciprocating components which constitute a hazard under normal operating conditions, must be guarded. Ensure that the guards are securely fastened.

Each guard must be capable of supporting (without permanent distortion) the weight of a 200-pound person, unless the guard is located where it is impossible for a person to step on it.
Load handling
Derrick operations may be directed only by the individual specifically designated for that purpose. Never load a derrick beyond the rated capacity. When loads approach the maximum rating of the derrick, be sure that the weight of the load has been determined within plus or minus 10 percent before it is lifted.

Hooks
Hooks must meet the manufacturer’s recommendations and may not be overloaded. Use safety latch type hooks wherever possible.

Attaching the load
Attach the load to the hook by means of slings or other suitable devices. Prior to the move, be sure that the hoist rope is not wrapped around the load.

Moving the load
Secure and balance the load in the sling or lifting device before it is lifted more than a few inches.

Before starting to hoist, ensure that:

- Hoist rope is not kinked.
- Multiple part lines are not twisted around each other.
- The hook is brought over the load in such a way as to prevent swinging.

During hoisting, ensure that:

- There is no sudden acceleration or deceleration of the moving load, and
- The load does not contact any obstructions.

Do not use a derrick for side loading, except when specifically authorized by a responsible person who has determined that the structural components will not be overstressed.

Never hoist, lower, or swing the load while anyone is on the load or hook and avoid carrying loads over people. Ensure that the boom and hoisting rope systems are not twisted.

The derrick operator must test the brakes each time a load approaching the rated load is handled by raising it a few inches and applying the brakes. Neither the load nor boom may be lowered below the point where less than two full wraps of rope remain on their respective drums.

When rotating a derrick, avoid sudden starts and stops. Maintain a rotational speed which ensures that the load will not swing out beyond the radius at which it can be controlled.

Holding the load
The operator may not leave his or her position at the controls while the load is suspended. Also, while the load is suspended, do not allow personnel to stand or pass under the load. If the load has to remain suspended for any considerable length of time, a dog, or pawl and ratchet, or other equivalent means (rather than the brake alone) must be used to hold the load.

Winch heads
Ropes must not be handled on a winch head without the knowledge of the operator. While a winch head is being used, the operator has to remain within convenient reach of the power unit control lever.

Securing boom
Engage dogs, pawls, or other positive holding mechanism on the hoist. When not in use, the derrick boom has to be:

- Laid down;
• Secured to a stationary member, as nearly under the head as possible, by attachment of a sling to the load block; or

• Hoisted to a vertical position and secured to the mast.

**Derrick inspections**

**Initial inspection**

All new and altered derricks must be inspected prior to initial use. Inspection procedures for derricks in regular service are divided into two general classifications, based on the intervals at which inspection should be performed. The intervals — frequent and periodic — depend on the nature of the crane’s critical components and the degree of their exposure to wear, deterioration, or malfunction.

• Frequent inspection — daily to monthly intervals.

• Periodic inspection — one to 12 month intervals.

**Frequent inspections**

Items such as the following must be inspected for defects as indicated, including observation during operation for any defects which might appear between regular inspections. Deficiencies must be carefully examined for any safety hazard.

**Daily**

- All control mechanisms for adjustment, wear, and lubrication; tension in guys; deterioration or leakage in air or hydraulic systems.

- Hoist brakes, clutches, and operating levers — check for proper functioning before beginning operations.

- Plumb of the mast.

- Derrick hooks for deformations or cracks; hooks with cracks or having more than 15 percent in excess of normal throat opening, or more than 10° twist from the plane of the unbent hook.

- Electrical apparatus for malfunctioning; signs of excessive deterioration, dirt, and moisture accumulation.

**Daily, visually**

- All chords and lacing; rope reeving — visual inspection for noncompliance with derrick manufacturer’s recommendations.

**Periodic inspections**

Complete derrick inspections must be performed at one to 12 month intervals, depending on the activity, severity of service, and environment. Be sure to include foundation or supports in the inspection to ensure their continued ability to sustain the imposed loads. Examine any deficiencies found during the inspection to determine if they constitute a safety hazard. Derrick inspections must include the items listed for “frequent” inspections in addition to the following:

- Structural members for deformations, cracks, and corrosion.

- Bolts or rivets for tightness.

- Parts such as pins, bearings, shafts, gears, sheaves, drums, rollers, locking and clamping devices, for wear, cracks, and distortion.

- Gudgeon pin for cracks, wear, and distortion each time the derrick is to be erected.

- Power plants for proper performance and compliance with applicable safety requirements.
Hooks.

**Derricks not in regular use**

*One through six months*
A derrick which has been idle for one month or more, but less than six months, must be given an inspection covering the items listed for frequent and periodic inspections before being placed into service.

*Over six months*
A derrick which has been idle for over six months must be given a complete inspection covering the items listed for frequent and periodic inspections. Additionally, all rope which has been idle for a month or more due to shutdown or storage of a derrick on which it is installed must be given a thorough inspection before it is used. Inspect for all types of deterioration. Document the inspection and keep it readily available. The certification must include:

- Date of inspection,
- Signature of the person who performed the inspection, and
- An identifier for the ropes which were inspected.

*Standby derricks*
Standby derricks must be inspected at least semi-annually covering the items listed for frequent and periodic inspections. Additionally, all rope which has been idle for a month or more due to shutdown or storage of a derrick on which it is installed must be given a thorough inspection before it is used. Inspect for all types of deterioration. Document the inspection and keep it readily available. The certification must include:

- Date of inspection,
- Signature of the person who performed the inspection, and An identifier for the ropes which were inspected.

**Operational tests**
Prior to initial use, test all new and altered derricks for at least the following functions:

- Load hoisting and lowering,
- Boom up and down,
- Swing, and
- Operation of clutches and brakes of hoist.

Also, all anchorages must be approved by the appointed person. Rock and hairpin anchorages may require special testing.

**Rope inspections**

**Running ropes**
A thorough inspection of all ropes in use must be made at least once a month. Prepare a certification record and keep it on file where readily available. This certification must include:

- Date of inspection,
- Signature of the person who performed the inspection, and
- An identifier for the ropes which were inspected.

Inspect for any deterioration resulting in appreciable loss of original strength and decide whether further use of the rope would constitute a safety hazard. Some of the conditions that could result in an appreciable loss of strength include:
• Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.

• A number of broken outside wires and the degree of distribution or concentration of such broken wires.

• Worn outside wires.

• Corroded or broken wires at end connections.

• Corroded, cracked, bent, worn, or improperly applied end connections.

• Severe kinking, crushing, cutting, or unstranding.

**Limited travel ropes**

Heavy wear and/or broken wires may occur at sections in contact with equalizer sheaves or other sheaves where rope travel is limited, or with saddles. Take particular care when inspecting ropes at these locations.

**Idle ropes**

All rope which has been idle for a month or more due to shutdown or storage of a derrick on which it is installed must be given a thorough inspection before it is used. Inspect for all types of deterioration. Prepare a certification record and kept readily available. The certificate must include:

• Date of inspection,

• Signature of the person who performed the inspection, and

• An identifier for the ropes which were inspected.

**Nonrotating ropes**

Take particular care in the inspection of nonrotating rope.

**Maintenance and repairs**

Keeping a derrick in safe operating condition requires preventive maintenance as well as timely repairs. Establish a preventive maintenance program based on the derrick manufacturer’s recommendations.

**Maintenance procedures**

Before adjustments and repairs are started on a derrick, take the following precautions:

• Place the derrick to be repaired in a location where it will cause the least interference with other equipment and operations in the area.

• Engage all hoist drum dogs.

• If an electric hoist is used, lock the main or emergency switch in the open position.

• Place “Warning” or “Out of order” signs on the derrick and hoist.

• Make boom repairs when the booms are lowered and adequately supported or safely tied off.

• Set up a good communication system between the hoist operator and the appointed individual in charge of derrick operations before any work on the equipment is started.

After adjustments and repairs have been made, the derrick may not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.

**Adjustments and repairs**

Correct any unsafe conditions disclosed by inspection before operation is resumed. Maintain all adjustments to assure correct functioning of components. Repairs or replacements must be provided promptly as needed for safe operation. The following conditions require prompt repair or replacement:
Glossary of terms for derricks

A-frame derrick means a derrick in which the boom is hinged from a cross member between the bottom ends of two upright members spread apart at the lower ends and joined at the top; the boom point secured to the junction of the side members, and the side members are braced or guyed from this junction point.

A basket derrick is a derrick without a boom, similar to a gin pole, with its base supported by ropes attached to corner posts or other parts of the structure. The base is at a lower elevation than its supports. The location of the base of a basket derrick can be changed by varying the length of the rope supports. The top of the pole is secured with multiple reeved guys to position the top of the pole to the desired location by varying the length of the upper guy lines. The load is raised and lowered by ropes through a sheave or block secured to the top of the pole.

Breast derrick means a derrick without boom. The mast consists of two side members spread farther apart at the base than at the top and tied together at top and bottom by rigid members. The mast is prevented from tipping forward by guys connected to its top. The load is raised and lowered by ropes through a sheave or block secured to the top crosspiece.

Chicago boom derrick means a boom which is attached to a structure, an outside upright member of the structure serving as the mast, and the boom being stepped in a fixed socket clamped to the upright. The derrick is complete with load, boom, and boom point swing line falls.

A gin pole derrick is a derrick without a boom. Its guys are so arranged from its top as to permit leaning the mast in any direction. The load is raised and lowered by ropes reeved through sheaves or blocks at the top of the mast.

Guy derrick means a fixed derrick consisting of a mast capable of being rotated, supported in a vertical position by guys, and a boom whose bottom end is hinged or pivoted to move in a vertical plane with a reeved rope between the head of the mast and the boom point for raising and lowering the boom, and a reeved rope from the boom point for raising and lowering the load.

Shearleg derrick means a derrick without a boom and similar to a breast derrick. The mast, wide at the bottom and narrow at the top, is hinged at the bottom and has its top secured by a multiple reeved guy to permit handling loads at various radii by means of load tackle suspended from the mast top.

A stiffleg derrick is a derrick similar to a guy derrick except that the mast is supported or held in place by two or more stiff members, called stifflags, which are capable of resisting either tensile or compressive forces. Sills are generally provided to connect the lower ends of the stifflags to the foot of the mast.

Appointed means assigned specific responsibilities by the employer or the employer’s representative.

A boom is a timber or metal section or strut, pivoted or hinged at the heel (lower end) at a location fixed in height on a frame or mast or vertical member, and with its point (upper end) supported by chains, ropes, or rods to the upper end of the frame, mast, or vertical member. A rope for raising and lowering the load is reeved through sheaves or a block at the boom point. The length of the boom shall be taken as the straight line distance between the axis of the foot pin and the axis of the boom point sheave pin, or where used, the axis of the upper load block attachment pin.
Boom harness means the block and sheave arrangement on the boom point to which the topping lift cable is reeved for lowering and raising the boom.

The boom point is the outward end of the top section of the boom.

Derrick bullwheel means a horizontal ring or wheel, fastened to the foot of a derrick, for the purpose of turning the derrick by means of ropes leading from this wheel to a powered drum.

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

Eye means a loop formed at the end of a rope by securing the dead end to the live end at the base of the loop.

A fiddle block is a block consisting of two sheaves in the same plane held in place by the same cheek plates.

The foot bearing or foot block (sill block) is the lower support on which the mast rotates.

A gudgeon pin is a pin connecting the mast cap to the mast allowing rotation of the mast.

A guy is a rope used to steady or secure the mast or other member in the desired position.

Load, working means the external load, in pounds, applied to the derrick, including the weight of load attaching equipment such as load blocks, shackles, and slings.

Load block, lower means the assembly of sheaves, pins, and frame suspended by the hoisting rope.

Load block, upper means the assembly of sheaves, pins, and frame suspended from the boom.

Mast means the upright member of the derrick.

Mast cap (spider) means the fitting at the top of the mast to which the guys are connected.

Reeving means a rope system in which the rope travels around drums and sheaves. Rope refers to wire rope unless otherwise specified.

Safety hook means a hook with a latch to prevent slings or load from accidentally slipping off the hook.

Side loading is a load applied at an angle to the vertical plane of the boom.

The sill is a member connecting the foot block and stiffleg or a member connecting the lower ends of a double member mast.

A standby derrick is a derrick not in regular service which is used occasionally or intermittently as required.

Stiffleg means a rigid member supporting the mast at the head.

Swing means rotation of the mast and/or boom for movements of loads in a horizontal direction about the axis of rotation.