

Crane, Hoist and Sling Safety Program

Section II: NAU Staff

Overview

Cranes, hoists, and slings pose a serious safety hazard if not used properly. It is the intent of Northern Arizona University (NAU) to ensure all users and owners are trained in the safe operation and the hazards of using cranes, hoists and slings. All equipment, as such, must be safely maintained.

Scope & Applicability

This program applies to all NAU faculty, staff and students at all NAU locations.

This program covers the following cranes and hoists: overhead and gantry cranes, semi-gantry cranes, cantilever gantry cranes, wall cranes, monorail cranes, bridge cranes, single girder cranes, overhead hoists, engine hoists or winches, mobile cranes, and other hoists and cranes having the same fundamental characteristics.

This program does not cover cab operated cranes and mobile cranes (wheel-mounted, rough-terrain, all-terrain, commercial truck-mounted, and boom truck cranes).

The program covers the following types of slings used at NAU: alloy steel chain, wire rope, metal mesh, natural and synthetic fiber rope, and synthetic webbing.

Environmental Health and Safety

Table of Contents:

| | |
|---------------------------------------------------------------------------------------|-----------|
| References | 3 |
| Definitions | 3 |
| Responsibilities | 5 |
| Training | 6 |
| Personal Protective Equipment..... | 7 |
| General Procedures | 7 |
| Specific Requirements and Procedures | 8 |
| Inspections..... | 8 |
| Maintenance | 11 |
| Recordkeeping..... | 11 |
| Crane Operation | 12 |
| Chains, Slings, and Hoists..... | 13 |
| Rigging Personnel Platforms | 16 |
| Mobile Cranes (Additional Guidance)..... | 16 |
| Contractors | 17 |
| Appendix A: Monthly Crane/Hoist Frequent Inspection Checklist..... | 18 |
| Appendix B: Annual Crane/Hoist Periodic Inspection Checklist | 19 |
| Appendix C: Annual Sling Periodic Inspection Checklist..... | 21 |
| Appendix D: Examples of Cranes and Hoists | 23 |
| Appendix E: Examples of Slings..... | 26 |
| Appendix F: Safe Work Practices for Cranes, Hoists and Slings..... | 27 |
| Appendix G: Bridge Crane Operator Evaluation Form..... | 30 |
| Appendix I: Instructions for Conducting Bridge Crane Operator Evaluations..... | 31 |

Environmental Health and Safety

References

OSHA Publication – Sling Safety - #3072
OSHA Standard – Overhead and Gantry Cranes – 29 CFR 1910.179
OSHA Standard – Slings – 29 CFR 1910.184
ANSI/ASME B30.2 – Overhead and Gantry Cranes
ANSI/ASME B30.9 – Slings
ANSI/ASME B30.10 – Hooks
ANSI/ASME B30.11 – Monorails and Underhung Cranes
ANSI/ASME B30.16 – Overhead Hoists (Underhung)
ANSI/ASME B30.17 – Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
HMI (Hoist Manufacturers Institute) – Manually Lever Operated Hoist Inspection and Hoist Maintenance Personnel Manual

Definitions

Authorized Person (Repair): Someone with training and experience pertaining to crane and hoist repair, with the expertise to address the specific safety considerations that are unique to cranes and hoists.

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

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.

Bumper: A 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 into contact. This device may be attached to the bridge, trolley or runway stop.

Certification/Certified: Training to a standardized criterion or content by a person or organization accredited by a recognized approving organization to provide that specific training material.

Competent Trainer: A person who has demonstrated familiarity with the type of crane/hoist in their work area. A contractor or equipment vendor who has experience training, crane/hoist operation and is familiar with the equipment is also permitted to be a Competent Trainer.

Competent Evaluator: A person in the department/work area who is experienced and competent with the crane, and is familiar with the equipment and its safe operation. The classroom portion of the crane/hoist training must have been successfully completed to be considered competent regarding conducting

Environmental Health and Safety

the evaluation portion of the crane training. The competent evaluator could be, but is not limited to, a certified operator, supervisor/manager or safety officer.

Crane: For this document, a crane is defined as any power-operated equipment, when used in construction that can hoist, lower and horizontally move a suspended load. Such equipment includes, but is not limited to: permanently installed or mobile cranes (such as wheel-mounted, rough-terrain, all-terrain, commercial truck-mounted, and boom truck cranes); multi-purpose machines when configured to hoist and lower (by means of a winch) a suspended load.

Exceptions:

1. Digger Derrick (pole truck)
2. Bucket Truck Hoists
3. Boom truck cranes under 2000lb
4. Powered personnel lifts (boom and scissor type)

Department/School: Unit designated for providing necessary funding to meet the requirements of this program to include inspections and repairs.

Designated Person: Person selected or assigned by NAU or NAU's representative as being qualified to perform specific duties, including periodic inspections.

Drum: The cylindrical member around which rope is wound for lifting or lowering the load.

End Truck: An assembly consisting of the frame and wheels which support the crane girder(s) and allow movement along the runway.

Floor operated crane: Crane controlled by an operator on the floor or an independent platform using a pendant or non-conductive rope.

Gantry crane: A crane that has a hoist in a trolley which runs horizontally along gantry rails, usually fitted underneath a beam spanning between uprights which themselves have wheels so that the whole crane can move at right angles to the direction of the gantry rails.

Hoist: A suspended machinery unit that is used for lifting or lowering a freely suspended (unguided) load.

Latch Hook: A type of hook with a mechanical device to close the throat opening of the hook.

Limit Device: A device that is operated by some part or motion of a power-driven hoist to limit motion.

Environmental Health and Safety

Load: The total superimposed weight of the load block and hook.

Monorail: A trolley suspension crane hoist, whose trolley is suspended from a single rail. This type of crane hoist is used to move a load horizontally.

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

Qualification/Qualified: Training based on a specific learning objective, skill, or demonstration of ability to complete a specific task. Depending on regulations, the Qualification Evaluator may be a supervisor or in-house trainer, or a specialist approved to evaluate specific qualifications by a recognized organization.

Rated Load (Capacity): The maximum load designated by the manufacturer for which a crane or individual hoist is designed and built.

Reeving: A system in which a rope or chain travels around drums, sheaves or sprockets.

Responsible Person: A person that is accountable for the duties as assigned above. This person could be a Principal Investigator (PI) or manager of the area.

Rope: Refers to wire rope unless otherwise specified.

Sheave: A grooved wheel or pulley used with a rope or chain to change direction and point of application of a pulling force.

Trolley: The unit which travels on the bridge rails and carries the hoisting mechanism.

Wall mounted jib crane: A crane with a jib and with or without a trolley. The wall crane is supported from a side wall or columns of a building.

Responsibilities

Department Administration

- Designate individuals as the Responsible Person for the implementation of this program within their work area. Evaluate individuals on performance.
- Ensure adequate funding/time/resources are available to support this program.
- Set a positive example by adhering to all safety requirements, engaging with staff/supervisors regarding safety, noting deficiencies and assigning people/resources to make corrections.

Supervisor/PI/Responsible Person

Environmental Health and Safety

- Ensure that responsibilities assigned within this program are carried out within their administrative work area. Evaluate individuals on performance.
- Actively support this program as part of the work area's overall safety effort.
- Be aware of the contents of this program and its application.
- Ensure equipment users receive training appropriate to their assigned tasks. Maintain documentation of such training.
- Ensure equipment users comply with all provisions of this program.
- Ensure equipment users are provided with and use any required protective equipment.
- Take prompt corrective action when unsafe conditions or practices are observed.
- Investigate injuries and incidents related to crane, hoist and sling usage, and ensure that corrective/preventive measures are taken.

Operators and Riggers

- Attend all training required by this program.
- Follow the work practices described in this program, including the use of appropriate protective equipment.
- Immediately report any unsafe conditions or concerns related to cranes, hoists or slings to their Responsible Person. Do not proceed with work until safety has been re-established.

Environmental Health and Safety (EHS) Department

- Assist work units in implementing the provisions of this program.
- Periodically evaluate the overall effectiveness of this program and update as necessary.
- Review and approve competent trainers and evaluators.
- Maintain an inventory and periodically evaluate equipment records covered by this program.
- Recommend intervals for frequent and periodic inspections.
- Investigate accidents, incidents, and near misses related to cranes on campus and recommend corrective/preventive measures.

Training

1. Training must be completed prior to any use of a crane or hoist. Training of crane and hoist operators at NAU is a two-step process for most cranes/hoists which consists of classroom instruction and hands-on training/evaluation.
2. Classroom instruction, hands-on training and operator evaluations may be conducted by a competent trainer in the organization, the equipment manufacturer, a safety consultant or a vendor who specializes in crane/hoist training. Documentation of these trainings must be kept by the department supervisor and/or input into the EHS Safety Management System.
3. Hands-on training and hands-on evaluation portions of the training may also be conducted by a competent operator/rigger in the department who is

Environmental Health and Safety

experienced with the specific equipment. This person could be a trained operator, supervisor/manager or department safety officer.

4. Training must be specific to the type of equipment being used.
5. Training shall include the following
 - a. Characteristics of safe operation.
 - b. Inspection procedures.
 - c. Load handling.
 - d. Operator responsibilities.
 - e. Communication used during crane and hoist operation.
 - f. Hands-on equipment training.
6. Trainees must successfully complete hands-on training before being allowed to operate the equipment independently. Trainees shall be given adequate supervision and time to learn basic operating skills.
7. Refresher training in relevant topics shall be provided to a crane or hoist operator when any of the following occur:
 - a. The operator is observed using the equipment in an unsafe manner.
 - b. The operator is involved in an accident or a near-miss incident.
 - c. The operator is assigned to operate a different type of equipment.
 - d. A condition in the workplace changes in a manner that could affect safe operation of the equipment.

Personal Protective Equipment

All employees who handle the wire slings and the hoist cables shall wear appropriate protective gloves to prevent any hand injury.

High visibility vests, hard hats, and safety glasses are required when working inside the lift zone.

Select environments may require additional PPE such as hard toe shoes or fall protection. Contact EHS for site specific hazard evaluations before proceeding with new operations or work at new installations.

General Procedures

1. The PI/Supervisor must notify Environmental Health and Safety (EHS) prior to any new crane or hoist installation, or if existing units are relocated or brought back into service after disuse. All installations must meet applicable OSHA and ANSI standards.
 - a. The Maximum load rating must be clearly visible on all fixed and mobile cranes.
2. All mobile and fixed cranes must be inspected and maintained on the regular schedules advised in this document. Any maintenance must be made by authorized personnel. Inspection/maintenance records must be kept on file for occasional review by EHS or regulatory inspectors.

Environmental Health and Safety

3. Departments must designate a responsible person to ensure local adherence to safety guidelines and that operation is limited to only appropriately qualified or certified (depending on the equipment/work requirements) crane operators and riggers.
 - a. There may be minor tasks, such as light pole installation, loading and unloading of equipment or materials, etc., where a Qualified rigger can be used in lieu of a Certified rigger. This is based on the responsible person's evaluation of the task.
4. Follow all manufacturer's instructions and warnings while operating cranes and lifts
5. Do not make lifts over occupied areas or building spaces
 - a. At a minimum, for loads not exceeding 250 lbs, the occupied area of a building directly under the swing area of a crane lift shall be vacated by all students, employees, faculty and staff for the duration of the lift.
 - b. For any loads over 250 lbs, the responsible person must evaluate the lift in order to.
 - i. Determine if evacuation of the work zone is necessary, and
 - ii. Determine the size of the evacuation area.
6. The work zone, including crane swing and lift areas shall be barricaded or fenced to prevent unauthorized personnel from entering. Only the operator and riggers performing the lift shall be allowed in the work zone.
7. Operators and Riggers must be properly trained (Certified or Qualified as conditions require) prior to performing any crane work. Training documentation records must be kept by supervisors for access by regulatory inspectors or EHS.
8. Operators shall follow safe work practices when operating cranes, hoists and slings. (See Appendix F).
9. Hard hats, high visibility vests or clothing and safety glasses are required of the operator and the riggers on any crane jobsite.

Specific Procedures and Requirements:

Inspections

Overhead crane inspections are divided into two general classifications: Frequent Inspections and Periodic Inspections. Inspection checklists are completed as part of the inspection process. Inspection checklists shall be available for inspection.

Frequent Inspection

Rope slings, hooks and other lifting equipment shall be visually inspected prior to each day's use. All parts including chains, cables, ropes, hooks, etc., on overhead and gantry

Environmental Health and Safety

cranes shall be visually inspected daily for deformation, cracks, excessive wear, twists, stretch, or other signs of deterioration that may pose a hazard during use.

Hooks and chains shall be visually inspected daily and monthly with a record which documents the date of inspection, the signature of the person who performed the inspection, and serial number or other identifier from the equipment. Hooks that have cracks or have more than 15% in excess of normal throat opening or more than 10% twist from the plane of the unbent hook should be replaced.

Running ropes shall be inspected monthly. A certification record which includes the date of the inspection and signature of the person who performed the inspection should be prepared. Any deterioration which results in appreciable loss of strength shall be inspected and a determination made as to whether further use of the rope constitutes a safety hazard. The monthly inspection will consist of noting the following disqualifying conditions:

- a. Reduction of rope diameter below a nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.
- b. Three broken wires in one strand in one lay length or six broken wires in any one lay length.
- c. Worn outside wires.
- d. Corroded or broken wires at connections.
- e. Corroded, cracked, bent, worn or improperly applied end connections on the equipment name plate.
- f. Severe kinking, crushing, cutting or un-stranding.

Periodic Inspections

Periodic inspections shall be conducted by a factory trained employee or a contract certified inspection service.

A complete inspection of the crane shall be performed at least every 12 months. The inspection should include the following:

- a. Noting any cracked, corroded, worn or loose members or parts.
- b. Noting and replacing loose bolts and tightening those bolts.
- c. Testing the limit indicators (wind, load, etc), power plant and electrical apparatus.
- d. Load testing must be performed at no more than 125 percent of the rated load, unless it is otherwise recommended by the equipment manufacturer.

Environmental Health and Safety

- e. Examining the electrical apparatus for any signs of pitting, or any deterioration of controller contractors, limit switches and push button stations.
- f. Travel distance steering.
- g. Testing the braking system for excessive wear on the lining, pawls and ratchets.
- h. Hooks and cables.
- i. Any other manufacturer recommended inspection points.

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

Inspections for Cranes, Hoists and Slings

The Responsible Person shall ensure the following inspections are completed and recorded in department records:

1. Pre-Use Inspection (performed by operator)
 - a. Visually inspect the crane, hoist and/or slings for defects.
 - b. Identify conditions that could affect the safe use of the equipment.
 - c. Immediately report any unsafe crane conditions to the Responsible Person. Do not proceed until safe condition is restored.
2. Frequent/Monthly Inspection (Crane and Hoists) – (See Appendix A)
 - a. A documented frequent inspection of all cranes and hoists shall be performed. Inspections must be performed by a designated person.
 - b. Inspections shall be performed monthly or if a crane is rarely used, at an interval determined by the Responsible Person in collaboration with EHS.
3. Periodic/Annual Inspection (Cranes and Hoists) – (See Appendix B)
 - a. A documented periodic inspection of all cranes and hoists shall be performed by a designated person.
 - b. All cranes and hoists shall be labeled or marked to show date of last annual inspection.
 - c. Intervals for periodic inspections will be determined in agreement with EHS but must be performed at least annually.
4. Cranes and Hoists Not in Regular Use
 - a. A unit which has been idle for a period of one month or more shall be given a frequent inspection before placing in service. When applicable, a thorough inspection of wire ropes must be completed.
 - b. A unit which has been idle for a period of six months or more shall be given a frequent and periodic inspection before placing in service.
5. 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:

Environmental Health and Safety

- a. Hoisting and lowering
 - b. Trolley travel
 - c. Bridge travel
 - d. Limit switches, locking and safety devices
 - e. Load Tests
 - i. Shall not be more than 125% of the rated load unless otherwise recommended by the manufacturer.
6. If any unsafe conditions exist, the equipment shall be removed from service and tagged "Out of Service, Do Not Use."
7. Periodic/Annual Inspection (Chains and Slings) – (See Appendix C)
- a. A documented periodic inspection of all chains and slings shall be performed by a designated person.
 - b. Each chain and sling will have a permanent tag physically attached.
 - c. Each chain and sling will be traceable to an NIST standard.
 - d. Intervals for periodic inspections will be determined in agreement with EHS but must be performed at least annually.

Maintenance

Preventive maintenance shall be performed as prescribed by the manufacturer as detailed in the owner's manual.

Recordkeeping

The Responsible Person shall maintain the following records to meet the requirements of this program:

1. A listing of all applicable cranes, hoists and slings.
2. A record of training which includes: (Use Appendix F or equivalent)
 - a. Name of trainer.
 - b. Name of operator.
 - c. Date of training (classroom, hands-on training, hands-on evaluation).
3. The responsible party will maintain the following records to meet the requirements of this program:
 - a. Copies of all frequent inspection records for one year after completion.
 - b. Copies of periodic and annual inspection records for at least four years.
 - c. Copies of repair records for the life of the equipment.
 - d. Copies of load test results for the life of the equipment.
4. EHS is responsible for auditing the required records to ensure that the requirements of this program are met.
5. EHS will receive and retain training records for training they have provided.

Crane Operation

Operators shall not leave their position at the controls while the load is suspended or pass under a suspended load on the hook. Other employees shall not walk under a suspended load.

Environmental Health and Safety

Maximum Load Rating

The rated load of the crane shall be plainly marked on each side of the crane. If the crane has more than one hoisting unit, each hoist and each unit should be clearly marked. Markings shall be legible from the working surface. The load shall not exceed the rated load of the crane or hoist. If the rated load is not clearly marked, do not guess. Contact the manufacturer for load information and replacement labels.

A load is defined as the total superimposed weight on the load block or hook and includes any lifting devices such as magnets, spreader bars, chains and slings. A common misconception is that the operator may exceed the rated load up to a built-in safety factor. Rated loads represent the maximum limit that equipment is guaranteed to operate properly and safely and may not be exceeded for any reason.

Attaching the Load

The operator/rigger must be familiar with the appropriate rigging and hoisting techniques before moving the load. The following items shall also be noted:

1. The hoist chain or hoist rope must be free of kinks or twists and shall not be wrapped around the load.
2. The load should be attached to the load block hook by means of slings or other approved devices. The sling should clear all obstacles.

Every load shall be well secured and properly balanced in a sling or other lifting device. If the operator/rigger is unsure of how to appropriately rig a load, contact the Responsible Person, Supervisor, or EHS for assistance before proceeding.

Moving the Load

The load must be well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches. The hoist rope shall not be kinked, and multi-part lines shall not be twisted around each other. The hook must be brought over the load in such a manner as to prevent swinging. There must be no sudden acceleration or deceleration of the moving load. Contact with obstructions must be avoided.

Do not hoist, lower or travel loads while workers are on the load or hook.

Do not move loads over people or occupied portions of buildings.

The operator will test the brakes each time a load approaching the rated load is handled. The brakes will be tested by raising the load a few inches and applying the brakes.

The load will not be lowered below the point where less than 3 full wraps remain on the hoisting drum.

The operator will not leave his position while the load is suspended. The operator must be aware of the appropriate chains, hoist, and sling requirements.

Environmental Health and Safety

Chains, Slings, and Hoists

Safe Operating Practices (All slings, chains and hoists)

Slings that are damaged or defective shall be destroyed. Slings shall not be shortened with knots, belts or other makeshift devices. Sling legs shall not be kinked.

Slings shall not be loaded in excess of their rated capacities. They shall be securely attached to their loads.

Slings must be padded or protected from the sharp edges of their loads.

Suspended loads shall be kept clear of all obstructions. All employees shall be kept clear of suspended loads and imminently lifted loads.

Keep hands and fingers away from the sling while the sling is being tightened around the load.

Do not pull slings from under a load when the load is resting on the sling.

Alloy Steel Chain Slings

All steel chain slings should have a permanently affixed durable identification stating size, grade, rated capacity and reach, and inspection date. Worn or damaged alloy steel chain slings or attachments shall not be used until it is repaired. All steel chain slings with cracked or deformed master links, coupling links or other components should be removed from service. Alloy steel chain slings shall be permanently removed from service if they are heated above 1,000°F.

Wire Rope Slings

Fiber core wire rope slings of all grades should be removed from service if they are exposed to temperatures in excess of 200°F.

Wire rope slings should be removed from service if any of the following is present:

1. Six randomly distributed broken wires in one rope lay or three broken wires in one strand in one rope lay.
2. Wear or scraping of one-third the original diameter of outside individual wires.
3. Kinking, crushing, bird caging, or any other damage is noted.
4. Corrosion of the rope or end attachments.
5. There is evidence of heat damage.
6. End attachments are cracked, deformed or worn.
7. It is determined that hooks have been opened more than 15 percent beyond the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook.

Metal Mesh Slings

Environmental Health and Safety

Each metal mesh sling shall have permanently affixed to it a durable marking that states the rated capacity for a vertical basket and choker hitch loadings.

If handles are used on metal mesh slings, the rated capacity must be at least equal to the metal fabric and exhibit no deformations after load testing. If handles are attached to fabric, they must be joined so that the rated capacity of the sling is not reduced, the load is evenly distributed across the width of the fabric, and the sharp edges will not damage the fabric.

Metal mesh slings shall not be used to lift loads in excess of their rated capacities. Metal mesh slings which are not impregnated with elastomers may be used in a temperature range of -20°F to 550°F without decreasing the working load limit. If the sling is impregnated with other materials, then the sling manufacturer's recommendations must be followed.

If metal mesh slings are repaired, they should not be used unless they are repaired by the sling manufacturer or authorized servicer. Once repaired, records must be maintained to indicate the date and the nature of repair and the person or organization who performed the repair.

Metal mesh slings must be immediately removed from service, if any of the following conditions are present:

- A. A broken weld or brazed joint along the sling edge.
- B. Reduction in wire diameter of 25% due to abrasion or 15% due to corrosion.
- C. Lack of flexibility due to distortion of the fabric.
- D. 15% reduction of the original cross sectional area of metal at any point around the handle eye.
- E. Distortion of the female handle so that the depth of the slot is increased more than 10%.
- F. Distortion of either handle so that the width of the eye is decreased more than 10%.

Natural and Synthetic Fiber Rope Slings

Natural and synthetic fiber rope slings, except for wet frozen slings, may be used in a temperature range from -20°F to 180°F without decreasing the working load limit. For operations outside of this range, the manufacturer's recommendations should be followed. 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:

- A. Abnormal wear.

Environmental Health and Safety

B. Powdered fiber between strands.

C. Variations in the size or roundness of strands.

D. Discoloration or rotting.

E. Distortion of hardware in the sling.

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

Each sling must be marked or coded to show the rated capacities for each type of hitch and type of synthetic web material.

Nylon web slings shall not be used where there are fumes, vapors, sprays, mists, or liquids of acids or phenolic present.

Polyester and polypropylene web slings shall not be used where there are fumes, vapors, sprays, mists or caustics present.

Web slings with aluminum fittings shall not be used where fumes, vapors, sprays, mists, or liquid caustics are present.

Synthetic polyester web slings shall not be used with temperatures in excess of 180°F. Polypropylene web slings shall not be used at temperatures in excess of 200°F.

Synthetic web slings shall be immediately removed and destroyed if there are:

A. Acid or caustic burns.

B. Melting or charring of any part of the sling surface.

C. Snags, punctures, tears or cuts.

D. Broken or worn stitches.

E. Distortion of fittings.

Rigging of Personnel Platforms

Use of cranes and hoists to lift personnel is generally prohibited. If this type of personnel lift is required or is the only available option, contact EHS for a policy exception and site evaluation before proceeding with any setup or lifting operations.

Mobile Cranes (Additional Guidance)

Environmental Health and Safety

The employing department shall comply with the manufacturer's specifications and limitations applicable to the crane operation. The attachments that are used with a crane shall not exceed the capacity, rating or scope recommended by the manufacturer. The rated load capacities, recommended operating speeds, and hazard warnings or instructions shall be conspicuously posted on all equipment. If labelling becomes illegible, contact the manufacturer for replacement labels.

OPERATING REQUIREMENTS

A. The designated responsible person or qualified operator will inspect all machinery and equipment prior to each use to make sure that it is in safe operating condition. If a damage or defects are found, they must be repaired prior to use.

B. A thorough annual inspection of the hoisting equipment shall be made by a qualified or certified person. The dates and the result of the inspections and any resulting maintenance or repair for each piece of equipment will be maintained by the department. The department will maintain records which include the date(s) of inspection, serial number or other identifier for the crane that was inspected, and results of that inspection. The most recent certification will be retained on file until a new one is prepared.

- a. All inspection records shall be kept with the department for review by regulatory or EHS inspectors.

C. Prior to use, all accessible areas within the swing radius of the rotating superstructure of the crane shall be barricaded in such a manner as to prevent employees from being struck or crushed by the crane.

D. Exhaust pipes shall be guarded or insulated in areas where contact by employees is possible in the performance of normal duties.

E. All windows in cabs shall be safety glass, or equivalent. There should be no visible distortion that will interfere with the safe operation of the machine or sight lines of the operator.

F. Guard rails, handholds, and steps shall be provided on cranes for easy access to the car and the cab.

G. Platforms and walkways shall have anti-skid surfaces.

H. An accessible fire extinguisher of 2A10BC rating or higher shall be available at all operator stations or cabs of equipment.

I. If the equipment or machinery must be operated next to electrical lines, then the following procedures must be followed:

Environmental Health and Safety

1. For electrical lines that are rated 50 KV or below, the minimum clearance between the lines and any part of the crane or load shall be 10 feet.
2. For lines rated over 50 KV, the minimum clearance between the lines and any part of the crane or load shall be 10 feet plus 0.4 inch for each 1 KV over 50 KV, or twice the length of the line insulator, but never less than 10 feet.
3. If the equipment is in transit with no load and boom lowered, the equipment clearance shall be a minimum of 4 feet for voltages less than 50 KV and 10 feet for voltages over 50 KV, up to and including 345KV, and 16 feet for voltages up to and including 750 KV.
4. A safety observer shall be designated to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means.
5. Any overhead wire shall be considered to be an energized line unless documentation is available to determine that the electrical lines are de-energized.

Contractors

Contractors are required to follow all applicable OSHA regulations and manufacturer's instructions. Contractors are not permitted to use any crane, hoist or sling owned by NAU unless given documented authorization by the responsible owner and Environmental Health and Safety. For contractor specific requirements, please refer to *Section I: Contractors* of this document

Environmental Health and Safety

Appendix A

Crane/Hoist Frequent Inspection Checklist

Location:

ID number or identifier:

Inspector Name (print):

Date:

| Inspection Item | Yes | No | N/A |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|-----|
| 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. | | | |
| Comments: | | | |

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Appendix B

Crane/Hoist Periodic Inspection Checklist

Location:

ID number or identifier:

Inspector Name (print):

Date:

| # | Inspection Item | Yes | No | N/A |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|-----|
| 1 | Conduct frequent inspection of equipment. Does it pass the frequent 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 the gasoline, diesel, electric, or other power units 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? | | | |

Comments:

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Hook:

| | | | | |
|----|---------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 13 | Are 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? | | | |

Wire Rope/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? | | | |
| 20 | Is chain lubricated to manufacturer's requirement? | | | |

Refer to owner's manual for any additional inspection items:

Comments:

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Appendix C

| Sling Periodic Inspection Checklist | | | |
|-----------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|--------------|
| Location: | | | |
| ID number or identifier: | | | |
| Inspector Name (print): | | | Date: |
| Item (Slings) | Yes | No | N/A |
| Chain/Slings: | | | |
| 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 safe use of sling. | | | |
| 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, | | | |

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| | | | |
|--------------------------------------------------------------------------------------------------|--|--|--|
| Other conditions that cause doubt as to the continued safe use of the sling. | | | |
| <i>Metal Mesh Slings:</i> | | | |
| 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. | | | |
| Comments: | | | |
| | | | |

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Appendix D

Examples of Cranes and Hoists



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.

Jib Crane

Wall Crane



A type of crane has a hoist which typically runs horizontally along rail/s.

Gantry Crane

Semi Gantry Crane

Monorail

Switching Monorail

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Mobile Cranes



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.

Bridge Crane



Winches

***Follow the manufacturer's
recommendations***





Hoists

Chain Hoist





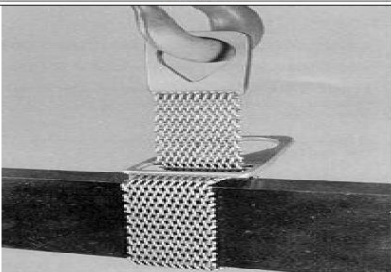


Wire Rope Hoist

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| | |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><u>Manually operated hoists</u></p> <p><u>Lever Hoist</u> <u>Chain Fall Hoist</u> <u>Come Along Hoist</u></p> |
|  | <p><u>Engine Hoists</u></p> <p>Follow the manufacturer's recommendations</p> |

Appendix E

Examples of Slings

| | |
|-------------------------------------------------------------------------------------|------------------------------------------------|
|  | <p>Alloy Steel Chain</p> |
|  | <p>Wire Rope</p> |
|  | <p>Metal Mesh</p> |
|  | <p>Natural and Synthetic Fiber Rope</p> |
|  | <p>Synthetic Web</p> |

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Appendix F

Safe Work Practices of Cranes, Hoists and Chains/Slings

Cranes and Hoists

General:

- ☐ A personal protective equipment (PPE) hazard assessment must be performed for the task. PPE considerations should include a hardhat, safety glasses and safety shoes.
- ☐ Rated load capacities, recommended operating speeds, special hazard warnings and/or instructions, shall be conspicuously posted on all equipment. Instructions or warnings shall be visible to operators while they are at their control stations.
- ☐ Do not exceed the rated load capacity of the crane, hoist, slings or other components. (Keep in mind that the hoist may be higher rated than the rail/beam or vice versa).
- ☐ Persons operating the crane, hoist or sling shall inspect all machinery and equipment prior to each use to make sure it is in safe operating condition.
- ☐ Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains or other reciprocating, rotating, or other moving parts or equipment shall be guarded if such parts are exposed to contact by users, or otherwise create a hazard.
- ☐ No modifications or additions which affect the capacity or safe operation of the equipment shall be made without the manufacturer's written approval. If such modifications or changes are made, the capacity, operation, and maintenance instruction plates, tags, or decals, shall be changed accordingly. In no case shall the original safety factor of the equipment be reduced.
- ☐ Disconnect power to a hoist or crane that is unsafe or in need of repair and tag "Out of Service, Do Not Use."
- ☐ Never operate a hoist or crane that in your opinion is UNSAFE TO OPERATE.

Engaging the Load:

- ☐ The sling or other device shall be properly seated and secured in the base of the hook.
- ☐ The load shall not be applied to the point of the hook or the hook latch.
- ☐ Before moving the load, the operator shall be sure chains and wire rope are not kinked or twisted and that multiple part chains or ropes are not twisted about each other.
- ☐ The rope or chain must be properly seated on the drum, sheaves or sprockets before the lift takes place.
- ☐ Remove slack from the sling, chain or cable before lifting a load.

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- ☐ The hoist must be centered over the load.
- ☐ The operator shall not pick up a load more than the rated load of the hoist or crane.
- ☐ Specific attention should be given to balancing of the load to prevent slipping.

Moving the Load:

- ☐ The operator shall not engage in any activity that will divert his/her attention from the task.
- ☐ The operator shall respond to signals from a designated person only. However, the operator shall obey a stop signal at all times, no matter who gives it.
- ☐ The operator shall make sure the load and hoist will clear all obstacles before moving or rotating the load.
- ☐ A person shall be designated to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means.
- ☐ The operator shall inch powered hoists and cranes slowly in engagement with a load, but should avoid unnecessary inching and quick reversals of direction.
- ☐ A load shall not be lifted more than a few inches until it is well balanced in the sling or lifting device.
- ☐ When lifting loads at or near capacity, brake action shall be tested by lifting the load a few inches off the surface to verify that the brakes are holding.
- ☐ On rope hoists, the load shall not be lowered below the point where less than two wraps of rope remain on each anchorage of the hoist drum, unless a lower limit device is provided. In this case no less than one wrap may remain on each anchorage of the hoist drum.
- ☐ Loads shall not be suspended over personnel, unless unit is specifically designed.
- ☐ All users shall be kept clear of loads about to be lifted and of suspended loads.
- ☐ Under no circumstances may anyone ride the hook or load.
- ☐ Directional movement should be made smoothly and deliberately to avoid swing.
- ☐ Never pull a hoist by the controller cable.
- ☐ Contact between trolleys (on two trolley cranes) or between trolleys and stops should be avoided.
- ☐ The operator shall not use the upper (or lower, if provided) limit device(s) as a normal means of stopping the hoist. These are emergency devices only.

Placing the Load:

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- ☐ Never leave the controls unattended while a load is suspended. If it becomes necessary to leave the controls, lower the load to the floor.
- ☐ The load block should be positioned above head level when the hoist is not in use.
- ☐ Care shall be exercised when removing a sling from under a landed and blocked load.

Slings

- ☐ Slings shall be inspected prior to each use to make sure they are in safe operating condition.
- ☐ Slings that are damaged or defective shall not be used.
- ☐ Slings shall not be shortened with knots or bolts or other makeshift devices.
- ☐ Sling legs shall not be loaded more than their rated capacities.
- ☐ Slings used in a basket hitch shall have the loads balanced to prevent slippage.
- ☐ Slings shall be securely attached to their loads.
- ☐ Slings shall be padded or protected from sharp edges of their loads.
- ☐ Suspended loads shall be kept clear of all obstructions.
- ☐ Hands and fingers shall not be placed between the sling and its load while the sling is being tightened around the load.
- ☐ Shock loading is prohibited (abrupt starting or stopping of the load).
- ☐ A sling shall not be pulled from under a load when the load is resting on the sling.
- ☐ Slings shall be properly stored when not in use so that they are not subject to mechanical damage, moisture, corrosives, extreme temperature or kinking.

Environmental Health and Safety

Appendix G
Bridge Crane Operator Evaluation Form

| | |
|------------------------|--------------------|
| Trainee Name: | Work Area: |
| Evaluator Name: | Department: |
| Crane location: | Date: |

NOTE: Operators must be evaluated on each type of bridge crane.

| <u>Step</u> | <u>Evaluation</u> | <u>N/A</u> | <u>Pass</u> | <u>Fail</u> |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------------|--------------------|
| 1. Pre-use equipment inspection | Did operator utilize demonstrate competency to complete a frequent inspection? If not, was the operator able to explain all the items they were looking for? Was the owner's manual referenced for any additional items to be checked? | | | |
| 2. Load inspection | Was the weight of the load identified as not to exceed the rated capacity? | | | |
| | Was load properly secured, balanced and stable? | | | |
| 3. Move plan | Was a destination identified? | | | |
| 4. Control operation | Was operator familiar with all controls? | | | |
| | Was load speed and control satisfactory? (no sudden stops or acceleration) | | | |
| 5. Worksite Inspection | Was operator aware of activities in the vicinity including personnel and equipment? | | | |
| 6. Post move | Was hoist/crane properly stowed? (Hook near bottom of the hoist) | | | |
| | Were slings properly stored? (not subject to mechanical damage, moisture, corrosives, extreme temp., or kinking) | | | |
| 7. Comments | <i>Must be included for all "Failed" tasks. If task is failed the evaluator must explain what was done incorrectly and have the trainee repeat the task until it is completed correctly.</i> | | | |
| <i>Trainee Signature:</i> | | | | |
| <i>Evaluator Signature:</i> | | | | |

Environmental Health and Safety

Appendix H

Instructions for Conducting Bridge Crane Operator Evaluations

(Note: The evaluation can be done in-house using an experienced and competent Yale person or an outside vendor/safety consultant may be used.)

1. **Pre-Requisites:**
 - a. Completed the classroom portion of a crane / hoist training class.
 - b. Review and become familiar with the Yale Crane, Hoist and Sling written program.
 - c. Be experienced with the equipment you will be training on.
 - d. Review owner's manual.
2. Make sure the equipment is in safe condition.
3. Make sure the location is safe.
4. Have operator perform each item on the Bridge Crane Operator Evaluation Form. (Appendix H)
5. Assess the operator's performance. (Appendix H)
6. Explain any "failed" tasks and have operator repeat task.
7. Sign form.
8. File form with designated person. (Supervisor, work unit safety officer, department safety officer, etc.)