



Overhead Crane Safety and Prevention



*Funding and support for this project has been provided by the
State of Washington, Department of Labor & Industries, Safety & Health Investment Projects*

Training Objectives

Part I – Crane Basics

- Types of Cranes
- The Parts of the Crane
- Inspecting the Crane
- Maintaining the Crane

Part II – Crane Safety Communication

- Basic Crane Safety
- Crane Safety Tools
- Warning Markers and Hand Signs

Part III – Safe Crane Operational Procedures

- Loads and Lifts
- Testing
- Operational Qualifications
- Conduct of Operators



Part I

Crane Basics



Types of Cranes

Gantry Cranes



Jib Cranes



Bridge Cranes



Monorail Cranes



Types of Cranes

Gantry Cranes

A type of crane that is built upon a bridge-like overhead structure (gantry).



Types of Cranes

Bridge Cranes

An overhead crane that consists of parallel runways with a traveling bridge.



Types of Cranes

Monorail Cranes



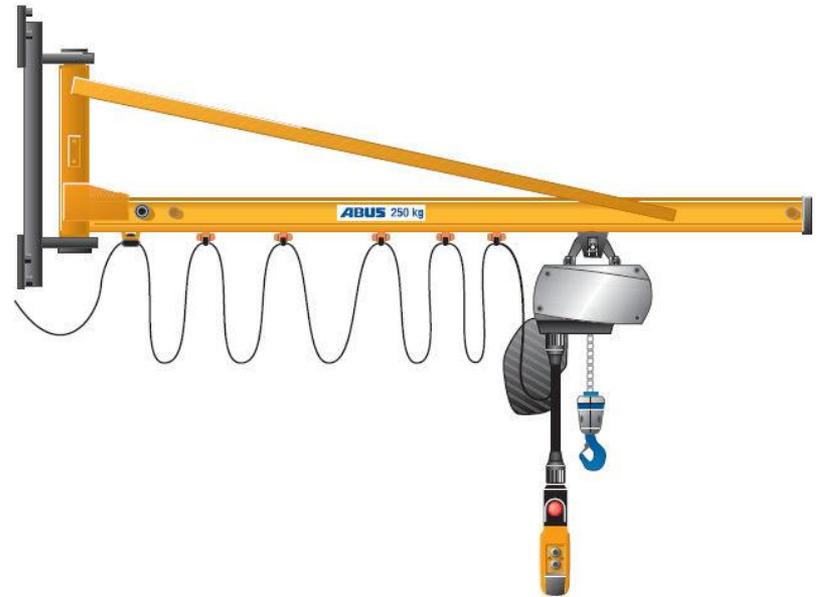
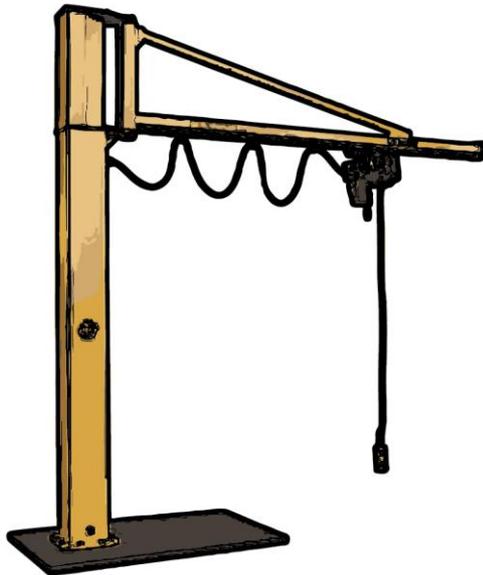
A type of overhead crane that travels suspended on a single rail.



Types of Cranes

Jib Cranes

A type of crane where a horizontal beam extends out to lift and move a load along the beam.



Crane Operators



Hoist Operator

The employee that uses the hoist to lift, lower, and move a load by means of an overhead crane.



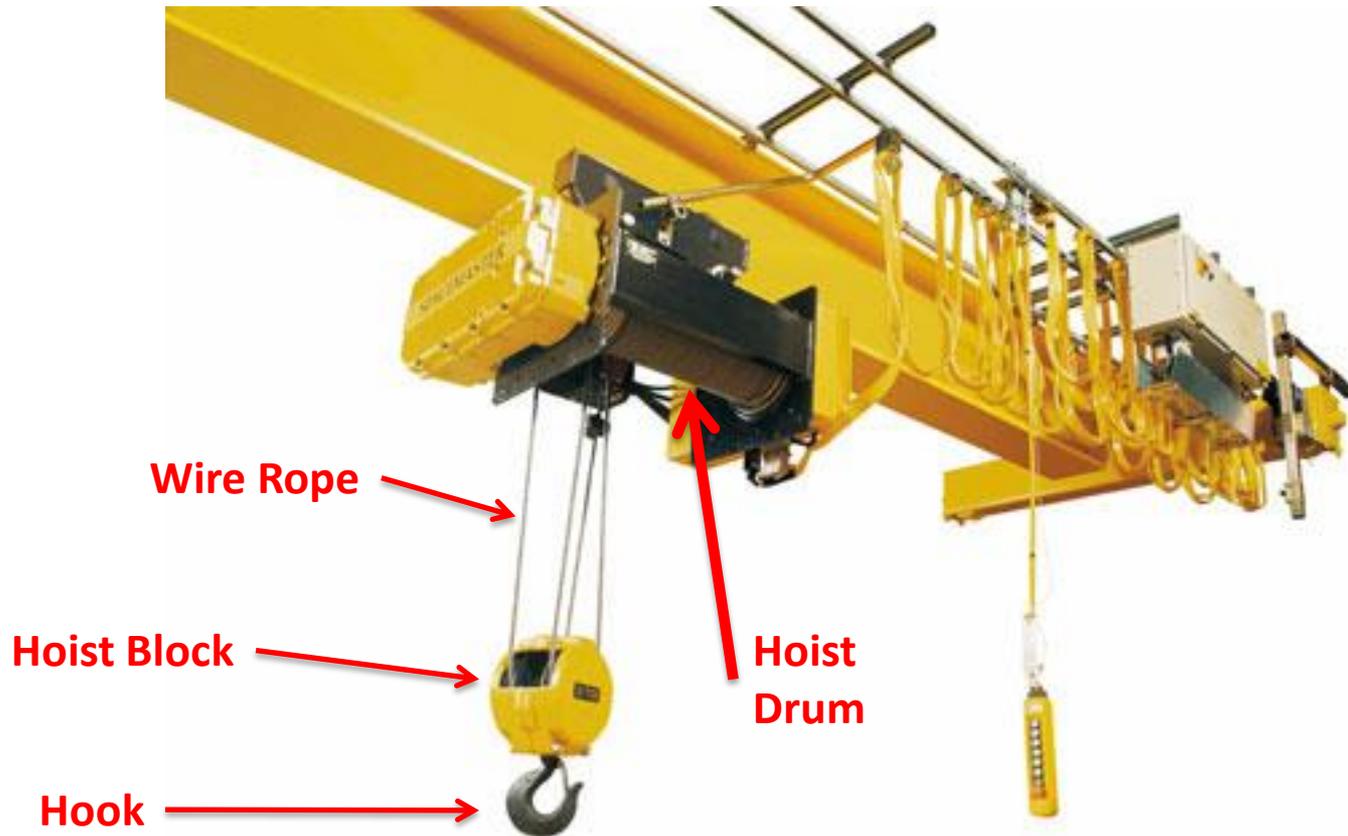
Rigger

The employee that is responsible for balancing and securing the load to the hook, and will direct the hoist operator during the lift.



The Parts of the Crane

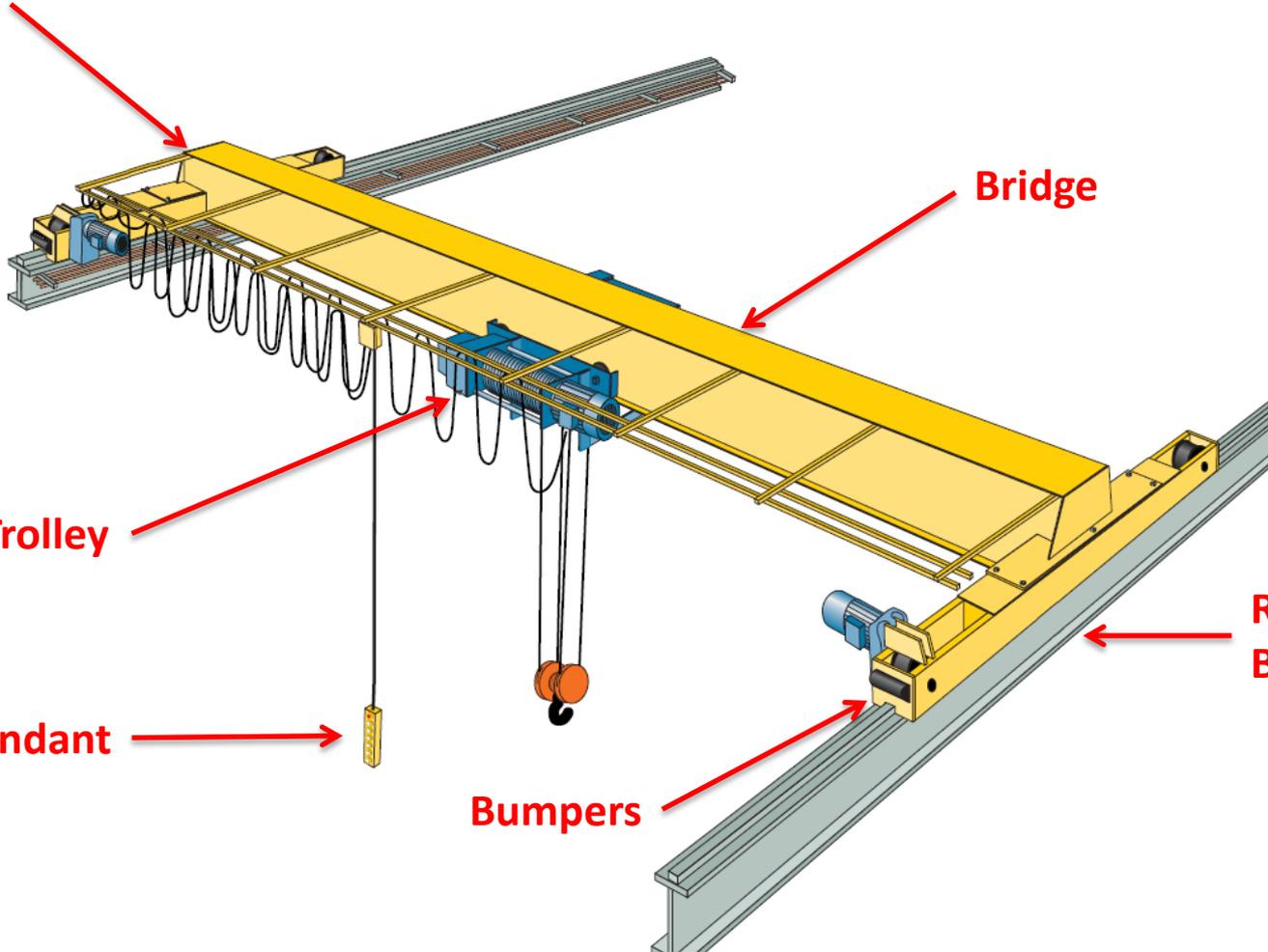
Hoisting Mechanisms



The Parts of the Crane

Overhead Parts

End
Trucks



Bridge

Trolley

Pendant

Bumpers

Runaway
Beam



The Parts of the Crane

Safety Parts



Power Supply



Fire Extinguisher



Load Rating



Inspecting the Crane

Inspections are one of the tools that are used to help prevent machine breakdowns and accidents.

Three Types of Inspections:

1. Day-To-Day (Daily) Inspections
2. Frequent Inspections
3. Periodic Inspections



Inspecting the Crane

Day-to-Day Inspections

Day-to-Day inspections should be small inspections that occur before the beginning of a shift or before using the crane for the first time each work day.

Day-to-Day inspections should include:

- Inspect the wire rope for abnormalities and/or damage.
- Inspect the drum for proper rope alignment.
- Inspect the area around the machine for any indication of leaking or dripping fluids.
- Inspect the block and hook for any cracks or damage.
- Visually inspect any bumpers for damage or abnormalities.
- Visually inspect Limit Switches for abnormalities and test for proper functionality.



Inspecting the Crane

Frequent Inspections

Frequent Inspections are visual examinations by the operator or other designated personnel with written records not required.

Frequent Inspections should include:

- Operating mechanisms for proper operation, proper adjustment, and unusual sounds.
- Upper-Limit device(s) in accordance with ASME standards.
- Tanks, Valves, pumps, lines and other parts of air or hydraulic systems for leakage.
- Hooks and hook latches (if used) in accordance with ASME standards.
- Hoist ropes and end connections in accordance with ASME standards.
- Rope and proper spooling on the drum(s) and sheave(s).



Inspecting the Crane

Periodic Inspections

Periodic Inspections are visual inspections of the equipment in place by a designated person making records of apparent external conditions to provide the basis for a continuing evaluation.

Periodic Inspections should include:

- Deformed, cracked or corroded members.
- Loose or missing bolts, nuts, pins or rivets.
- Cracked or worn sheaves and drums.
- Worn, cracked, or distorted parts.
- Excessive wear of brake system parts.
- Excessive wear of drive chain sprockets and excessive drive chain stretch.
- Deterioration of controllers, master switches, contacts, limit switches, and push-button stations.
- Gasoline, diesel, electric, or other power plants for proper operation.
- Motion-limit devices that interrupt power or cause a warning to be activated.
- Rope reeving for compliance with crane manufacturers design.
- All function, instruction, caution, and warning labels or plates for legibility and replacement.

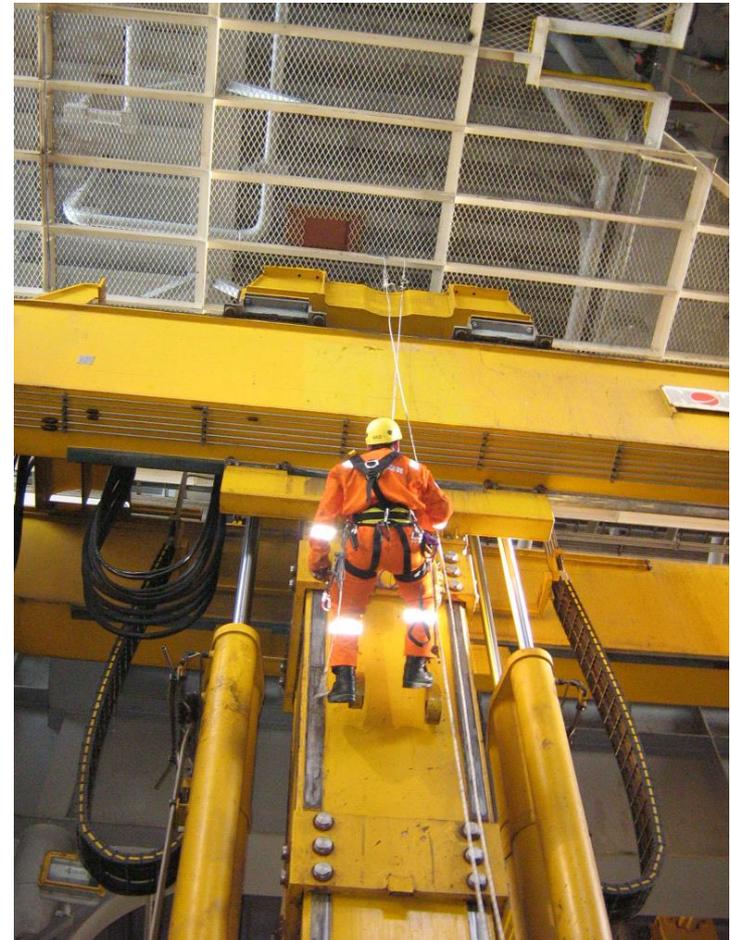


Inspecting the Crane

Cranes Not in Regular Service

Cranes that have been sitting idle for a period of 1 month or more, but less than 1 year, should have a Frequent Inspection before entering service.

Cranes that have been sitting idle for a period of 1 year or more, should have a Periodic Inspection before entering service.



Inspecting the Crane

Wire Rope Inspections

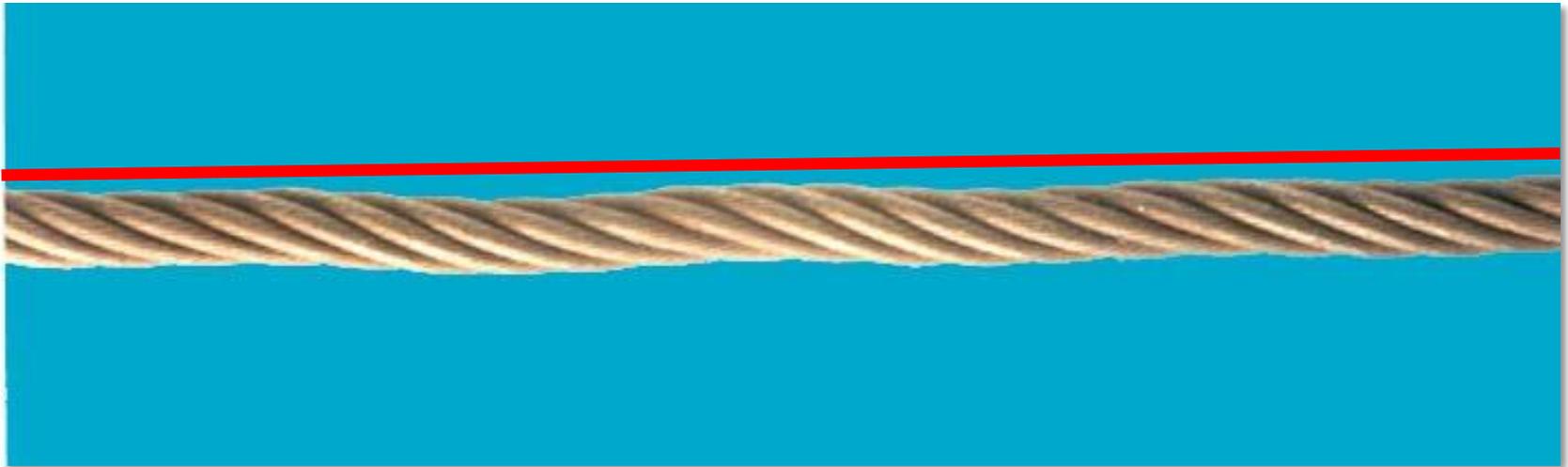


Properly inspecting the rope, and keeping an eye out for changes in the rope, is important to maintaining a safe work environment.

Wire Rope Inspections

Waviness

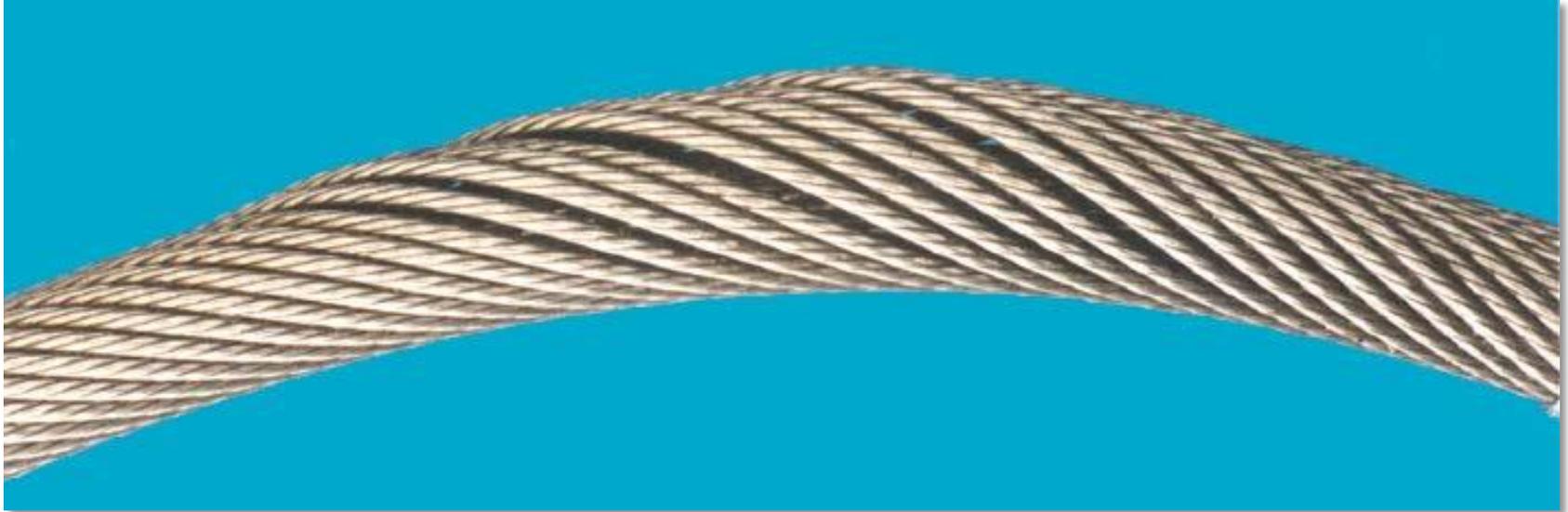
Waviness is a deformation in which the longitudinal axis of the wire rope takes the shape of a helix under either a loaded or unloaded condition.



Wire Rope Inspection

Basket/Lantern Deformation (Birdcage)

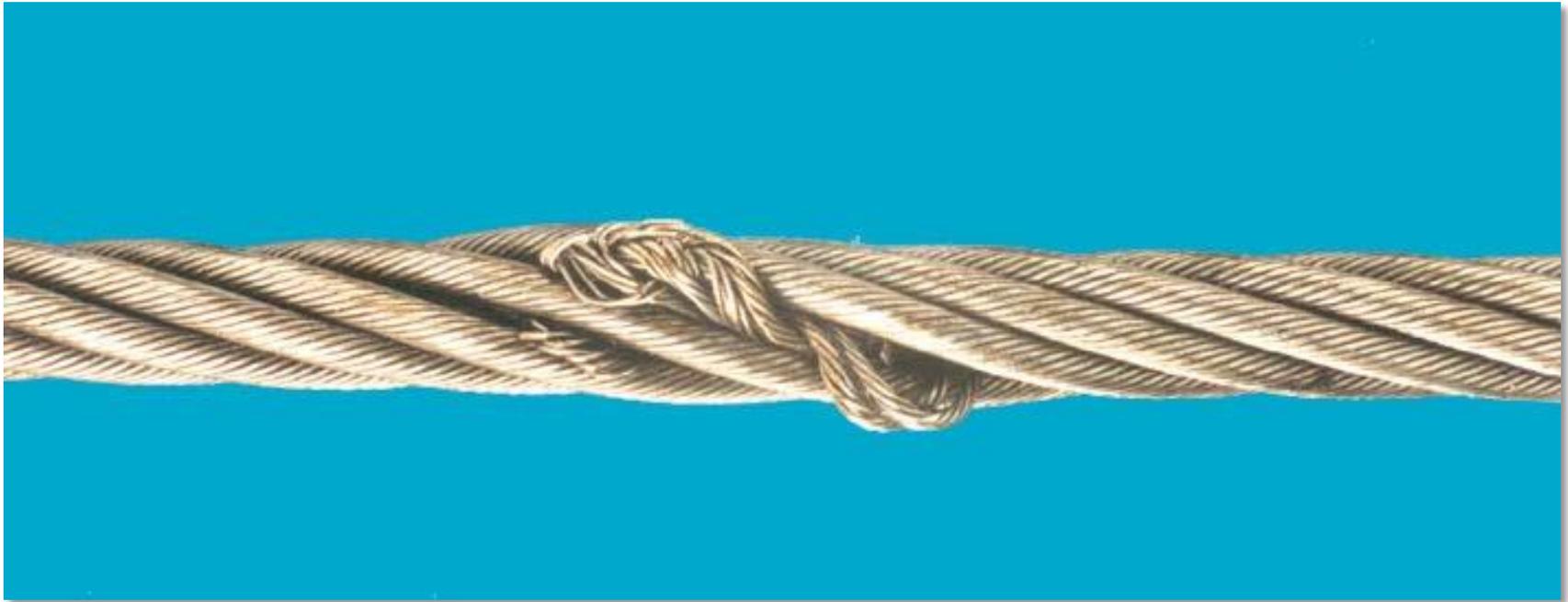
A basket, or lantern, deformation, also known as a birdcage, develops when the outer layer of strands in the wire rope becomes longer than the inner layer(s).



Wire Rope Inspection

Core Protrusion/Distortion

A core protrusion is a special type of basket or lantern deformation. In this case the rope imbalance is indicated by a protrusion of the core of the wire rope.



Wire Rope Inspection

Strand Protrusion/Distortion

A strand protrusion, or distortion, is when one of the outer strands of the wire rope protrudes out.



Wire Rope Inspection

Wire Protrusion

When certain wires, or groups of wires, will rise up on the side of the rope opposite to the sheave groove in the form of loops.



Wire Rope Inspection

Local Increase in Diameter of Rope

A local increase in rope diameter can occur and might effect a relatively long length of the rope.



Wire Rope Inspection

Flattened Portion

A flattened portion of a rope is a section of the rope that has lost its circular form.



Wire Rope Inspection

Kinks

A kink is a deformation created by a loop in the rope which has been tightened without allowing for rotation about its axis.



Wire Rope Inspection

Other Kink Examples



Positive Kink

Negative Kink



Maintenance



Maintenance Topics with Overhead Cranes:

1. Preventive Maintenance
2. Maintenance Procedures
3. Adjustments and Repairs
4. Rope Maintenance and Replacement

Maintenance

Preventive

Preventive Maintenance is maintenance that is conducted before an issue is identified.

This includes, but is not limited to:

- Fluid Replacement
- Frequently Worked Parts
- Pads
- Hoses
- Warning Devices and Signs



Maintenance

Maintenance Procedures

The following precautions shall be taken before performing any maintenance on a crane:

- (1) The crane shall be moved to a location where it will cause the least interference with other cranes and operations in the area.
- (2) If a load is attached to the crane, it shall be landed.
- (3) All controllers shall be placed in the off position.
- (4) A lockout/tagout procedure shall be performed.
- (5) Warning signs and barriers shall be utilized on the floor beneath the crane where overhead maintenance work creates a hazard.
- (6) If the runway remains energized, stops or a signalperson, located full-time at a visual vantage point for observing the approach of an active crane, shall be provided to help the persons performing maintenance with the machine.
- (7) A guard or barrier shall be installed between adjacent runways for the length of any established work area.

Maintenance

Adjustments and Repairs

The following list is an example of components that might need adjustment or repairs:

- (1) operating mechanisms on the crane
- (2) limit devices
- (3) control systems
- (4) brakes
- (5) damaged or worn hooks
- (6) critical parts that are cracked, broken, bent, or excessively worn
- (7) pitted or burned electrical contacts
- (8) function, instruction, caution, and warning labels



Maintenance

Wire Rope Maintenance and Replacement

While maintenance precautions on the rope can be taken, the strain on the rope will eventually lead to the need for it to be replaced.

If left in service long enough, wire ropes will deteriorate and eventually break.





Part II

Crane Safety Communications

Basic Crane Safety

1. No one but a regularly authorized operator is allowed to use any crane.
2. Do not carry a load over people on the floor. Sound warning devices to alert persons nearby.
3. Do not allow anyone to ride on a load carried by the crane or on the crane hook.
4. Never try to stop the load with your hands or body.
5. Inspect equipment daily before use. Always keep an eye out for changes in the equipment and safety area.
6. Never pull a hoist by the pendant cable.
7. Never leave the controls unattended while a load is suspended. Lower the load to the floor if it is necessary to leave the controls.
8. Before moving the trolley or bridge, be sure that the hook is high enough to clear all obstacles.
9. Do not drag slings, chains, or lifting devices out from under loads that have been landed.
10. If you are asked to do something that you do not feel comfortable or safe about, contact a foreman or supervisor for advice.

Crane Safety Tools

The following section discusses some of the safety tools used around overhead cranes in the workplace.

- Tagged Crane or Hoist
- Warning Devices
- Warning Signs and Markings
- Hand Signals



Crane Safety Tools

Tagged Cranes and Hoists

A crane, and/or equipment, that is shutdown for various reasons should be locked out and tagged out.

Do not operate or use any equipment that is locked and/or tagged out. Speak with a supervisor or foreman regarding the operations of any equipment.



Crane Safety Tools

Warning Devices

A warning device is any device that helps bring attention to people in the area of the crane being in operation.



- (1) Manually operated gong
- (2) Power-operated bell, siren, or horn
- (3) Rotating beacon
- (4) Strobe light

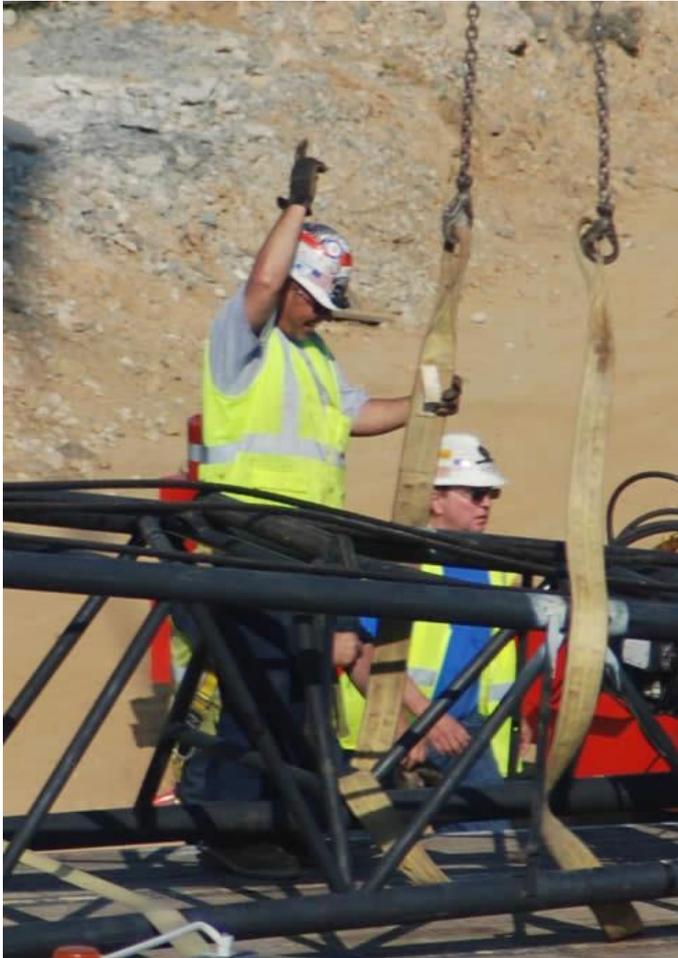
Warning Signs and Markings

Warning signs and markings should be present in all workplaces operating a crane to communicate dangers and hazards with the machine.



Hand Signals

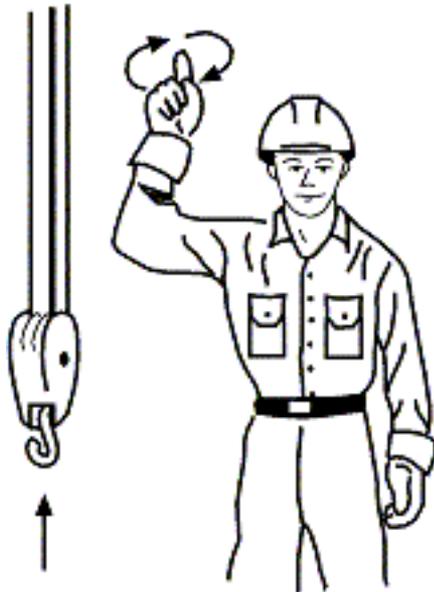
Standard



Hand signals are used when voice communications cannot be heard.

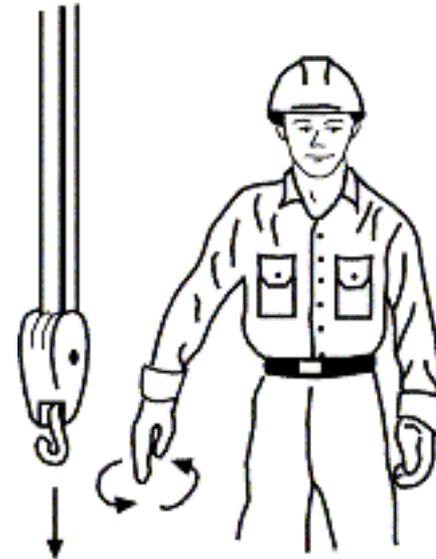
Hand Signals

Standard



Hoist

With forearm vertical, forefinger pointing up, move hand in small horizontal circle.

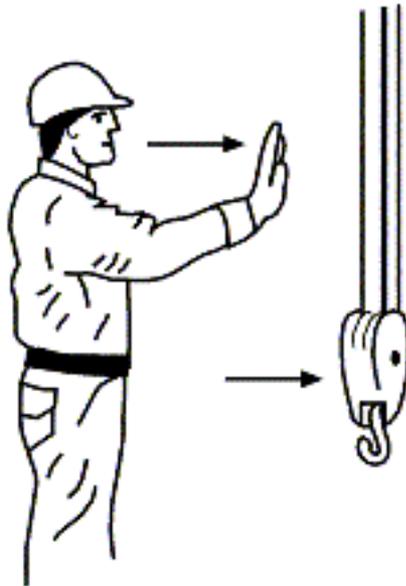


Lower

With arm extended downward, forefinger pointing down, move hand in small horizontal circle.

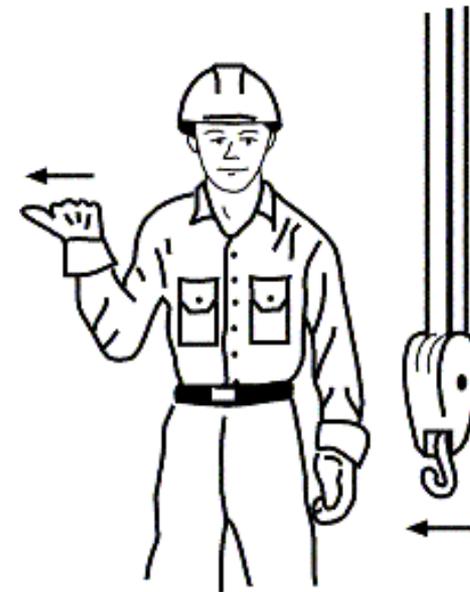
Hand Signals

Standard



Bridge Travel

Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.

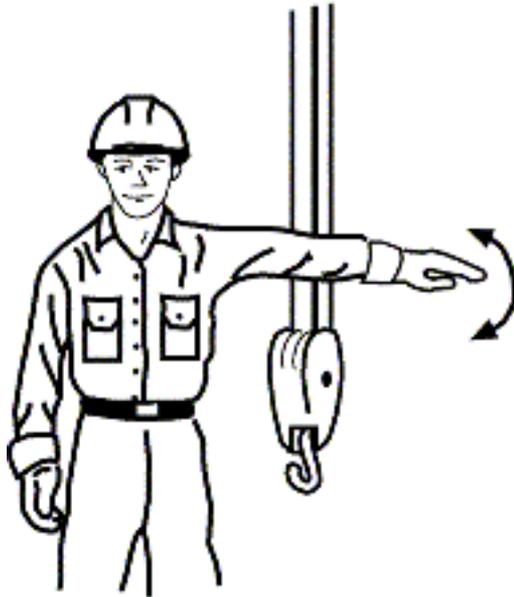


Trolley Travel

Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.

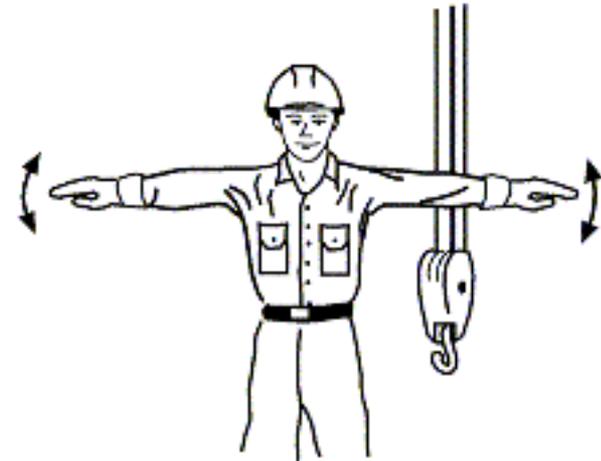
Hand Signals

Standard



Stop

Arm extended, palm down, move arm back and forth horizontally.

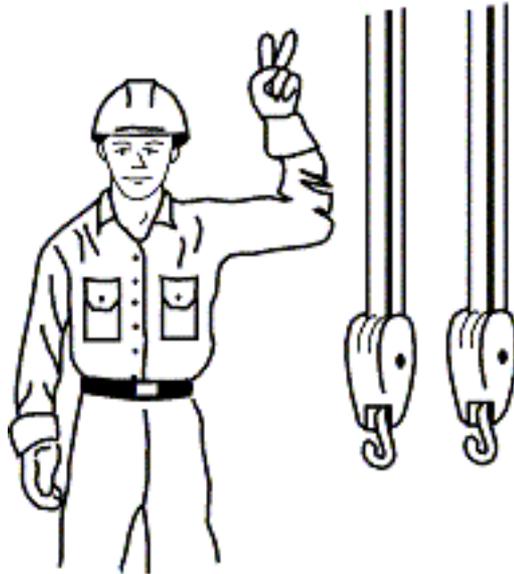


Emergency Stop

Both arms extended, palms down, move arms back and forth horizontally.

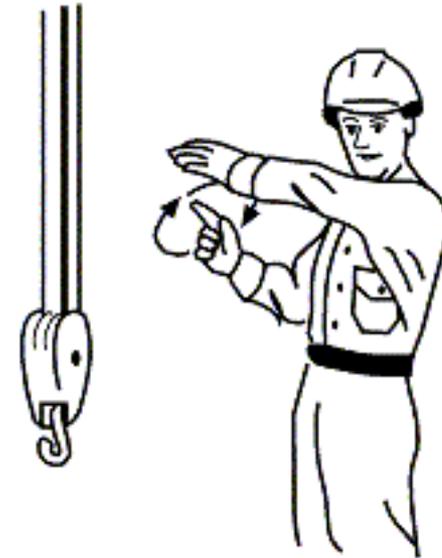
Hand Signals

Standard



Multiple Trolleys

Hold up one finger for block marked "1"
and two fingers for block marked "2".
Regular signals follow.

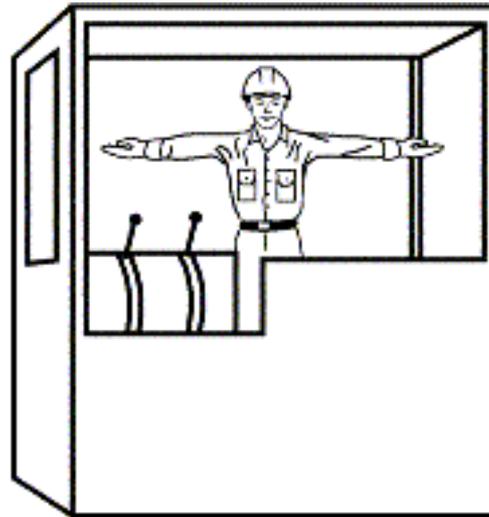


Move Slowly

Use one hand to give any motion signal
and place other hand motionless in front
of hand giving the motion signal.

Hand Signals

Standard



Magnet is Disconnected

Crane operator spreads both hands apart – palms up.

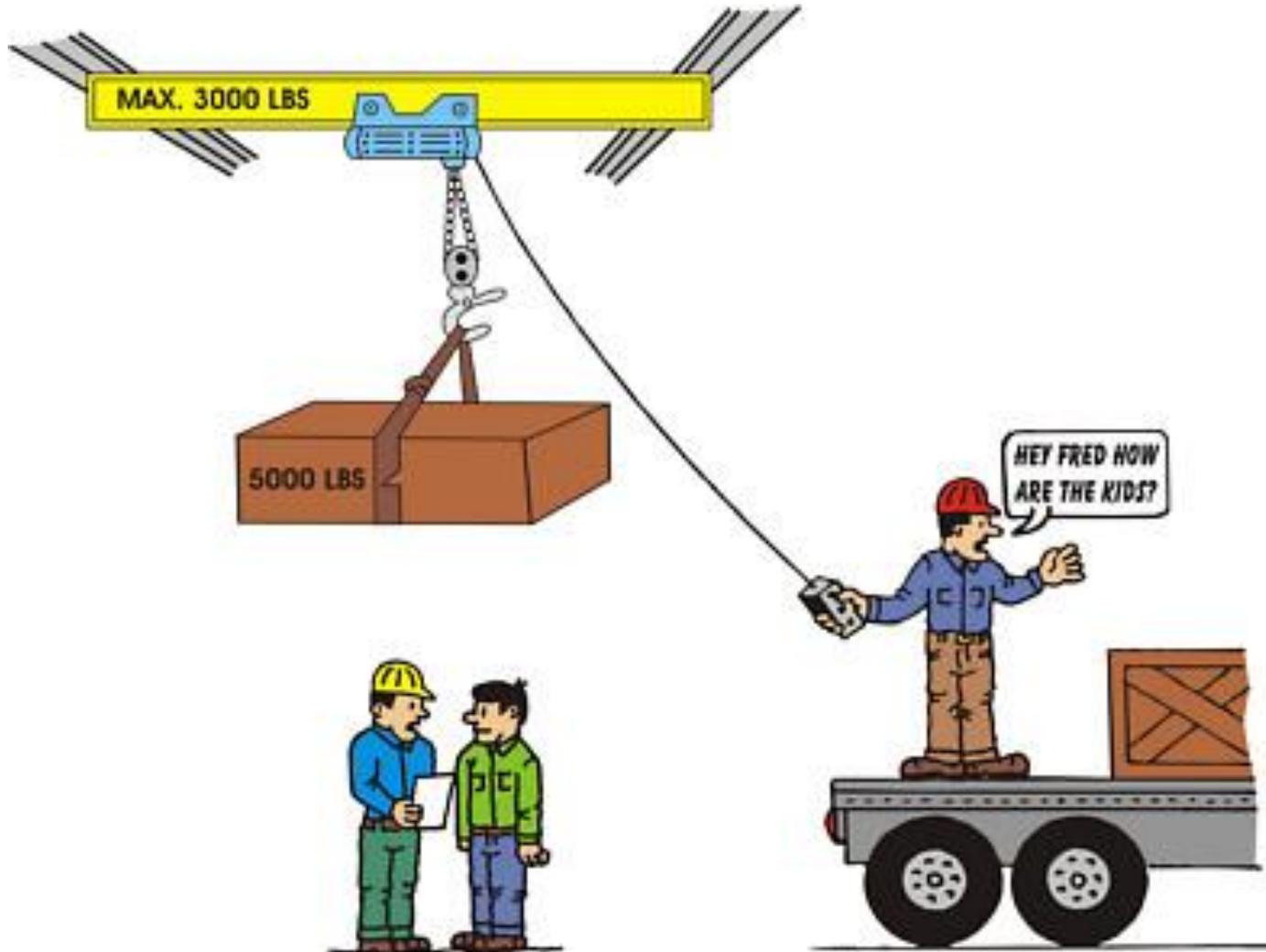
Hand Signals

Special

In some cases more communication is needed past the standard hand signals.

1. Special operations may require additions to or modifications of standard signals.
2. Special signals shall be agreed upon and understood by the signal person and the operator.
3. Special signals shall not conflict with standard signals.





Discussion: Can you identify the safety violations in this drawing?



Part III

Safe Crane Operational Procedures

Loads

As much as we discuss safety with the crane itself, the preparation and handling of the load is just as much of a factor in the safety of a lift.



Loads

Load Marking and Weight of Loads



Load Markings are posted on all sides of the crane and on the hoist block.



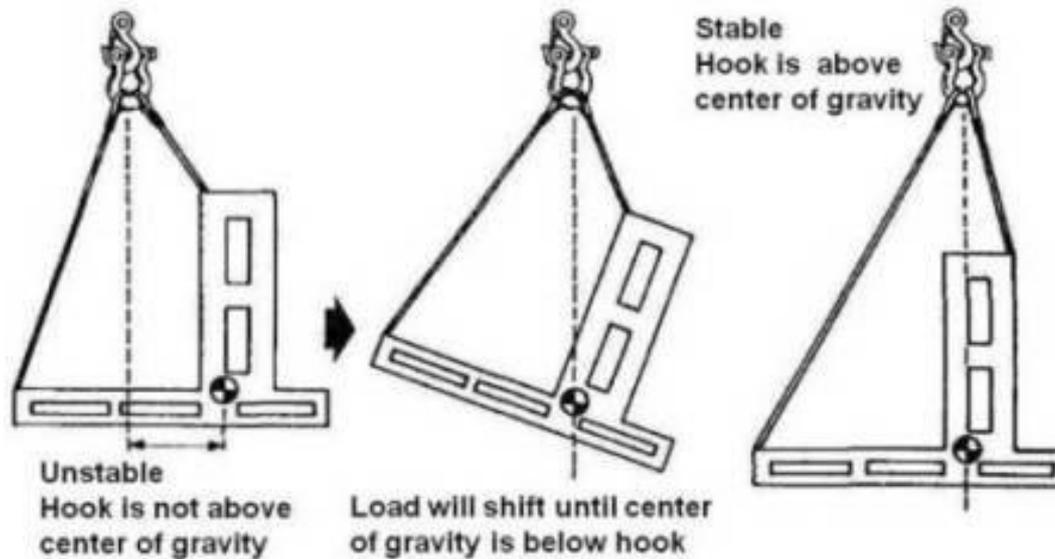
Knowing the load weight is important to preventing accidents with the lift.

Loads

Attaching the Load

Important Factors:

1. Use appropriate sling/hardware (Work Load Limit)
2. Sling Angle
3. Center of Gravity Alignment



Effect of Center of Gravity on Lift



Loads

Moving the Load

1. The appointed person directing the lift shall ascertain that the load and hoist devices are attached and functioning properly.
2. During the lift there should be no sudden acceleration or deceleration of the load.
3. Cranes shall not be used for side pulls except when specifically authorized.
4. The operator should avoid carrying loads over people.
5. The load shall not be lowered below the point where two wraps of rope remain on the hoisting drum.
6. No suspended load should ever be left unattended by the crane operator.



Planned Engineered Lifts

In the case that a lift needs to be made that is heavier than the rated load of the crane a planned engineered lift may be possible. These lifts shall be treated as a special and separate event.



Testing



While inspections are visual assessments of the crane and equipment, tests examine the operation and function of the machine.

Testing

Operational Tests

Operational testing are tests that examine the operation of all of the crane parts without a load.

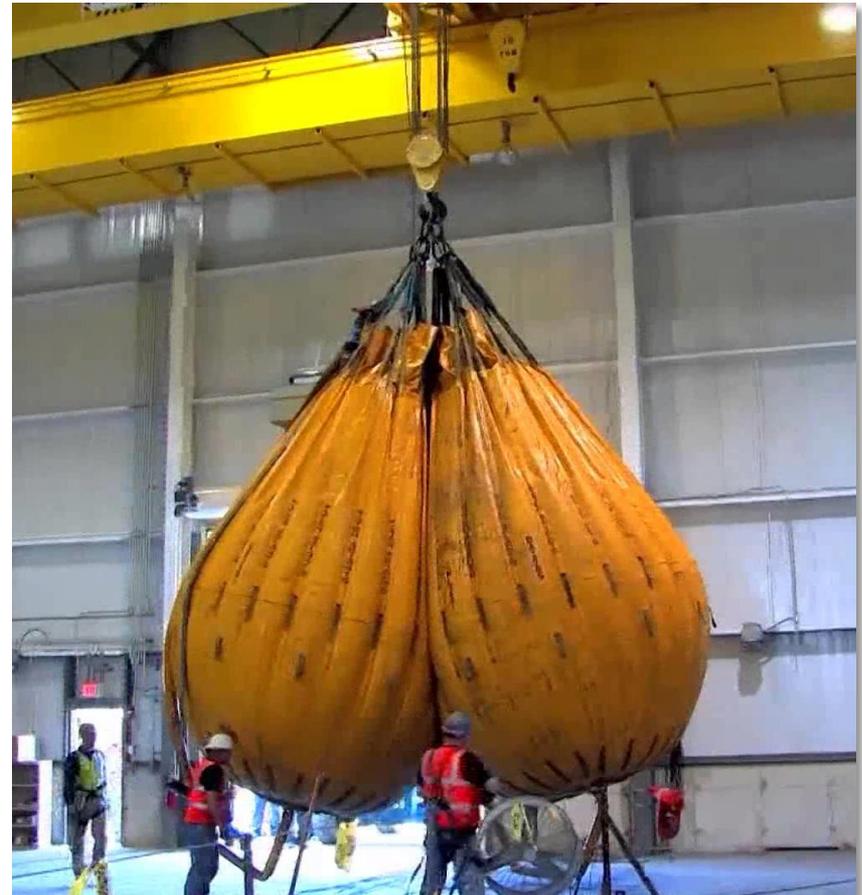
- (1) Lifting and lowering
- (2) Trolley travel
- (3) Bridge travel
- (4) Hoist-limit devices
- (5) Travel-limiting devices
- (6) Locking and indicating devices

Testing

Load Tests

A load test examines the cranes ability to lift and move a load.

- (1) Hoist the test load a distance to assure that the load is supported.
- (2) Transport the test load by means of the trolley for the full length of the bridge.
- (3) Transport the test load by means of the bridge for the full length of the runway.
- (4) Lower the test load, and stop and hold the test load with the brakes.



Operational Qualifications

Each type of crane and work setting have different qualifications for operating overhead cranes.

Cranes shall be operated only by the following qualified persons:

- (1) Designated persons
- (2) Trainees under the direct supervision of a designated person
- (3) Maintenance and test personnel

Check with your employer for more information on the requirements for working with overhead cranes in your workplace.

Operational Qualifications

Floor and Remote Operators



Floor and Remote Hoist Operators shall be required by the employer to pass a practical operating examination.

The use of remote-control equipment involves such a wide variety of service requirement and conditions that each installation should be carefully analyzed.

Operational Qualifications

Cab Operators

- (1) Have vision of at least 20/30 in one eye and 20/50 in the other
- (2) Be able to distinguish color
- (3) Be able to hear adequately for a specific operation
- (4) Have sufficient strength, endurance, agility, coordination and speed of reaction to meet the demands of the equipment operation
- (5) Not have evidence of physical defects or emotional instability that could render hazard to the operator or others
- (6) Not have any evidence of being subject to seizures or loss of physical control



Conduct of the Operators

- (1) The operators and employees shall not engage in any practice that will divert attention while actually engaged in operating the crane.
- (2) When physically, or otherwise unfit, an operator shall not engage in the operation of the equipment.
- (3) The operator shall be familiar with, and follow all signals from appropriate people during a lift.
- (4) Each operator shall be responsible for those operations under the operator's control.
- (5) Each operator shall activate the warning device before starting the bridge/trolley, and intermittently during travel of the crane.

Conduct of the Operators

- (6) The operator shall not close the main switch until certain that no worker is on or adjacent to the crane.
- (7) The operator shall be familiar with the equipment and its proper care.
- (8) Contacts with runway stops or other cranes shall be made with extreme caution.
- (9) Before the operator performs any maintenance work on the crane, the operator shall lock and tag the main switch in the de-energized position.



Part IV
Case Studies

Case Study #1

An employee was being trained for the first time in the work area by the head mechanic. The employee would replace the mechanic when he went on vacation. The employee and the mechanic were on top of the overhead crane doing repairs. The overhead crane operator signaled to the mechanic that he needed to pass over the mechanic and the employee. They both bent down on the catwalk. As the first section of the overhead crane passed over them, the bottom of the crane knocked the wire cutter off the gear box. The employee stood up to see what fell. The mechanic tried to tell him to get back down before the second section of the crane passed over; however, the employee was struck in the head and killed.

Case Study #1 - Questions

1. Identify the safety failure in this accident.

The crane should not have passed overhead of the workers on the catwalk.

2. What safety Maintenance Precaution should have been added to this situation?

A signal person with full view of the operation shall be provided to help the persons performing maintenance with the machine;

The crane shall be moved to a location where it will cause the least interference with other cranes and operations in the area.



Case Study #2

An employee was working inside a large concrete pipe mold setting up the core. The core was put in place by an overhead bridge crane. The employee had unhooked the core from the slings and the crane operator, operating from a cab, had moved the cab over the mold to make sure it was straight. The operator was moving the cab back toward the wall and raising the block out of the mold at the same time. He accidentally raised the block all the way up. The upper limit switch failed to work; it two-blocked and broke the wire rope, dropping a more than 300 lb block back down inside the mold. The load struck the employee, breaking his neck. He was hospitalized.

Case Study #2 - Questions

1. Identify a failure point in this accident.

Limit Switch failure, Employee working too close to the overhead load.

2. What kind of preventative measure could have identified the limit switch failure?

Testing of the limit switch as part of a Day-To-Day Inspection.

3. Identify the safety error from the hoist operators responsibilities.

Moving the cab and the load at the same time. Lifting a load over a person. Lifting a load higher than is needed.



Case Study #3

An employee was to remove a telescoping cylinder from a trailer for repair. The front of the trailer was raised approximately 6 ft off the chassis using a 3-ton overhead crane with a pendant controlled hoist. The lifting sling was a shop-made sling comprised of a transport chain (3/8 in. links) with a hook attached at each end of the sling. While the front of the trailer was raised, a link broke, causing the trailer to collapse onto the chassis, then fall over onto the employee. The employee later died from the accident.

Case Study #3 - Questions

1. Identify the failure points in this accident.

The sling was not rated, proof tested, or inspected; Employee was not working at a safe distance from the suspended load.

2. What kind of preventative measure could have identified the defect with the sling?

Inspect all hoisting devices for accordance with ASME standards.

3. Identify the preventative safety measure that was missed in this accident.

Selecting a sling that meets the Weight Lift Limit of the load, Employee should have been standing a safe distance from the load.



Case Study #4

An employee, who had been on the job for 1 1/2 months, was operating a 15-ton capacity overhead top running bridge crane with a suspended load of 6 tons. The crane was operated by a floor-operated pendant control device. The load was a railroad switch panel 30 feet long by 12 feet wide. The employee was operating the pendant control crane in a 4 1/2 ft wide aisle between a pile of railroad panels and a railroad gondola. There were tripping hazards on the floor. The employee lifted the panel from a flat position up to a 30 degree angle. The load then shifted and struck the employee, killing him.

Case Study #4 - Questions

1. Identify the failure point in this accident.

Improper center of gravity balance.

1. Identify one safety issue that was present in this particular shop.

Tripping hazards on the shop floor, Inadequate room for the employee to maneuver.

2. In this situation what should the employee have done to help prevent this accident?

The employee should have lowered the load and re-aligned the hoist/sling when he noticed it was starting to raise at an angle.



This brings an end to this training.
Does anyone have any last questions
or comments to wrap up?

*Funding and support for this project has been provided by the
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Investment Projects*



Citations

Images:

- All images were obtained through Google images.

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