

# Sanford

## Underground Research Facility



## ENVIRONMENT, HEALTH, AND SAFETY

## CRANES AND HOISTS

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## Table of Contents

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<b>Version Control .....</b>	<b>ii</b>
<b>Table of Contents .....</b>	<b>iii</b>
<b>1.0 PURPOSE .....</b>	<b>1</b>
<b>2.0 SCOPE .....</b>	<b>1</b>
<b>3.0 DEFINITIONS .....</b>	<b>1</b>
<b>4.0 ROLES AND RESPONSIBILITIES .....</b>	<b>4</b>
4.1. Facility Infrastructure Director.....	4
4.2. Certified Inspector is responsible for:.....	5
4.3. The ESH Director is responsible for: .....	5
4.4. Engineering Director is responsible for: .....	5
4.5. Supervisors and Foremen are responsible for:.....	5
4.6. The Person-in-charge is responsible for: .....	6
4.7. The Qualified Operator is responsible for: .....	6
4.8. Qualified Rigger is responsible for: .....	6
<b>5.0 PROGRAM DESCRIPTION .....</b>	<b>6</b>
5.1. Training .....	6
5.2. Incidental Operator .....	7
5.3. Control of Cranes and Hoists .....	7
5.4. Inspection, Maintenance, and Repair .....	7
5.5. Crane/Structure Modification.....	9
5.6. New, Re-Installed, Altered, Repaired, and Modified Cranes and Hoists .....	9
5.7. Rated Load Tests .....	10
5.8. Crane Damage.....	10
5.9. Working from a Suspended Platform or Atop a Bridge Crane .....	10
5.10. Performing Lifts.....	11
<b>6.0 REFERENCE AND RELATED DOCUMENTS.....</b>	<b>12</b>
6.1. Related Documents.....	12
6.2. Appendix .....	12
6.3. Forms .....	12
6.4. Standards .....	13

## 1.0 PURPOSE

It is the purpose of the Sanford Underground Research Facility (SURF), that all hoisting and rigging equipment, design, installation, inspection, testing, and operations activities shall be in accordance with OSHA standards. A list of these standards is provided in section 6.4

## 2.0 SCOPE

This chapter applies to all personnel and equipment used to perform any crane and hoist activity at SURF.

Activities involving the following equipment are included:

- Overhead/Bridge Cranes
- Mobile Cranes
- Hoists (non-regulated MSHA hoist)
  - o Electric winches (cable)
  - o Air tuggers
  - o Chainfall (mechanical)
  - o Chainfall (electrical)
- Hand winch
  - o Come-a-long
  - o PullzAll™
- Miscellaneous lifting devices (i.e. counterweight/engine lift, transmission jack)
- Rigging hardware and accessories
- Powered industrial vehicle when used as a hoist

This chapter does not apply to the Ross and Yates Cage, or Skip.

## 3.0 DEFINITIONS

**Annual Inspection:** A formal process which evaluates operational status of equipment. See Periodic Inspection Table 1.

**Certified Inspector:** A person who has successfully passed a commercially recognized training course providing certification, e.g. KoneCrane Course 819-820.

**Competent Person:** A person capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. Ability to demonstrate proficiency for assigned tasks.

**Crane:** A device for lifting and lowering a load, and moving it horizontally. Cranes may be driven manually, by power, or by a combination of both. Types of cranes: (See Appendix A)

- **Boom Truck** - A crane consisting of a rotating superstructure (center post or turntable), a fixed or telescopic boom, operating machinery, and one or more operator's stations mounted on a frame attached to a commercial truck chassis with a payload hauling capability.
- **Gantry Crane** - A crane similar to an overhead crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two or more legs running on a fixed rail or affixed on one end of the I-beam with rotational capability.
- **Mobile Crane** - A cable-controlled crane mounted on crawlers or rubber-tired carriers. May consist of a fixed length boom, telescopic or lattice extensions, capable of being moved between operating locations by transport over the road.
- **Overhead/Bridge Crane** - A crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure.

**Critical Lift:** Any load requiring exceptional care in handling. For example:

- Safety concerns.
- Size or shape.
- Weight which exceeds 75% of the rated load.
- Close-tolerance installation.
- High susceptibility to damage.
- High value or potential impact of a high value item.
- Impact to operations (budget, schedule).
- Load out of view of the crane operator.
- Potential release of hazardous material into the environment.
- Hoisting of personnel from an overhead crane.
- Single lift involving multiple cranes, or other unusual factors.

**Documented Inspection:** A formal process which evaluates operational status of equipment and is recorded by monthly and annual inspection or deficiency report. Records shall include the date of inspection, the signature of the person who performed the inspection and the serial number or other identifying mark.

**Engineering Notes:** Documentation of the professional evaluation performed on structural design specifications.

**Fall Zone:** The area where it is reasonably foreseeable that a partially or completely suspended material(s) could fall in the event of a failure. Including:

- The area directly beneath the load.
- The strike/impact zone and the resulting tip radius.
- The secondary effects of the load impacting anything unrelated to the lift which in turn may create a larger exposure zone.

**Hoist:** A machinery unit that is used for lifting or lowering a freely suspended load. Hoists may be integral to a crane or mounted in an affixed position, permanently or temporarily. Hoists may be hand-operated, air, or electric powered.

**Hoisting & Lifting Specialist:**

- Person providing oversight of all cranes, hoisting, rigging and system maintenance programs.
- Reports directly to the Facility Infrastructure Director.
- Certified Crane Inspector and Master Rigger qualifications or equivalent.

**Hoisting Devices:** Hoist, cranes, winches, tuggers and come-a-longs.

**Incidental Operator:** Non-SURF individual (contractor, researcher) who does not operate overhead cranes on a regular basis (several times a week). A South Dakota Science and Technology Authority (SDSTA) employee who operates a lifting device from a third party not owned or managed by SURF.

**Initial Load Test:** The test performed when a crane is newly installed or re-installed. Although an initial service lift may exceed the capacity of the crane, it is not considered a "Critical Lift". (see Rated Load Test)

**Inspection:** Inspections assess the condition of equipment to assure its ability to perform intended tasks. Inspection frequency and schedule are outlined in Table 1.

**Load:** The total weight superimposed on the load block or hook. This includes not only the material being lifted but also all the rigging equipment necessary to attach the load to the load block; i.e., lines, shackles, rigging, etc.

**Modified:** A variation or alteration that changes the original configuration of the crane or adds other features not originally installed with the crane and impacts the crane's lifting capacity or load bearing components.

**Monthly Inspection:** See Periodic inspection.

**Periodic Inspection:** Includes monthly and annual inspection requirements. See Table 1 for inspection items.

**Person-in-Charge (PIC):** A Qualified Person appointed to be responsible for the safe execution of a Critical Lift.

**Pre-operational Inspection:** An undocumented visual inspection conducted before each use.

**Qualified Person:** A person who, by possession of a recognized degree in an applicable field or a certificate of professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

**Qualified Operator:** A person who has successfully completed the training requirements outlined in this chapter and has been so designated by the Department Director. Licensing or certification is required for mobile cranes with a lifting capacity above 2,000 lbs.

**Qualified Rigger:** An individual responsible for rigging activities associated with a Critical Lift. One who has extensive experience, knowledge or possess a recognized degree or certificate.

**Rated Load:** The posted maximum load designated by the manufacturer for which a crane or individual hoist is designed and built. This load shall not exceed 80% of the rated load test or manufacturer's specification, whichever is less.

**Rated Load Marking:** The rated load of the crane shall be plainly marked on each side of the crane, and if the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its load block and this marking shall be clearly legible from the ground or floor.

**Rated Load Test:** A formal process utilizing a known weight to evaluate both the hoisting device and supporting structure capability to safely establish the Rated Load.

**Suspended Platform:** An engineered designed conveyance which is attached below-the-hook. Serves as a Work Deck which may be raised and lowered by a crane.

## 4.0 ROLES AND RESPONSIBILITIES

**4.1. Facility Infrastructure Director** is responsible for:

- Oversight of the Hoisting & Lifting Specialist.
- Maintaining an inventory of all hoisting devices on site.
- Maintaining load testing equipment.
- Completing and documenting all required maintenance.
- Recording activities as reported by Certified Inspector.
- The development and implementation of a hoisting devices training program.
- Operator qualifications for specific hoisting devices.
- Establishing trainer competency requirements for specific hoisting devices.
- Providing the ability to evaluate hoisting devices safe operations for Qualified and Incidental Operators.
- Maintaining manuals and manufacturer information and records related to testing, lifting capacity, inspection, and repair of all hoisting devices.
- Performing a yearly audit of all hoisting devices.
- Selection of a qualified contractor to perform annual inspection, testing, maintenance and repair of cranes as needed.
- Conducting an annual review of Overhead Cranes and Hoists Chapter (Document-73405).

- Designating Qualified Operators, Certified Inspectors and Qualified Riggers.
- Record keeping and document retention system.

**4.2. *Certified Inspector*** is responsible for:

- Performing all periodic inspections on cranes and hoists.
- Performing the Rated Load Test.
- Ensuring that the inspection tag is completed and visible.
- Providing all results to the Facility Infrastructure Director.

**4.3. *The ESH Director*** is responsible for:

- Providing consultation services regarding safety of operations.
- Coordinating and scheduling training.
- Maintaining training records.
- Review and maintenance of all Critical Lift Plans and associated JHAs.
- Auditing the use of hoisting operations for compliance with the requirements of this document.
- Assisting Facility Infrastructure Department with development and implementation of training needs.
- Deviations from the requirements of this chapter require ESH Director approval.
- All suspended platform JHAs must be reviewed by the ESH Director.

**4.4. *Engineering Director*** is responsible for:

- Modifications - Cranes may be modified, provided such modifications and the supporting structure are checked thoroughly for the new rated load by a qualified engineer or the equipment manufacturer. The crane shall have a rated load test performed. New rated load shall be displayed.
- Support structures must be evaluated for load capacity.
- Provide consultation and design of all new hoisting devices that are attached to supporting structure. The supporting structure must exceed the lifting capacity of the hoisting device.
- Arranging for an initial inspection of all new, modified or re-installed cranes, hoists and monorails that are attached to supporting structure.
- Maintain documentation of all structural support evaluations and modifications.
- Responsible for establishing the design criteria for suspended work platforms.

**4.5. *Supervisors and Foremen*** are responsible for:

- Assuring that employees assigned to operate hoisting devices are competent or under supervision of a competent person.
- Ensuring that all hoisting devices within their areas of responsibility are inspected, tested, maintained, and repaired as required in this document.
- All hoisting devices shall be inspected for defects prior to use.



- Ensuring that lift plans are submitted for all Critical Lifts
- For Critical Lifts, appointing a qualified Person-in-Charge.
- Arranging for the monthly and annual inspections of the hoisting equipment within their work areas.

**4.6. The Person-in-charge** is responsible for:

- Ensuring that a Job Hazards Analysis (JHA) and appropriate Lift Plan/Permit has been developed and approved for Critical Lifts.
- Execution of the lift in accordance with the JHA and Lift Plan/Permit.

**4.7. The Qualified Operator** is responsible for:

- Execution of the lift in accordance with the JHA, SOP or Lift Plan.
- Identify hazards and mitigations associated with the hazard, including appropriate personal protective equipment (PPE).
- Identifying appropriately trained individuals, if required, to participate in the lift. The skill level of each participant in the lift shall be commensurate with the assigned duty.
- Performing a pre-lift inspection
  - Lift site location
  - Crane inspection
  - Below-the-hook devices
  - Rigging
  - If a problem or situation appears to not be safe, initiate a Stop Work.
- All deficiencies are to be reported and documented.

**4.8. Qualified Rigger** is responsible for:

- Rigging activities associated with a Critical Lift.
- Coordinate with Qualified Operator and the Person-In-Charge

## **5.0 PROGRAM DESCRIPTION**

### **5.1. Training**

Training requirements are based on the complexity of specific equipment and processes used. May include:

- Vendor provided training
- Regulatory requirements
- Training in accordance to manufacture direction
- Practical demonstration on hoisting devices
- Inspection requirements

## **5.2. Incidental Operator**

Third Party: May operate Sanford Laboratory cranes/hoist only when they have met the following conditions:

- Permission to use a Sanford Laboratory crane is required from the associated Department Director.
- The appointed SURF representative overseeing the work activity reviews the qualifications and training of Incidental Operator.
- Demonstrate to a SURF Qualified Operator their competency to operate the specific hoist.
- Contractor use of cranes/hoist (regardless of whether the crane is owned by Sanford Laboratory or the Contractor) should be included in the contract or corresponding Science documentation.

SURF Employee: May operate a third-party crane or hoist when they have met the following conditions:

- Permission to use a third-party crane is required from the associated owner and SURF supervisor.
- The appointed SURF representative overseeing the work activity reviews the qualifications and training of Incidental Operator.
- Demonstrate to a SURF Qualified Operator their competency to operate the specific hoist.

## **5.3. Control of Cranes and Hoists**

- Cranes and Hoists when taken out of service, shall be isolated and tagged.
  - Tag shall specify reason, date & point of contact. Refer to ESH Manual LOTO Chapter 7000.
  - Disabled equipment shall be reported to Supervisor and impairment controls utilized as necessary.
  - If controls can be inadvertently contacted, access shall be restricted to prevent unintended activation.
  - Crane travel ways shall be visually inspected to ensure unobstructed and safe movement.

## **5.4. Inspection, Maintenance, and Repair**

The Facility Infrastructure Department is responsible for assuring cranes and hoists are inspected annually and maintained/repared as necessary (see Table 1).

### **Inspections and Repairs**

#### **A. Pre-Use (Daily) Inspection**

- The pre-operational inspection must be performed (see Table 1). This inspection is a non-documented visual inspection completed by the operator.

### **B. Monthly Inspection**

- This periodic inspection must be performed on all cranes (see Table 2). This inspection is a visual inspection completed by the certified inspector. (Reference to monthly inspection form).
- This inspection must be performed on a crane which has been idle for a period of 1 month or more.
- The inspection will be annotated on an inspection tag attached to the controls or to the device.
  - New/Repaired/Adjusted Crane
  - Records are maintained in ManagerPlus™ or designated database.

### **C. Running Rope Inspection**

- Any deterioration, resulting in appreciable loss of original strength, shall be carefully observed and determination made as to whether further use of the rope would constitute a safety hazard.
- Conditions that could result in an appreciable loss of strength are shown in Table 1: Running Rope Monthly inspections.
- Inspection must be documented by the Certified Inspector.

### **D. Periodic Inspection (Monthly/Annual)**

- Only cranes and hoists that have been inspected by a Certified Inspector and have passed inspection within the past year may be operated.
- This periodic inspection must be performed on all cranes (see Table 1).
- If a crane or hoist has not passed its inspection, it must be taken out of service. Inspection requirements must be met before unit is placed back in service.
- Records of inspections, repairs and modifications shall be available for review.
- Repairs to cranes or hoists may only be performed by qualified personnel as specified by the Facility Infrastructure Department.

<b>Frequent Inspection Items</b>		
including observation during operation for any defects which might appear between regular inspections		
Daily	All functional operating mechanisms for maladjustment interfering with proper operation.	
Daily	Deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of air or hydraulic systems.	
Daily	Hooks with deformation or cracks? If yes, follow below criteria:	
	It becomes a monthly inspection requirement.	<b><u>Inspection with a certification record</u></b> which includes the date of inspection, the signature of the person who performed the inspection and the serial number, or other identifier, of the hook inspected. For hooks with cracks or having more than 15 percent in excess of normal throat opening or more than 10° twist from the plane of the unbent hook refer to OSHA 1910.179.
Daily	Hoist chains, including end connections, for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer's recommendations.	

Daily	All functional operating mechanisms for excessive wear of components.
Daily	Rope reeving for noncompliance with manufacturer's recommendations
<b>Periodic (1-12 Months) - Provides for Monthly/Annual Inspection Items</b>	
Deformed, cracked, or corroded members, excessive wear, or damage such as from chemicals or heat	
Wire rope reeving for compliance with the manufacturer's specifications	
Cracked or worn sheaves and drums.	
Loose bolts or rivets.	
Gasoline, diesel, electric, or other powerplants for improper performance or noncompliance with applicable safety requirements.	
Worn, cracked or distorted parts such as pins, bearings, shafts, gears, rollers, locking and clamping devices.	
Excessive wear on brake system parts, linings, pawls, and ratchets.	
Load, wind, and other indicators over their full range, for any significant inaccuracies.	
Excessive wear of chain drive sprockets and excessive chain stretch.	
Electrical apparatus, for signs of pitting or any deterioration of controller contactors, limit switches and pushbutton stations.	
<b>Running Ropes Inspection: <u>A certification record which includes the date of inspection, the signature of the person who performed the inspection and an identifier for the ropes which were inspected shall be kept on file where readily available to appointed personnel.</u></b>	
Monthly	Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.
Monthly	Worn outside wires.
Monthly	Corroded or broken wires at end connections
Monthly	Corroded, cracked, bent, worn, or improperly applied end connections.
Monthly	Severe kinking, crushing, cutting, or unstranding.

**Table 1**

### **5.5. Crane/Structure Modification**

Cranes/Structure may only be modified and rerated provided such modifications and the supporting structure are checked thoroughly by a qualified engineer or the equipment manufacturer. Considerations shall be given to the following:

- Design
- QA/QC construction processes
- Pre-defined commissioning requirements

### **5.6. New, Re-Installed, Altered, Repaired, and Modified Cranes and Hoists Operational Tests**

Prior to being placed into service; equipment shall be evaluated by a Qualified Person. Evaluation must consider:

- New or re-installed cranes and hoists
  - Must be commissioned and are subject to the requirements of the annual inspection and *Rated Load Test* processes.
- Repaired equipment
  - Must be evaluated for functional reliability commensurate with repair.
- Altered or modified cranes and hoists
  - Only qualified engineers may design and direct QA activities.
  - Must be commissioned and are subject to the requirements of the annual inspection and *Rated Load Test* processes.
- Records are maintained in ManagerPlus™ or designated database.

### **5.7. Rated Load Tests**

This test must be performed by a Certified Inspector. The test loads shall be between 100 and 125 percent of the rated load unless otherwise recommended by the manufacturer. The test reports shall be placed on file where readily available to appointed personnel. Does not meet the requirements of a critical lift.

### **5.8. Crane Damage**

When a crane is damaged or fails operational testing, it shall be tagged and locked out of service by the Facility Infrastructure Department (See [Lockout/Tagout \(LOTO\) Verification](#)).

Incidents resulting in damage to a crane shall be investigated and documented by the Facility Infrastructure Department.

The crane shall not be returned to service until it has been repaired and appropriate acceptance testing is conducted.

### **5.9. Working from a Suspended Platform or Atop a Bridge Crane**

Using a crane platform may be a suitable alternative method to perform maintenance activities.

All platforms shall comply with the following:

- A. A qualified person familiar with structural design must design the personnel platform and attachment/suspension system used for hoisting personnel. At a minimum 1926.1431(e)-(k) must be considered.
- B. The personnel platform must be equipped with a guardrail system and must be enclosed at least from the toeboard to mid-rail with either solid construction material or expanded metal having openings no greater than ½ inch (1.27 cm).
- C. Anchor points to which personal fall arrest systems are attached must meet the OSHA requirements of 5000 lbs.
- D. All rigging (below-the-hook) shall be included in the suspended platform design and is a dedicated stand-alone system.

Prior to starting work from a crane platform, a Job Hazard Analysis (JHA) ([Job Hazards Analysis Form](#)) shall be performed in reference to OSHA 29 CFR 1926.1431(k)-(o). All suspended platform JHAs must be reviewed by the ESH Director.

At a minimum the JHA shall consider:

**Suspended Platform**

- A.** Personnel may only work from within an engineered platform.
- B.** Fall protection shall be used.
- C.** Personnel suspended in a platform may only travel vertically. If horizontal movement is needed, personnel will go to the ground and the platform relocated to desired location first.
- D.** The platform shall not be moved until all employees on the crane are in locations where they will not be exposed to injury.
- E.** A means of positive communication shall be established between the crane operator, the platform personnel and any exposed worker.
- F.** When two bridge cranes utilize the same runway, rail-stops or other suitable methods shall be used to prevent contact.
- G.** When a suspended work platform is being utilized, the area shall be guarded, barricaded, or other positive controls established to prevent access to overhead hazards.
- H.** Lockout/Tagout procedures shall be implemented, as appropriate.

**Atop the Bridge Deck**

- A.** Safe egress to and from a crane shall be provided.
- B.** Verify guardrail system is in place prior to commencing work.
- C.** When ladders are used, SURF working at height requirements must be adhered to. (Fall Protection Chapter)
- D.** When two bridge cranes utilize the same runway, rail-stops or other suitable methods shall be used to prevent contact.
- E.** Lockout/Tagout procedures shall be implemented, as appropriate.

## **5.10. Performing Lifts**

### **A. All Lifts**

- Must be performed as planned. Deviations from the established lift planning must be reviewed by the Qualified Person, and the supervisor may be consulted as necessary.
- Must have a designated Qualified Person overseeing the activity.
- Only trained, qualified, and authorized personnel will be allowed to rig loads or operate cranes or hoists.
- All pre-use inspections for hoists, cranes, and hoisting and rigging hardware and accessories must be performed prior to the lift.
- Personnel must not place any part of their body under a suspended load within a Fall Zone. However, if no alternative exists and the work must be performed under a suspended load or in the Fall Zone, a qualified rigger is

required and Critical Lifts requirements apply.

### **B. Critical Lifts**

- When lifting a load that exceeds 75% of the rated load requires exceptional care in handling because of its size, shape, close tolerance installation, a high susceptibility to damage, value, impact to operations, hoisting of personnel with an overhead crane or other unusual factors.
- A JHA will be performed
- A written lift plan will be developed that includes the following:
  - a. Identification of the Person-in-Charge (PIC) of the lift.
  - b. Detailed plan including equipment, PPE, and description of how critical connections will be made.
  - c. Pre-lift inspection of lift site location.
  - d. Pre-lift inspection of equipment.
- A Post-lift review shall be conducted and any lessons learned shall be documented.

### **C. Mobile Crane (less than 2000 lbs)**

- Must submit a JHA prior to work being performed.
  - All individuals involved in a mobile crane lift or exposed to those activities must review and sign off on the JHA.
  - The JHA must reflect the highest risk lift planned for daily activities.

### **D. Mobile Crane (equal to or greater than 2000 lbs)**

- Must submit a JHA prior to work being performed.
- All individuals involved in a mobile crane lift or exposed to those activities must review and sign off on the JHA.
- The JHA must reflect the highest risk lift planned for daily activities.
- Require a licensed operator approved by a government accredited crane operator testing organization.
- Must complete the Critical Lift Plan-Permit.

## **6.0 REFERENCE AND RELATED DOCUMENTS**

### **6.1. Related Documents**

- [Slings, Rigging Hardware, and Below-The-Hook Lifting Devices](#)

### **6.2. Appendix**

- A. Crane and Hoist photos

### **6.3. Forms**

- A. Critical Lift Plan Permit
- B. Crane Operator's Monthly Inspection Report
- C. Annual Inspection Report

#### **6.4. Standards**

- 29 CFR 1910, Subpart N, OSHA General Industry Standards - Materials Handling and Storage.
- 29 CFR 1926 Subpart N, OSHA Construction Standard - Helicopters, Hoists, Elevators, and Conveyers



## Appendix A Crane and Hoist Photo Examples

### Cranes:



Figure 1: Bridge Crane



**Figure 2: Overhead Bridge/Gantry Crane**



**Figure 3: Mobile Gantry Crane**



**Figure 4: Articulating Jib Crane**

## Hoists:



**Figure 5: Monorail Hoist System**





**Figure 6: Overhead Electric Chain Hoist**

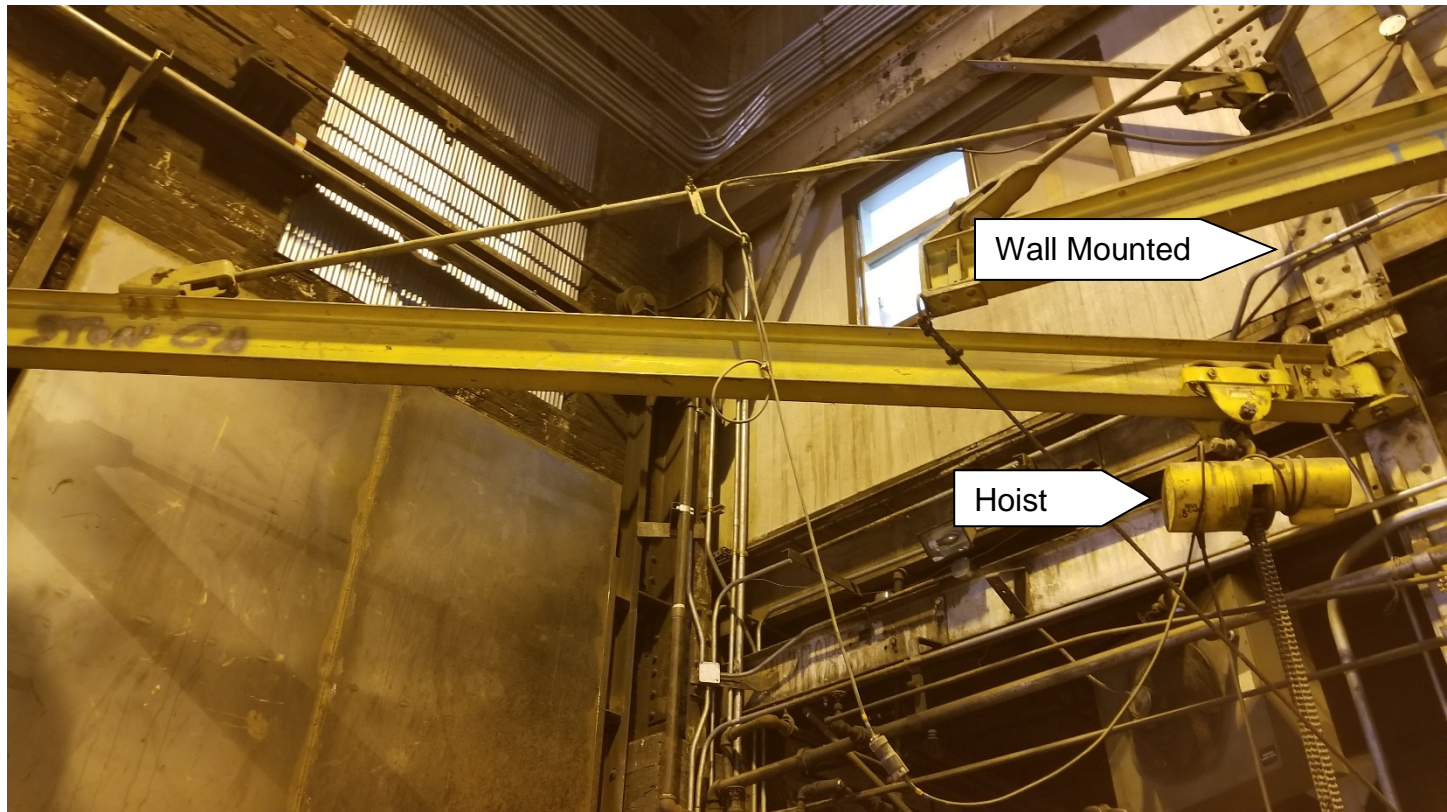


Figure 7: Wall-Mounted Electric Chain Hoist

Figure 8: Portable Air Tugger with Auto brake







Figure 9: Portable Electric Hoist



**Figure 10: Manual Come Along Hoist**