

California Institute of Technology

CRANE AND HOIST SAFETY PLAN



Caltech Environmental Health and Safety Office
1200 E. California Blvd., M/C B125-6
Pasadena, CA 91125
Phone: 626.395.6727
Email: safety@caltech.edu
Website: safety.caltech.edu

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CRANE AND HOIST SAFETY PLAN

PURPOSE

The purpose of the Crane and Hoist Safety Plan is to define safe work practices and inspection procedures to help ensure that the operators of overhead cranes as well as the Caltech community are protected from potential hazards associated with the movement of equipment and material using a crane, hoist, and related equipment.

SCOPE

This Plan applies to Caltech faculty, staff, postdoctoral scholars, students, and visitors, including remote properties of the Institute that operate and use overhead cranes, hoists and associated lifting equipment.

This Plan is applicable to all overhead and gantry cranes, including semi-gantry, cantilever gantry, wall cranes, bridge cranes, electric hoists, manual hoists, pneumatic hoists, chains and slings, and other hoisting equipment that have similar fundamental characteristics.

OBJECTIVES

This Plan promotes compliance with applicable federal, state and local regulations, including:

- CCR TITLE 8 Group 13: Cranes and Hoisting Equipment
- OSHA 29 CFR 1910.179: Overhead and Gantry Cranes
- OSHA 29 CFR 1926.1400: Cranes and Derricks in Construction

The Crane and Hoist Safety Plan is intended to:

- Provide a safe work environment for personnel who operate, maintain, and/or work around cranes and hoists.
- Define inspection procedures for cranes, hoists, chains, slings, etc.
- Promote a safe environment for the Caltech community.

This Plan does not include the following:

- Mobile cranes
- Tower cranes
- Engine hoists
- Powered Industrial Trucks (PIT), Aerial Work Platforms, or other mobile equipment covered in other Institute programs

For cranes or industrial trucks used in construction, refer to the Institute [Contractor Safety Guide](#).

ROLES AND RESPONSIBILITIES

Division Responsibilities

- Require that any crane and hoist within their area of responsibility is inspected by a qualified person.

Supervisors

- Designate and identify qualified personnel to operate cranes, hoists, and slings within their area of responsibility.
- Verify that operators are qualified and have received proper training.
- Maintain cranes, hoists, and slings are maintained in proper working order and repaired or replaced when necessary.
- Confirm that scheduled inspections and testing are conducted as required.
- Enforce the requirements of the Plan are observed, particularly with respect to inspections.
- Establish and maintain an inspection record keeping system for those cranes and hoists within their responsibility, including the date of inspection, and the signature of the person who performed the inspection.

Crane / Hoist Operators

- Operate only equipment for which they are trained.
- Follow this Plan and applicable safety requirements for crane/hoist operation, inspection, and maintenance.
- Perform required inspections and complete associated documentation.
- Notify supervisor of identified deficiencies.
- Report all crane and hoist incidents to supervisor immediately.

Environmental Health and Safety (EH&S)

- Review the Crane and Hoist Safety Plan on a periodic basis and revise as necessary.
- Provide technical assistance regarding the regulatory requirements of cranes, hoists, chains, and slings.

DEFINITIONS

Brake – A device used to stop motion by friction or power means.

Bridge – The part of a crane consisting of girders, trucks, end ties, foot walks and a drive mechanism which carries the trolley(s).

Bridge Crane – Crane with bridge mounted on tracks which enables three-dimensional handling.

Bridge Travel – Crane movement in a direction parallel to the crane runway.

Bumper (Buffer) – 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.

Certificating Agency – Certificating agencies are qualified agencies, and/or persons, licensed by Cal/OSHA, within the Department of Industrial Relations, to examine, test and certify cranes and derricks in accordance with Sections 344.60 through 344.67 of Title 8 of the California Code of Regulations.

Certified Agent – The manufacturer, or a person who is currently registered as a professional civil, mechanical, or structural engineer by the State of California, and is knowledgeable in the structure and use of the equipment.

Chain Sprocket or Drum Groove – Grooved wheel in which the hoist rope or chain is seated.

Clearance – The distance from any part of the crane to a point of the nearest obstruction.

Come-Along – A mechanical device typically consisting of a chain, strap or cable attached at each end that is used to facilitate movement of materials by using a mechanical advantage.

Crane – A machine for lifting or lowering a load and moving it horizontally, in which the hoisting mechanism is an integral part of the machine.

It may be driven manually or by power and may be a fixed or a mobile machine, but does not include stackers, lift trucks, power shovels, backhoes, or excavators. Some of the common types of cranes are defined as follows:

- **Cantilever Gantry Crane** – A gantry or semi-gantry crane in which the bridge girders or trusses extend transversely beyond the crane runway on one or both sides.
- **Floor Operated Crane** – A crane which is pendant or nonconductive rope controlled by an operator on the floor or on an independent platform.
- **Gantry Crane** – A crane similar to an overhead traveling crane, except that the bridge for

carrying the trolley or trolleys is rigidly supported on two or more movable legs running on fixed rails or other track systems.

- **Overhead Traveling or Bridge Crane** – A crane on a pair of parallel elevated runways, adapted to lift and lower a load and carry it horizontally parallel to, or at right angles to, the runways or both; and consisting of one or more trolleys operating on the bridge which in turn consists of one or more girders or trusses mounted on trucks operating on the elevated runways, with its operation limited to the area between the runways.
- **Semi-Gantry or Single Leg Crane** – A gantry crane with one end of the bridge rigidly supported on one or more movable legs, running on a fixed rail or runway, the other end of the bridge being supported by a truck running on an elevated rail or runway.
- **Wall Crane** – A crane having jib with or without a trolley and supported from a side wall or line of columns of a building.

Critical lift – A critical lift is any lift that exceeds 75 percent of the rated capacity of the crane or hoisting equipment for the planned configuration, or any lift that requires the use of more than one crane or hoist, involves lifting personnel, or is otherwise designated critical due to increased risk.

Critical lift planning – All critical lifts shall be planned in advance and documented in a written Critical Lift Plan. The plan shall, at a minimum, identify the load and rigging weights, crane/hoist configuration and rated capacity, load path, ground and structural conditions, roles and responsibilities (including lift director, operator, rigger, and spotter), communication methods, and control measures for identified hazards. The Critical Lift Plan shall be reviewed and approved by the lift director (or other designated competent person) and communicated to all personnel involved in the lift before the lift begins.

Designated Person – A person selected or assigned by the employer or the employer's representative as being qualified to perform specific duties.

Fall Zone – The area (including but not limited to the area directly beneath the load) in which it is reasonably foreseeable that partially or completely suspended materials could fall in the event of an accident.

Hand-Held Hoist – Lever operated roller chain hoist.

Hoist – An apparatus for raising or lowering a load by the application of a pulling force, but does not include a car or platform riding in guides. Some common types of hoists are defined as follows:

- **Base-Mounted Electric Hoist** – A hoist similar to an overhead electric hoist, except that it has a base or feet and may be mounted overhead, on a vertical plane, or in any position for

which it is designed.

- **Clevis Suspension Hoist** – A hoist whose upper suspension member is a clevis: A U-shaped rigging connector with holes for a pin, which is used to fasten the hook to a bracket/chain.
- **Hook Suspension Hoist** – A hoist whose upper suspension member is a hook.
- **Monorail Hoist** – A hoist whose hoisting mechanism is suspended from one or more trolleys mounted on a single track.
- **Overhead Electric Hoist** – A motor-driven hoist having one or more drums or sheave (rotating, grooved wheel) for rope or chain and supported overhead. It may be fixed or traveling.
- **Simple Drum Hoist** – A hoist with one or more drums controlled by manually operated clutches, brakes, or ratchet and pawl on drum (mechanical device that lets a wheel or shaft move in one direction while preventing it from moving backward), and control levers, which is operated either manually or by a power source.

Hoist Chain – The load bearing chain in a hoist.

Hoisting – The act of raising, or lowering a load with equipment covered by this standard. As used in this standard, “hoisting” can be done by means other than wire rope/hoist drum equipment.

Hoisting Machine – A power operated machine used for lifting or lowering a load, utilizing a drum and wire rope, excluding elevators. This shall include but not be limited to a crane, derrick and cableway.

Hoist Motion – That motion of a crane which raises and lowers a load.

Limit Switch – A device designed to automatically cut off the power when a crane, trolley, hoist, or similar mechanism reaches, or is about to reach, the limit of its travel.

Load – The object(s) being hoisted and/or the weight of the object(s). Both uses refer to the object(s) and the load-attaching equipment, such as ropes, slings, shackles, and any other ancillary attachment as defined by the crane/derrick manufacturer.

Load Block (Lower) – The load carrying assembly of hook or shackle, swivel, sheaves, pins, and frame suspended by the hoisting ropes.

Load Block (Upper) – The fixed assembly of sheaves, pins, and frame suspended from the boom.

Operational Aid – An accessory that provides information to facilitate operation of a crane or that takes control of particular functions without action of the operator when a limiting condition is

sensed. These include, but are not limited to, the devices listed in [Section 5018](#).

Overhead Loads – Loads either passed or suspended directly over employee-occupied workspaces or passageways.

Pendant – A rope or strand of specified length with fixed end connections.

Qualified Evaluator – A person who is qualified, by way of training and/or experience, to accurately assess and perform crane inspections. This does not include certificated inspections for cranes over three tons.

Qualified Operator – A person who is qualified, by way of training and/or experience, to operate or work with and around cranes, hoists, and related equipment. This person can identify existing and potential hazards associated with the movement of equipment and material using a crane, hoist, and related equipment. This person is also given the authorization to take prompt corrective measures to eliminate those hazards associated with the movement of equipment and material using a crane, hoist and/or related equipment. This definition only applies to overhead and gantry cranes.

Qualified Person – A person who, by way of training and/or experience, has successfully demonstrated their ability to anticipate and recognize hazards involving the use of cranes/hoists.

Rated Capacity – The maximum working load permitted by the manufacturer under specified working conditions. Such working conditions typically include a specific combination of factors such as equipment configuration, radii, boom length, and other parameters of use.

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

Rope – Refers to wire rope, unless otherwise specified.

Runway – A firm, level surface designed, prepared and designated as a path of travel for the weight and configuration of the crane being used to lift and travel with the crane suspended platform. An existing surface may be used if it meets these criteria.

Safety Hook – A hook with a safety latch or arrangement to close the throat of the hook, in such manner as to prevent slings or load attachment from accidentally slipping off the hook.

Side Pull – The portion of a hoist pull acting horizontally when the hoist lines are not operated vertically.

Sling – Lifting devices such as chain, wire rope, metal mesh, fiber rope and synthetic web utilized to secure a load to be moved.

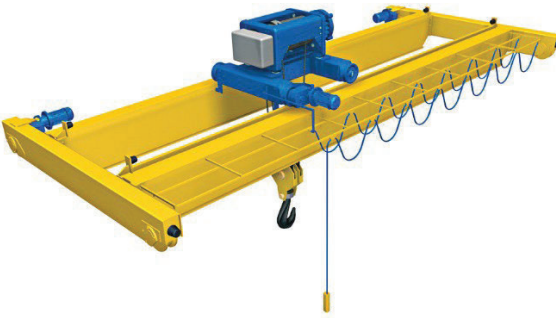
Tag Line – A rope attached to a lifted load for purposes of controlling load spinning and pendular motions or used to stabilize a bucket or magnet during material handling operations.

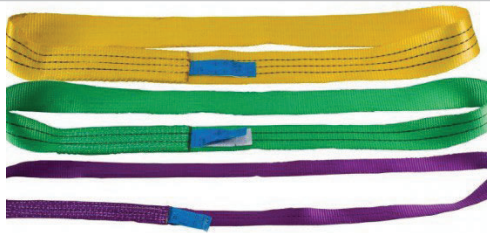
Trolley (For Overhead and Gantry Cranes) – A truck or carriage supporting the load mounted on an overhead beam, bridge, cableway or track.

Trolley Travel – The trolley movement at right angles to the crane runway.

Wire Rope – A flexible rope constructed by laying steel wires into various patterns of multi-wired strands around a core system to produce a helically wound rope to improve handling and avoid kinking.

TYPES OF CRANES/HOISTS/RIGGING

Gantry Cranes	Semi-Gantry Crane
	
Cantilever Gantry Crane	Wall Crane
	
Bridge Crane	Electric Overhead Hoist
	

Manual Hoist 	Pneumatic Powered Hoist 
Chain Slings 	Metal Mesh Sling 
Wire Rope Sling 	Fiber Rope Slings 
Synthetic Web Slings 	

INSPECTIONS

Cranes must be consistently inspected to prevent equipment failure, and to determine whether cranes and crane components can be expected to perform as intended. Crane and Hoist inspections are divided into six general classifications:

1. Initial Inspection
2. Frequent (Daily) Inspection
3. Periodic Inspection
4. Inspection of equipment not in regular use
5. Annual Inspection
6. Quadrennial Inspection

In addition, the inspection provisions as outlined in the manufacturer owner's manual specific to the equipment shall be followed.

All inspections shall be completed by a competent person (unless otherwise specified, such as for annual and quadrennial inspections). Deficiencies shall be corrected by a qualified person.

If any adjustments have to be made to the unit, the crane or crane components will not be operated until all the guards have been installed, all safety devices reactivated, and all maintenance equipment moved. If any defect is found, the crane will not be operated until the repair or the adjustment is complete.

Initial Inspection

New, re-installed, altered, repaired, or modified equipment shall be inspected prior to initial use to verify whether the crane or hoist can be expected to perform as intended.

The operational inspection shall include the following function tests, as applicable:

- a. Hoisting and lowering boom and load
- b. Trolley travel
- c. Bridge travel
- d. Hoist-limiting devices
- e. Travel-limiting devices
- f. Locking and indicating devices, if provided
- g. Swing mechanism

Frequent Inspections

Frequent (Daily) inspections shall be conducted prior to the first operation of the crane on any work shift.

Items that shall be inspected include:

1. Moving parts: Check all moving parts for wear or misalignment that could stop the crane from working correctly.
2. Hydraulic/air systems: Look at hoses, tanks, valves, and pumps for leaks, dirt, or damage, especially flexible hoses that move a lot.
3. Hydraulic fluid: Make sure hydraulic fluid is at the proper level.
4. Hooks and latches: Check for bending, cracks, excessive wear, or other damage.
5. Hoist chains and attachments: Inspect chains and their connectors for wear, twisting, stretching, or damage that could affect lifting.
6. Wire ropes and slings: Look for worn, broken, kinked, twisted, or stretched wire ropes and slings, including end connections.
7. Rope setup: Make sure wire ropes are installed according to the manufacturer's instructions.
8. Electrical components: Check for malfunction, signs of damage, dirt, or moisture on electrical parts.
9. Tires (if used): Make sure tires are properly inflated and in good condition if they support the crane.
10. Leveling: Make sure the crane is level within manufacturer's tolerances — check before each shift and after moving or setting up the crane.
11. Cab windows: Make sure operator windows aren't cracked or broken so visibility isn't impaired.
12. Safety devices and aids: Make sure all safety systems and operational aids are working properly.
13. Limit switches: Test all limit switches to make sure they work, even with no load on the hook.

Periodic Inspections

Periodic inspections shall be conducted by a qualified evaluator, and equipment shall be inspected at least four times a year. These periodic inspections shall be evenly spaced throughout the year, or as close as scheduling permits. Cranes shall not be operated for more than 750 hours between periodic inspections.

Periodic inspections shall be documented, and the most recent inspection kept on file. The following shall be documented:

- Date

- Name and signature of the person who conducted the inspection
- Asset number/serial number of the crane that was inspected
- Components inspected
- If there were any findings

Items that shall be inspected include all the items as part of the *Frequent Inspections*, in addition to the following:

1. Check all moving and working parts of the crane to make sure they are not worn out or damaged.
2. Inspect parts that wear down over time, and ensure they are in good condition, such as:
 - a. Cables/ropes
 - b. Brakes
 - c. Clutches
 - d. Chains
 - e. Other similar components

Inspection of Cranes Not in Regular Use

Equipment which has been idle for three months or more, shall be inspected before being placed back into service. The inspection shall follow the requirements of a *Periodic Inspection*.

All rope which has been idle for one month or more due to shutdown or storage of a crane, shall be thoroughly inspected before it is placed back into service.

Equipment Over Three Tons Rated Capacity

All cranes that have a load rating of over three tons must be certified by a licensed certifying agency. This equipment must undergo an annual inspection and a quadrennial inspection/load testing by a licensed certifying agency, and a compliance certificates (Plate V) must be maintained for each crane.

Annual Inspection

Annual inspections shall be completed by a certificated agency. This annual inspection shall be done before the anniversary date of the last quadrennial inspection. The certificate (Plate V) shall be documented and kept on file for at least 4 years.

Quadrennial Inspection

Quadrennial inspections include an in-depth inspection of the crane and all components, a proof load test, and re-certification. Once inspection and load testing are complete, the certifying

agency will issue the certificate on a Plate V form. This form should be documented until the next quadrennial inspection is completed.

Proof Load Testing

For cranes over three tons, proof load testing shall be conducted for all new equipment prior to initial use, and after major modifications or repairs to important structural components are completed, and before they are returned to service. Proof load testing shall also be conducted every four years, as part of the quadrennial inspection.

Proof load test requirements:

- a. For boom equipped cranes, proof loads shall be based on the manufacturer's load ratings and consist of a proof load as large as possible, but not exceeding 110% of the maximum load ratings. Loads shall be applied at the designed maximum and minimum boom angles.
- b. Trolley equipped monorail cranes and overhead cranes shall be tested to a proof load as close as possible, but not exceeding 125% of the manufacturer's load rating. They must be tested by traversing the proof load the full length of the track, bridge/runway(s) and cross-overs, in all directions capable of operation, where practicable.
- c. During a load test, the authorized certificating agent shall prepare a written report of the load sustained during the test and the operations performed during the test. Reports shall be placed on file for that particular crane or hoist(s) and retained at least 48 months for annual/quadrennial exams.

Sling Inspection – General

Each day before use, the sling and all fastenings and attachments shall be inspected for damage or defects by a competent person. Additional inspections shall be performed during sling use where service conditions warrant. Damaged or defective slings shall be immediately removed from service, tagged, and turned into supervisor for proper destruction and disposal.

Wire Rope Sling Inspection

A wire rope sling shall be removed from service if conditions such as the following are present:

- Missing or illegible sling identification.
- Broken wires:
 - For strand-laid and single-part slings, 10 randomly distributed broken wires in one

- rope lay, or 5 broken wires in one strand in one rope lay.
- For cable-laid slings, 20 broken wires per lay.
- For less than eight-part braided slings, 20 broken wires per braid.
- For eight-part or more than eight braided slings, 40 broken wires per braid.
 - Severe localized abrasion or scraping.
 - Kinking, crushing, bird caging, or any other damage is noted.
 - Corrosion of the rope or end attachments.
 - Evidence of heat damage.
 - End attachments are cracked, deformed or worn.
 - Evidence of hook removal criteria as defined in the Frequent Inspection section of this Plan.
 - Other conditions, including visible damage, cause doubt as to their integrity.

Alloy Steel Chain Slings

An alloy steel chain sling shall be removed from service if conditions such as the following are present:

- Missing or illegible sling identification.
- Cracks or breaks.
- Excessive wear, nicks, or gouges.
- Stretched chain links or components.
- Bent, twisted, or deformed chain links or components.
- Evidence of heat damage.
- Excessive pitting or corrosion.
- Lack of ability of chain or components to hinge (articulate) freely.
- Weld splatter.
- Evidence of hook removal criteria as defined in the Frequent Inspection section of this Plan.
- Other conditions, including visible damage, that cause doubt as to their integrity.

Synthetic Web Sling Inspection (Typically Nylon or Polyester)

A synthetic web or round sling shall be removed from service if conditions such as the following are present:

- Missing or illegible sling identification.
- Acid or caustic burns.
- Melting or charring of any part of the sling.
- Holes, tears, cuts, or snags.
- Broken or worn stitching in load bearing splices.

- Weld splatter that exposes core yarns.
- Excessive abrasive wear.
- Knots in any part of the sling.
- Discoloration & brittle or stiff areas on any part of the sling, may mean chemical or ultraviolet/sunlight damage.
- Fittings that are pitted, corroded, cracked, bent, twisted, gouged, or broken.
- Evidence of hook removal criteria as defined in the Frequent Inspection section of this Plan.
- Other conditions, including visible damage, that cause doubt as to the safety of their continued use.

Natural and Synthetic Fiber Rope Sling Inspection

Each sling should be marked or coded to show the rated capacities for each type of hitch and type of material. Fiber rope slings should not be spliced in any manner. Natural and synthetic fiber rope slings shall be immediately removed from service if there is:

- Abnormal wear.
- Powdered fiber between strands.
- Variation in the size or roundness of strands.
- Discoloration or rotting.
- Distortion of hardware in the sling.
- Any other conditions, including visible damage, that cause doubt as to the safety of their continued use.

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

Metal Mesh Sling Inspection

A metal mesh sling shall be removed from service if any condition such as the following is present:

- Missing or illegible sling identification.
- Broken weld or a broken brazed joint along the sling edge.
- Broken wire in any part of the mesh.
- Reduction in wire diameter of 25% due to abrasion or 15% due to corrosion.
- Lack of flexibility due to distortion of the mesh.
- Distortion of the choker fitting so the depth of the slot is increased by more than 10%.
- Distortion of either end fitting so the width of the eye opening is decreased by more than 10%.
- A 15% reduction of the original cross-sectional area of any point around the hook opening

of the end fitting.

- Visible distortion of either end fitting out of its plane.
- Cracked end fitting.
- Spirals that are locked or without free articulation.
- Fitting that are pitted, corroded, cracked, bent, twisted, gouged, or broken.
- Any other conditions, including visible damage, that cause doubt as to the safety of their continued use.

OPERATING PROCEDURES

Operator Qualifications

The operator of overhead cranes shall be designated by their appropriate division/department and must be thoroughly trained in the safe operation of cranes/hoisting equipment. Trainees are authorized to operate cranes/hoisting equipment only when under the direct supervision of a qualified operator.

Rated Load Marking

The rated load of the crane/hoisting equipment shall be plainly marked on each side of the crane.

- These markings shall be clearly legible from the floor or ground.
- The load shall never exceed the rated load of the crane or hoist or attachment equipment, except during the load test procedures as noted in the Initial Inspection section of this Plan.
- Safe working load reduction may only be done by a certificated agency. This shall only be done if the equipment never utilizes more than a fraction of the safe working load rating and shall not be done for the sole purpose of avoiding correction of any deficiency. The new rated load shall be displayed in accordance with this section.

General

When operating cranes/hoisting equipment, full attention shall be given to the task being performed (e.g., no use of headsets, music, or other distractions). The operator shall ensure that signals used during the lift are understood and followed by all involved. See the [Uniform Hand Signal](#) section below.

If a crane/hoist has been locked and tagged out, only the authorized employee who placed the lock and/or tag is authorized to remove it. See the [Lockout/Tagout Program](#) for more information.

- No personnel shall be allowed to walk or be under a suspended load.
- All employees who handle wire slings and hoist cables shall wear leather gloves to prevent

any hand injury.

- Proper guards must be in place for exposed gears, belts, electrical equipment, couplings and fans.
- Suspended loads shall be kept clear of all unnecessary obstructions and personnel.
- Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load.
- Shock loading (a sudden, rapid and abrupt increase in the load on the lifting system beyond the normal gradual/static load) is prohibited.
- A sling shall not be pulled from under a load when the load is resting on the sling.

Rigging the Load

A rigger shall be a qualified person who has been trained and capable of safely performing rigging operations. Riggers shall accurately determine the weight of the load and ensure crane weight limitations are not exceeded (except when load testing) and determine the appropriate size and number of slings and associated components. The qualified operator must be familiar with the appropriate rigging and hoisting techniques to safely move a load.

- Ensure slings and hooks are in proper working condition with no excessive wear as determined in the inspection.
- Slings shall be securely attached to their loads.
- Slings shall not be loaded in excess of their rated capacities.
- Sharp edges on loads being lifted/lowered shall be padded to prevent wearing on slings.
- Slings used in a basket hitch shall have the loads balanced to prevent slippage.
- The hoist chain or hoist rope shall be free of kinks or twists.
- Slings shall not be shortened with knots, belts or other makeshift devices.
- Hoist chains or ropes shall not be wrapped around the load.
- Hoist chain or ropes shall be free from kinks or twists.
- The load shall be attached to the load block hook by means of slings or other approved devices.
- Determine the center of gravity of the load and ensure rigging maintains the load level during movement.
- Once slings are in place, lift the load only slightly off the ground to test the rigging and balance; re-work the rigging if necessary.
- Use a tag line when loads must traverse long distances or be otherwise controlled.
- Prior to lifting the load, the operator shall make certain that the load, sling, attachments, lifting devices and the load block are unobstructed.

Lifting and Lowering a Load

Overhead cranes shall only be operated by a qualified operator. Use a dedicated spotter if the load is out of view from the operator or there are conditions that warrant assistance (power lines, pedestrians, etc.). If a lift exceeds 75% of the rated capacity of the crane or hoisting equipment or requires the use of more than one crane or hoist, it is deemed as a critical lift, as defined in this Plan. Critical lifts shall be planned, documented in writing, and approved by the lift director prior to lifting operations. The person responsible for directing the lift shall make sure that the load is properly secured, balanced, and positioned in the sling or lifting device before it is lifted more than a few inches.

Before starting the lift, the person directing the lift shall make sure the hoist chain or ropes are not kinked or twisted. The load block shall be brought over the load in such a manner as to prevent swinging. The hoist chain or rope shall be inspected to ensure that it is properly seated in the chain sprocket or drum groove. Avoid sudden acceleration or deceleration of the moving load.

A minimum clearance of 3 inches overhead and 2 inches laterally must be provided and maintained between the crane and any unnecessary obstruction. Lift equipment shall not be used for side pulls. The operator shall not move the load while a person is on the load or hook.

No personnel, including the spotter(s) or operators, are to touch or manipulate a load with their hands/body unless they can demonstrate that it is infeasible to do otherwise. Taglines, shepherd hooks or the like shall be used to keep employees outside the fall zone.

The operator shall not carry loads over people or occupied workspaces. The operator shall test the brakes each time a load approaching the rated load is handled by raising the load a few inches and applying the brakes. The load shall not be lowered below the point where less than 2 full wraps remain on the hoisting drum, unless a lower limit device is provided. If a lower limit device is provided, no less than one wrap shall remain.

Trolley stops and/or bumpers shall be provided to limit the travel of the trolley along the runway and be capable of sufficiently stopping the trolley under normal operating conditions. Crane electric controllers shall be of the type that, when the operating handle or switch is released, return to the 'off' position and stop crane motion. Control circuits shall be designed so that failure of the controller or power loss results in a de-energized (fail-safe) condition.

Parking the Load

Operators shall not leave their position at the controls while the load is suspended. Before leaving

a load unattended, the operator shall land any load, place the controls or master switch in the off position and open the main line device of the specific crane or hoist. The main line disconnect shall not be closed until the operator has made sure that no one is on or adjacent to the crane or hoist. The load block of the hoist shall be raised above head level when not in use.

Signals

A signal person shall be provided when the point of operation is not in full and direct view of the operator. Only a qualified signal person shall be permitted to give signals, however, a “stop” signal may be given by any person at any time. Signals shall be by audible device (radio, telephone, other), voice, or hand.

Radio, Telephone, or other Electronic Signals

The device used to transmit signals shall be tested onsite before beginning operations, to ensure the signal transmission is effective, clear, and reliable.

Voice Signals

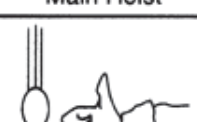
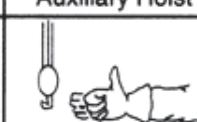
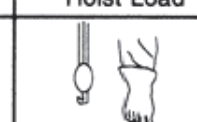
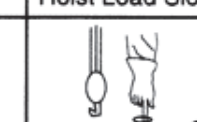
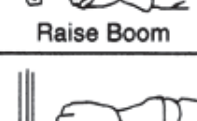
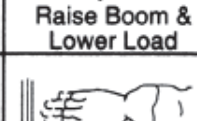
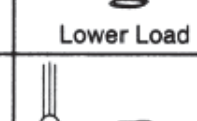
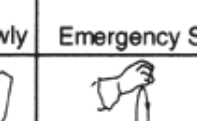
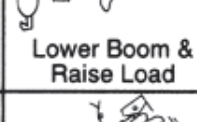
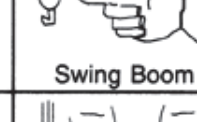
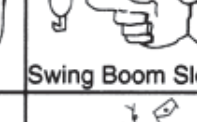
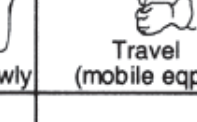
Prior to beginning lifting operations using voice communication, the crane operator and the signal person shall meet and agree on the specific voice signals to be used, including the phrasing and sequence of commands. Each voice signal shall contain the following three elements in the following order:

1. Function (hoist, boom, etc.)
2. Direction
3. Distance and/or speed, and
4. Stop commands

For example: ‘Hoist, up, 3 feet – slow’

Hand Signals

If electronic or voice signals between crane operator and signal person is not possible, a uniform hand signal system shall be used and clearly understood by all parties:

 Main Hoist	 Auxiliary Hoist	 Hoist Load	 Hoist Load Slowly	 Stop
 Raise Boom	 Raise Boom & Lower Load	 Lower Load	 Lower Load Slowly	 Emergency Stop
 Lower Boom	 Lower Boom & Raise Load	 Swing Boom	 Swing Boom Slowly	 Travel (mobile eqpt)
 Retract Boom 2 hands	 Retract Boom 1 hand	 Extend Boom 2 hands	 Extend Boom 1 hand	 Dog Everything

Maintenance

Preventive maintenance shall be performed as prescribed by the manufacturer as detailed in the owner's manual. The crane to be repaired or adjusted by designated/qualified personnel shall be run to a location where it will cause the least interference with other cranes and operations in the area. All controllers shall be in the off position. The main or emergency switch shall be open and locked in an open position.

During maintenance, "warning" or "out of order" signs shall be placed on the crane, also on the floor beneath or on the hook where visible from the floor. After adjustments and repairs have been made the crane shall not be operated until all guards have been reinstalled, safety devices re-activated and maintenance equipment removed. Any unsafe condition noted during the inspection of the crane shall be repaired and tested before the crane is used.

TRAINING

All operators must be familiar with and be trained to operate the specific equipment they are assigned to use, including its controls, operating equipment, and typical tasks. Qualified operators are designated to train new operators in the safe operation and use of the specific equipment in their work areas. Trainees are authorized to operate equipment only under direct supervision of a qualified operator.

Qualified operators must document written training records, including both knowledge and practical evaluations, for all new trainees. Training and evaluation shall be repeated when new equipment or procedures are introduced, when an operator's performance indicates the need for retraining, or as otherwise required by applicable regulations or by the Institute.

Upon completion, forward training records to safety.training@caltech.edu for inclusion in personnel training records.