

Cranes and Hoists

University of Tennessee Safety Guide GS-140

Document Contact: EHS-General Safety

Date effective: March 1, 2015

Revision Date: March 1, 2015

Purpose

Purpose: Many types of cranes, hoists, and rigging devices are used at the University of Tennessee Knoxville for lifting and moving materials. UT's program is to maintain a safe workplace for faculty, staff and students; therefore, it cannot be overemphasized that only qualified and licensed individuals shall operate these devices.

This program has been established to:

- Ensure the safe use of cranes, hoists and slings.
- Ensure that departments understand and comply with safety standards related to cranes and hoists.
- Assign responsibilities to personnel which are necessary for successful implementation of this program.

Scope and Applicability

Scope: This program applies to all employees at all UTK locations and covers cranes and hoists with the exception of mobile cranes, engine hoists or winches.

Applicability: This program applies to cranes and hoists that is attached to any building, research facility or equipment owned or operated by UTK and to all UT faculty, staff, students, supplemental labor, and subcontractor personnel who use such devices.

Abbreviations and Definitions

Abbreviations

None

Definitions

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, hoist trolleys, lift trucks, power shovels, backhoes, or excavators.

Hoist: An apparatus for raising or lowering a load, but does not include a car or platform riding in guides or horizontal motion.

Qualified Person/Operator: A person designated by the department who, by reason of training and/or experience, has demonstrated the ability to safely perform all assigned duties. Persons may be deemed "qualified" to operate all or only specific cranes and hoists within a department by their supervisor. "

Rigging: Collectively referred to as "below the hook devices", are also called "lift gear". May be any device used to carry, position, and secure a load while it is being hoisted or craned.

Roles and Responsibilities

Supervisors and Principal Investigators are responsible for:

- Ensuring that employees and students under their supervision receive the required training and are certified and licensed to operate the cranes and hoists in their areas.
- Providing training for prospective crane and hoist operators. This documented training must be conducted by a qualified, designated instructor who is a licensed crane and hoist operator.
- Ensuring that hoisting equipment is inspected and tested monthly by a responsible individual and that rigging equipment is inspected annually.
- Ensuring employees are provided with and use appropriate protective equipment.
- Taking prompt corrective action when unsafe conditions or practices are observed.

Crane and Hoist Operators are responsible for:

- Lockout/Tagout any equipment that is defective.
- Operating hoisting equipment safely.
- Conducting functional tests prior to using the equipment.
- Ensuring the appropriate personal protective equipment is worn and following UT's Crane and Hoist program.
- Selecting and using rigging equipment appropriately.
- Having a valid operator's license on their person while operating cranes or hoists.
- Participating in the medical certification program, as required.
- Conducting periodic and special load tests of cranes and hoists.
- Maintaining written records of inspections and tests and maintaining all manuals for cranes and hoists in a central file for reference.
- Attending all required training.
- Immediately reporting any unsafe conditions or concerns to their supervisor.
- Inspecting and load testing cranes and hoists following modification or extensive repairs (e.g., a replaced cable or hook, or structural modification.)
- Scheduling a non-destructive test and inspection for crane and hoist hooks at the time of the periodic load test, and testing and inspecting before use new replacement hooks and other hooks suspected of having been overloaded. The evaluation, inspection, and testing may include, but are not limited to visual, dye penetrant, and magnetic particle techniques referenced in ASME B30.10 (Hooks, Inspection and Testing.)

EHS is responsible for:

- Interpreting crane and hoist safety rules and standards.
- Revising Crane and Hoist Program.
- Assist in the investigation of accidents related to cranes.

Procedures

General Requirements for Cranes, Hoists and Slings:

- Only trained employees shall operate a crane or hoist.
- Cranes and hoists shall go through a pre-use, monthly and annual inspection.
- Any unsafe condition noted during an inspection shall be corrected before the equipment is used.

- Operators shall comply with the manufacturer's specifications and limitations applicable to the operation of the equipment.
- Where manufacturer's specifications are not available, the limitations assigned to the equipment shall be based on the determinations of a qualified engineer competent in this field and such determinations will be appropriately documented and recorded.
- Operators shall follow safe work practices when operating a cranes, hoists and slings. (See Appendix F)

Crane and Hoist Operators

To be qualified as a Crane and Hoist Operator, the candidate shall have received hands-on training from a licensed, qualified crane and hoist operator designated by the candidate's supervisor. Crane and Hoist Operators must renew their license every three years.

General Safety Rules

Operators shall comply with the following rules while operating the cranes and hoists:

- Do not engage in any practice that will divert your attention while operating the crane.
- Respond to signals only from the person who is directing the lift, or any appointed signal person. Obey a stop signal at all times, no matter who gives it.
- Do not move a load over people. People shall not be placed in jeopardy by being under a suspended load. Also, do not work under a suspended load unless the load is supported by blocks, jacks, or a solid footing that will safely support the entire weight. Have a crane or hoist operator remain at the controls or lock open and tag the main electrical disconnect switch.
- Ensure that the rated load capacity of a crane's bridge, individual hoist, or any sling or fitting is not exceeded. Know the weight of the object being lifted or use a dynamometer or load cell to determine the weight.
- Check that all controls are in the OFF position before closing the main-line disconnect switch.
- If spring-loaded reels are provided to lift pendants clear off the work area, ease the pendant up into the stop to prevent damaging the wire.
- Avoid side pulls. These can cause the hoist rope to slip out of the drum groove, damaging the rope or destabilizing the crane or hoist.
- To prevent shock loading, avoid sudden stops or starts. Shock loading can occur when a suspended load is accelerated or decelerated, and can overload the crane or hoist. When completing an upward or downward motion, ease the load slowly to a stop.

Operation

Pre-operational Test

At the start of each work shift, operators shall do the following steps before making lifts with any crane or hoist:

1. Test the upper-limit switch. Slowly raise the unloaded hook block until the limit switch trips.
2. Visually inspect the hook, load lines, trolley, and bridge as much as possible from the operator's station; in most instances, this will be the floor of the building.
3. If provided, test the lower-limit switch.
4. Test all direction and speed controls for both bridge and trolley travel.
5. Test all bridge and trolley limit switches, where provided, if operation will bring the equipment in close proximity to the limit switches.

6. Test the pendant emergency stop.
7. Test the hoist brake to verify there is no drift without a load.
8. If provided, test the bridge movement alarm.
9. Lock out and tag for repair any crane or hoist that fails any of the above tests.

Moving a Load

- Center the hook over the load to keep the cables from slipping out of the drum grooves and overlapping, and to prevent the load from swinging when it is lifted. Inspect the drum to verify that the cable is in the grooves.
- Use a tag line when loads must traverse long distances or must otherwise be controlled.
- Manila rope may be used for tag lines.
- Plan and check the travel path to avoid personnel and obstructions.
- Lift the load only high enough to clear the tallest obstruction in the travel path.
- Start and stop slowly.
- Land the load when the move is finished. Choose a safe landing.
- Never leave suspended loads unattended. In an emergency where the crane or hoist has become inoperative, if a load must be left suspended, barricade and post signs in the surrounding area, under the load, and on all four sides. Lock open and tag the crane or hoist's main electrical disconnect switch.

Parking a Crane or Hoist

- Remove all slings and accessories from the hook. Return the rigging device to the designated storage racks.
- Raise the hook at least 2.1 m (7 ft.) above the floor.
- Store the pendant away from aisles and work areas, or raise it at least 2.1 m (7 ft.) above the floor.
- Place the emergency stop switch (or push button) in the OFF position.

Rigging

General Rigging Safety Requirements

Only select rigging equipment that is in good condition. All rigging equipment shall be inspected annually; defective equipment is to be removed from service and destroyed to prevent inadvertent reuse. The load capacity limits shall be stamped or affixed to all rigging components. Damage to look for includes:

Nylon slings with:

- Abnormal wear.
- Torn stitching.
- Broken or cut fibers.
- Discoloration or deterioration.

Wire-rope slings with:

- Kinking, crushing, bird-caging, or other distortions.
- Evidence of heat damage.
- Cracks, deformation, or worn end attachments.
- Six randomly broken wires in a single rope lay.
- Three broken wires in one strand of rope.
- Hooks opened more than 15% at the throat.

- Hooks twisted sideways more than 10 deg. from the plane of the unbent hook.

Alloy steel chain slings with

- Cracked, bent, or elongated links or components.
- Cracked hooks.

Shackles, eye bolts, turnbuckles, or other components that are damaged or deformed.

Rigging a Load

Do the following when rigging a load:

- Determine the weight of the load. Do not guess.
- Determine the proper size for slings and components.
- Do not use manila rope for rigging.
- Make sure that shackle pins and shouldered eye bolts are installed in accordance with the manufacturer's recommendations.
- Make sure that ordinary (shoulder less) eye bolts are threaded in at least 1.5 times the bolt diameter.
- Use safety hoist rings (swivel eyes) as a preferred substitute for eye bolts wherever possible.
- Pad sharp edges to protect slings. Remember that machinery foundations or angle-iron edges may not feel sharp to the touch but could cut into rigging when under several tons of load. Wood, tire rubber, or other pliable materials may be suitable for padding.
- Do not use slings, eye bolts, shackles, or hooks that have been cut, welded, or brazed.
- Install wire-rope clips with the base only on the live end and the U-bolt only on the dead end. Follow the manufacturer's recommendations for the spacing for each specific wire size.
- Determine the center of gravity and balance the load before moving it.
- Initially lift the load only a few inches to test the rigging and balance.

Crane Overloading

Cranes or hoists shall not be loaded beyond their rated capacity for normal operations. Any crane or hoist suspected of having been overloaded shall be removed from service by locking open and tagging the main disconnect switch. Additionally, overloaded cranes shall be inspected, repaired, load tested, and approved for use before being returned to service.

Working at Heights on Cranes or Hoists

Anyone conducting maintenance or repair on cranes or hoists at heights greater than 6 ft. shall use fall protection. Fall protection should also be considered for heights less than 6 ft. Fall protection includes safety harnesses that are fitted with a lifeline and securely attached to a structural member of the crane or building or properly secured safety nets.

Use of a crane as a work platform should only be considered when conventional means of reaching an elevated worksite are hazardous or not possible. Personnel shall not board any bridge crane unless the main disconnect switch is locked and tagged open.

- Personnel shall not use bridge cranes without a permanent platform (catwalk) as work platforms. Bridge catwalks shall have a permanent ladder access.
- Personnel shall ride seated on the floor of a permanent platform with approved safety handrails, wear safety harnesses attached to designated anchors, and be in clear view of the crane operator at all times.

- Operators shall lock and tag open the main (or power) disconnect switch on the bridge catwalk when the crane is parked.

Hand Signals

Signals to the operator shall be in accordance with the standard hand signals unless voice communications equipment (telephone, radio, or equivalent) is used. Signals shall be discernible or audible at all times. Some special operations may require addition to or modification of the basic signals. For all such cases, these special signals shall be agreed upon and thoroughly understood by both the person giving the signals and the operator, and shall not be in conflict with the standard signals.

Inspection, Maintenance, and Testing

All tests and inspections shall be conducted in accordance with the manufacturer's recommendations.

- If any unsafe conditions exist, the equipment shall be removed from service.
- In order to remove a crane or hoist from service it shall be locked out and tagged out to prevent use.
- Cranes and hoists not in regular use
 - A unit which has been idle for a period of one month or more shall be given a monthly inspection before placing in service.
- Prior to initial use, all new, altered, modified or repaired cranes and hoists shall have the following testing performed by the installation company or third party:
 - Hoisting and lowering
 - Trolley travel
 - Bridge travel
 - Limit switches, locking and safety devices
 - Load Tests shall not be more than 125% of the rated load unless otherwise recommended by the manufacturer.

Monthly Tests and Inspections

- All in-service cranes and hoists shall be inspected monthly and the results documented.
- Defective cranes and hoists shall be locked and tagged "out of service" until all defects are corrected.

Annual Inspections

The Department shall schedule and supervise (or perform) annual preventive maintenance (PM) and annual inspections of all cranes and hoists. The annual PM and inspection shall cover:

- Hoisting and lowering mechanisms.
- Trolley travel or monorail travel.
- Bridge travel.
- Limit switches and locking and safety devices.
- Structural members.
- Bolts or rivets.
- Sheaves and drums.
- Parts such as pins, bearings, shafts, gears, rollers, locking devices, and clamping devices.
- Brake system parts, linings, pawls, and ratchets.
- Load, wind, and other indicators over their full range.
- Gasoline, diesel, electric, or other power plants.

- Chain-drive sprockets.
- Crane and hoist hooks.
- Electrical apparatus such as controller contractors, limit switches, and push button stations.
- Wire rope.
- Hoist chains.

Load Testing

- Newly installed cranes and hoists shall be load tested at 125% of the rated capacity by designated personnel.
- Slings shall have appropriate test data when purchased. It is the responsibility of the purchaser to ensure that the appropriate test data are obtained and maintained.
- Re-rated cranes and hoists shall be load tested to 125% of the new capacity if the new rating is greater than the previous rated capacity.
- Fixed cranes or hoists that have had major modifications or repair shall be load tested to 125% of the rated capacity.
- Cranes and hoists that have been overloaded shall be inspected prior to being returned to service.
- Personnel platforms, baskets, and rigging suspended from a crane or hoist hook shall be load tested initially, then re-tested annually thereafter or at each new job site.
- All cranes and hoists with a capacity greater than 2722 kg (3 tons) should be load tested every four years to 125% of the rated capacity. Cranes and hoists with a lesser capacity should be load tested every eight years to 125% of the rated capacity.
- All mobile hoists shall be load tested at intervals to be determined.

Recordkeeping

Training Records:

- Retain Qualifications and Training records for Operators and Stand-by Persons at least ten years after the person has retired or left University employment.

Equipment Inspections:

- Retain any written evidence of daily/pre-use inspections for the last year.
- Retain “Quarterly Inspections” for the last three years.
- For Crane/Hoist and rigging, initial load tests for less than three ton rated cranes, and quadrennial load tests for over three ton rated cranes, tests for all cranes and “job-made” rigging, retain records for the life of the crane or hoist.

Record Retention Requirements

- Retain indefinitely records of annual shop inspections that include cranes or hoists.
- Retain indefinitely records of training.
- Retain indefinitely copies of load testing and load rating reduction tests until equipment is dismantled or destroyed.

Training and Information

Qualified Crane Operators receive documented training on the operation of the Crane/Hoist and associated rigging they use before they are allowed to use the equipment. A “Qualified Person/Operator” may train a Stand-by Person for a specific and designated lift as long as the Operator discusses all safe-lift aspects and

known hazards concerning the lift with the Stand-by Person, and coordinates their lift/rigging planning, prior to conducting the lift.

The Department owning the crane or hoist has the option of providing training through:

- A training provider outside the University.
- Training within the department by a “Qualified Person”.
- Training must be completed prior to any use of a crane or hoist. Training of crane and hoist operators should consist of classroom instruction & hands-on training.
- Classroom instruction, hands-on training and operator evaluations can be conducted by either a competent trainer in the work unit, the equipment manufacturer, a safety consultant and/or a vendor who specializes in crane/hoist training. Hands-on training and hands-on evaluation portions of the training can also be conducted by an employee in the department/work unit who is experienced and competent with the equipment. This person could be a trained operator, supervisor/manager, or safety officer.
- Training must be specific to the type of equipment being used.
- Training shall include the following:
 - Characteristics of safe crane and hoist operation;
 - Inspection procedures;
 - Basic load handling considerations;
 - Operator responsibilities;
 - Communication used during crane and hoist operation;
 - Hands-on equipment training.
- Trainees must successfully complete hands-on training before being allowed to operate the equipment independently. Trainees will be given adequate supervision and time to learn basic operating skills.
- Refresher training in relevant topics will be provided to a crane or hoist operator when any of the following occur:
 - The operator has been observed to be using the equipment in an unsafe manner
 - The operator has been involved in an accident or a near-miss incident.
 - The operator is assigned to operate a different type of equipment.
 - A condition in the workplace changes in a manner that could affect safe operation of the equipment

References

ASME/ANSI B30.2, "Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)."

ASME/ANSI B30.9, "Slings." ASME/ANSI B30.10, "Hooks."

ASME/ANSI B30.11, "Monorails and Underhung Cranes." ASME/ANSI B30.16, "Overhead Hoists (Underhung)."

ASME/ANSI B30.17, "Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)."

ASME/ANSI B30.20, "Below-the-Hook Lifting Devices." ASME/ANSI B30.21, "Manually Lever Operated Hoists."

Code of Federal Regulation, Title 29, Part 1910.179, "Overhead and Gantry Cranes."

Code of Federal Regulation, Title 29, Part 1910.184, "Slings."

Code of Federal Regulation, Title 29, Part 1926.550, "Cranes and Derricks."

Mechanical Engineering Department Design Safety Standards, Chapter 2.2, "Lifting equipment." CMAA Specification No. 70, Specifications for Electric Overhead Traveling Cranes.

CMAA Specification No. 74, Specifications for Top-Running and Under-Running Single-Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist.

NFPA 70, Article 610, Cranes and Hoists.

Appendices

Appendix A: Pre-Use Crane, Hoist and Sling Inspection Guidelines

Appendix B: Crane & Hoist Monthly Inspection Checklist

Appendix C: Examples of Cranes and Hoists

Appendix D Examples of Slings

Appendix E: Crane and Hoist Training Certification Form

Disclaimer

The information provided in these guidelines is designed for educational use only and is not a substitute for specific training or experience.

The University of Tennessee Knoxville and the authors of these guidelines assume no liability for any individual's use of or reliance upon any material contained or referenced herein. The material contained in these guidelines may not be the most current.

This material may be freely distributed for nonprofit educational use. However, if included in publications, written or electronic, attributions must be made to the author. Commercial use of this material is prohibited without express written permission from the author.

Appendix A:

Pre-Use Crane, Hoist and Sling Inspection Guidelines

Item	Yes	No	N/A
<i>Cranes and Hoists</i>			
Load rating marked on each side of the crane.			
Load rating of the hoist marked on the hoist or its load block and legible from the ground? (If the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its loading block and this marking shall be clearly legible from the ground.)			
At least 3 inches of overhead clearance and 2 inches laterally between crane and obstructions.			
All controller functions labeled and legible.			
All operational controls and functional operating mechanisms working properly, properly adjusted and no unusual sounds.			
Upper limit switch operating properly. It shall be tested with no load on the hook. Extreme care shall be exercised; the block shall be "inched" into the limit device or run in at slow speed.			
Excessive wear of components on any functional operating mechanisms.			
Deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of the air or hydraulic system.			
Excessive dirt, grease, or foreign matter.			
Deformation and/or cracking of the hook, load block, drums and/or sheaves.			
Safety latch on crane/hoist load block that automatically closes.			
<i>Chain Slings:</i>			
Nicks, cracks, breaks, stretches, distortions, twists, gouges, bends, heat damage, discoloration, worn or damaged links and components,			
Lack of ability of the chain or components to hinge (articulate) freely,			
Pitting, corrosion or weld splatter,			
Missing or illegible sling identifications,			
Other conditions that cause doubt as to the continued safe use of the sling.			

Item	Yes	No	N/A
Wire Rope Slings:			
Broken wires,			
Pitting or corrosion,			
Localized wear (shiny worn spots), abrasion or scrapes,			
Damage or displacement of end fittings, hooks, rings, links, or collars,			
Distortions, kinks, bird caging, crushing, or other evidence of damage to wire rope structure,			
Missing or illegible sling identifications,			
Other conditions that cause doubt as to the continued safe use of the sling.			
Synthetic Fiber Rope / Synthetic Webbing Slings:			
Melting, charring or burning of any part of the surface,			
Snags, punctures, tears, cuts, fraying, broken or worn stitches,			
Change in diameter,			
Discoloration,			
Hard or stiff areas,			
Wear or elongation exceeding the amount recommended by the manufacturer,			
Distortion of fittings,			
Missing or illegible sling identifications,			
Other conditions that cause doubt as to the continued safe use of the sling.			
Metal Mesh Slings:			
Broken weld or brazed joints,			
Broken wire in any part of the mesh,			
Abrasion, corrosion, distortion, pitting, twisting, bending, cracking, gouging of any component,			
Lack of flexibility,			
Missing or illegible sling identifications,			
Other conditions that cause doubt as to the continued safe use of the sling.			

Appendix B: Crane & Hoist Monthly Inspection Checklist

#	Inspection Item	Yes	No	N/A
1	Conduct pre-use inspection of equipment. Does it pass the pre- use inspection? (See Appendix A)			
2	Any deformed, cracked, or corroded members?			
3	Are there worn, cracked, or distorted parts such as pins, bearings, wheels, shafts, gears, rollers, locking and clamping devices, bumpers, and stops?			
4	Is there excessive wear or improper operation of the brake system parts, linings, pawls, chain sprockets or ratchets?			
5	Any cracked or worn sheaves and drums?			
6	Are there loose or missing bolts, nuts, pins or rivets?			
7	Is there any signs of pitting or deterioration of controllers, master switches, contacts, limit switches, and push button stations?			
8	Are load, wind, and other indicators properly operating?			
9	Are gasoline, diesel, electric, or other power plants performing properly?			
10	Are stops provided at the limit of travel of the trolley?			
11	Corroded, cracked, bent, worn, or improperly applied end connections?			
12	Load chain reeving for compliance with hoist manufacturer's recommendation?			
Hook				
13	Is there any gouges, nicks, weld spatter, corrosion, deformation, cracks?			
14	Has the hook throat opening increased 5%, not to exceed ¼ inch (6 mm), more than the normal throat opening measured at the narrowest point?			
15	Is there any bend or twist from the plane of the unbent hook?			

#	Inspection Item	Yes	No	N/A
Chain				
16	Is there excessive drive chain stretch?			
17	Test the hoist under load in lifting and lowering directions and observe the operation of the chain and sprockets. Does the chain feed smoothly into and away from the sprockets?			
18	Does the chain bind, jump, or is noisy? If so, clean chain. If trouble continues inspect the chain and mating parts for wear, distortion, or other damage.			
19	Slacken the chain and move the adjacent links to one side to inspect for wear at the contact points. Is wear observed? Is stretching suspected?			





Refer to owner’s manual for any additional inspection items: Comments:


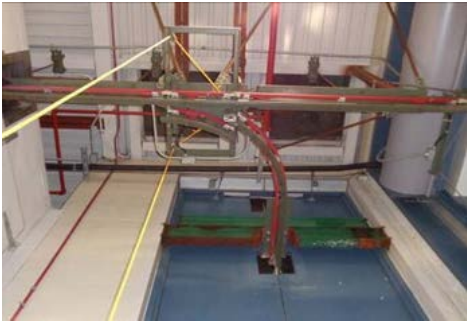


Crane ID number or identifier: _____


Inspector (print): _____





Sign: _____ Date: _____

Appendix C:**Examples of Cranes and Hoists**



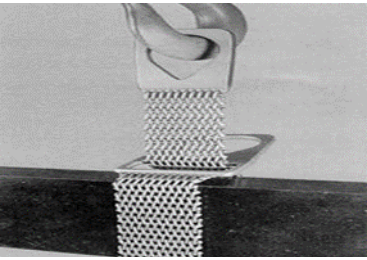


	<p>Jib Crane A type of crane where a horizontal member (jib or boom), supporting a moveable hoist, is fixed to a wall or to a floor-mounted pillar.</p>
	<p>Wall-Crane</p>
	<p>Gantry Crane A type of crane has a hoist which typically runs horizontally along rail/s</p>
	<p>Semi-Gantry Crane</p>

	<p>Monorail</p>
	<p>Switching Monorail</p>
	<p>Bridge Crane A load lifting system consisting of a hoist which moves laterally on a beam, girder, or bridge which in turn moves longitudinally on a runway made of beams and rails. Loads can be moved to any point within a rectangle formed by the bridge span and runway length.</p>
	<p>Mobile Crane</p> <p>Are not covered in this program.</p>

	<p>Winches</p> <p>Are not covered in this program Follow the manufacturer's recommendations</p>
	<p>Electric Chain Hoist</p>
	<p>Manually Operated Hoists</p> <p>Lever Hoist</p> <p>Chain Fall Hoist</p> <p>Come-Along Hoist</p>

 A photograph of a pneumatic chain hoist. It features a cylindrical metal body with a black handle on top, a chain hanging from the bottom, and a hook at the end of the chain. The hoist is mounted to a light-colored wall.	<p>Pneumatic Chain Hoist</p>
 A photograph of an electric wire-rope hoist. It is a bright red, rectangular unit with a yellow emergency stop button on the right side. A red hook is attached to the bottom of the hoist.	<p>Electric Wire-Rope Hoist</p>
 A photograph of a pneumatic wire-rope hoist. It has a blue motor housing and a long, thin red arm extending to the right. A coiled spring is visible on the left side of the motor housing.	<p>Pneumatic Wire-Rope Hoist</p>
 A photograph of an engine hoist. It is a black metal frame with a long, white arm extending to the right. The frame has four casters for mobility. The arm is labeled with '1 TON' and '150004'.	<p>Engine Hoist</p> <p>Are not covered in this program Follow the manufacturer's recommendations</p>

Appendix D:
Examples of Slings

 A black alloy steel chain with a hook at the top and two hooks at the bottom.	Alloy Steel Chain
 A collection of several silver wire ropes with loops at the ends.	Wire Rope
 A close-up of a metal mesh sling attached to a hook.	Metal Mesh
 A collection of yellow and white fiber ropes with loops at the ends.	Natural and Synthetic Fiber Rope
 A green synthetic webbing sling with a hook at the end. The text "2000KG L-2M" is visible on the webbing.	Synthetic Web

Appendix E: Crane and Hoist Training Certification Form

Name of Trainer (print) _____ (Sign): _____

<i>Name (Print)</i>	<i>Date of classroom training</i>	<i>Date of hands-on training</i>	<i>Date of Evaluation (if required)</i>	<i>Signature</i>