

FESHM 10100: OVERHEAD CRANES AND HOISTS

Revision History

Author	Description of Change	Revision Date
Roza Doubnik	<ul style="list-style-type: none"> Updated link to the Prime Contract No. DE-AC02-07CH11359 with the conformed, contract through Modification No. 302 from June 10, 2022. 	July 2022
Angela Aparicio Marcel Borcean	<ul style="list-style-type: none"> Removed “Special Lifts” and “Planned Engineered Lifts,” now covered in the new “Lift Plans” chapter. Added references to the “Lift Plans” chapter Added references to the “Crane Personnel Lifting Platforms” chapter. Revised operator training requirements. Added crane operator evaluator requirements. Moved “shop cranes” into a technical appendix and added roust-a-bouts in a technical appendix. 	August 2020
Marcel Borcean	<ul style="list-style-type: none"> Added definition of crane operator evaluator. Clarified that the evaluation phase comes after the classroom training phase. Revised Table of Contents. Removed Center Heads from 3.1 and add Contents for 4.4.1. and 4.4.2. Revised section 4.8.4.a. to clarify the usage of suspended crane man baskets. Deleted requirement to use FNAL Monthly Inspection paper form. Most crane inspection contractors prefer using electronic systems for recording inspections. 	January 2017

John P. Cassidy	<ul style="list-style-type: none"> • Changed the hoist definition to Overhead Hoist to match the definition in ASME B30.16. • Corrected the typo in 4.1.1.d to ASME 30.2 section 2-3.1.4. • Clarified the retraining requirement in Section 4.1.2. • Added information to Section 4.3 to require all annual and monthly inspections is performed by a qualified crane service contractor. D/S employees will no longer be authorized to conduct monthly inspections. • Removed the ES&H Section Head notification and HA requirement from the Planned Engineering Lift Section 4.7. • Removed ASME B30.22 as a reference standard. 	January 2015
John P. Cassidy	Section 3.5 has been modified by the Mechanical Safety Subcommittee to clarify the responsibility for PPE and when hard hats and safety shoes are required.	November 2012
John P. Cassidy	Section 3.5 has been updated requiring hard hats and safety shoes for hazard mitigation of overhead lifts.	May 2012
John P. Cassidy	Revision 1 Added FESHM Chapter formatting template and more complete guidance on Chapter content. Clarified definition of a crane. Included the length of retraining. Added Shop Cranes as characterized in ASME PALD - Portable Automotive Lifting Devices.	April 2012

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1.0 INTRODUCTION AND SCOPE

Cranes and hoists are found in many buildings and experimental enclosures throughout Fermilab. Improper use of material handling equipment creates a significant potential for property loss and serious injury. This chapter contains procedures for proper design, testing, and safe operation of cranes and hoists.

This chapter applies to cranes on the Fermilab site and cranes funded by DOE and managed by Fermi Research Alliance.

2.0 DEFINITIONS

Appointed - An appointed individual has been assigned specific responsibilities by the employer or the employer's representative.

Crane – A machine for lifting and lowering a load suspended by a hook or hooks and moving it horizontally. Cranes are driven manually, by power, or by a combination of both.

Hoist – A machinery unit that is used for lifting or lowering a freely suspended (unguided) load. Hoists may be hand-operated, air, or electric powered.

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

Crane Operator Evaluator- A qualified person who has been so designated by ES&H (Division Safety Officers) in consultation with FESS Crane Office.

Initial Load Test – The test performed when a crane is newly installed or re-installed. Refer to ASME B30.20. Although an initial Load Test may exceed the capacity of the crane, it is not considered a “Planned Engineered Lift”.

Inspection frequency definitions:

Frequent (Monthly) Inspection – Recorded visual examinations by a qualified crane service contractor as follows:

Normal Service – Monthly

Heavy Service – Weekly to Monthly

Severe Service – Daily to Weekly

Periodic (Annual) Inspection – Recorded visual inspection of the equipment in place by a qualified crane service contractor, as follows:

Normal Service – Yearly

Heavy Service – Yearly

Landlord - The division/section responsible for the space.

Lift Types Definitions – See FESHM 10200: *Lift Plans* for Ordinary, Critical, Planned Engineered and Pre-Engineered Production Lifts definitions.

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.

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 division/section head.

Qualified Rigger - A qualified rigger is a rigger who meets the criteria for a qualified person. A qualified rigger is a person that:

- possesses a recognized degree, certificate, or professional standing, or
- has extensive knowledge, training, and experience, and
- can successfully demonstrate the ability to solve problems related to rigging loads.

The person designated as the qualified rigger must have the ability to properly rig the load for a particular job. It does not mean that a rigger must be qualified to do every type of rigging job.

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

Re-installed – A crane is reinstalled when the crane or hoist or portions of a crane is/are physically removed from their original location and moved to a different location or returned to the original location. This definition does not include portable hoisting equipment.

Roust-A-Bout – A lifting device that typically consists of a mast and mobile base with a load pulley device (e.g. winch). See Technical Appendix 6.2.

Service Definitions:

Normal Crane Service – Service that involves operating at less than 85% of rated load and not more than 10 lift cycles/hr. except for isolated instances.

Heavy Crane Service – Service that involves operating at 85 to 100% of rated load or in excess of 10 lift cycles/hr. as a regular specified procedure.

Severe Crane Service – Service that involves normal or heavy service with abnormal operating conditions. (Typically found in steel mills and similar service – these conditions are not anticipated at Fermilab.)

Shop Cranes – A portable automotive lifting device, commonly called an engine hoist, typically characterized by a pair of laterally spaced legs, an upright mast, pivoting boom with a boom extension, and a hook which is used to raise and remove automotive components for service. See Technical Appendix 6.1.

3.0 RESPONSIBILITIES

3.1 Division/Section/Project Head

The Division/Section/Project (D/S/P) Head (where applicable) is responsible for implementing this program. Specifically, they are responsible for:

- Assuring, through the line management, that employees assigned to perform rigging or crane operation duties are qualified to perform the work assigned. Successful completion of crane training is necessary, but not necessarily sufficient, to deem a person qualified to perform all rigging and crane operation tasks.
- Nominating a Crane Operator Evaluator for their D/S/P.
- Ensuring that documentation on cranes and hoists is maintained.
- Ensuring that all cranes and hoists within their areas of responsibility are inspected, tested, maintained, and repaired as required in this document.
- Assuring that service subcontractors who perform inspection, testing, maintenance and repair of cranes have adequate oversight; usually provided by Facilities Engineering Services Section.

3.2 ES&H Section

The ES&H Section is responsible for:

- Providing consultation services to division/section/project heads regarding safety of operations and training opportunities.
- Designating a qualified person as the crane operator evaluator following on-the-job training and an evaluation.

3.3 WDRS Professional Development and Learning

The WDRS Professional Development and Learning is responsible for:

- Coordinating and scheduling training opportunities for newly selected and qualified operators.
- Maintaining training records of operators in the TRAIN database.

3.4 Mechanical Safety Subcommittee (MSS)

The Mechanical Safety Subcommittee will serve in a consulting capacity to ES&H and D/S/P in all matters concerning the inspection, maintenance and operation of cranes.

3.5 Facilities Engineering Services Section (FESS)

The Facilities Engineering Services Section (FESS) is responsible for:

- Maintaining manuals and manufacturer information and records related to testing, inspection, and repair of overhead cranes and hoists. This includes the distribution of related reports to the landlord division/section head or his/her designee.
- Providing consultation and design of all new overhead cranes and hoists.
- Arranging for an initial inspection of all new, modified or re-installed overhead bridge cranes, hoists and monorails.
- Arranging contracts with qualified subcontractors to perform annual inspections, monthly inspections, testing, maintenance and repair of cranes.
- Arranging for qualified subcontractors to perform annual inspections, monthly inspections, testing, modifications, upgrades, maintenance and repair of cranes. FESS will provide oversight of the subcontractor.
- Providing crane operator evaluators on-the-job training and an evaluation per Section 4.1.4.

3.6 The Qualified Operator

The Qualified Operator is responsible for:

- Recognizing if a lift or rigging task is within their capability based on previous experience or training. If level of training or experience is insufficient to assure a safe lift, the operator must state this to their supervisor and not proceed with the task.
- Following best practices in rigging and hoisting to assure a safe lift.
- Identify hazards and mitigations associated with the hazard, including appropriate personal protective equipment (PPE).
- Conducting a pre-use crane inspection (see section 4.3.3). If a problem or situation appears to be unsafe, or if the crane is not operating properly, the Qualified Operator should contact FESS to have a pre-lift inspection/repair completed by a subcontractor.
- Inspecting slings, fastenings and attachments for damage or defects prior to each use and remove from service if damaged or defective. (See [FESHM Chapter 10130: Slings and Rigging Hardware](#).)
- Ensuring the sling identification is legible and shows the rated capacities for each type of hitch (vertical, basket and choke). (See [FESHM Chapter 10130: Slings and Rigging Hardware](#).)
- At a minimum, ensure all persons involved in the lift or in the immediate vicinity shall wear hard hats and safety toe shoes/boots. The Qualified Operator shall check that all PPE requirements are met before beginning the overhead lift.
- Shall halt the lift if safe conditions change during the lift.
- Performing the lift in accordance with any formal hazard analysis (HA). (See [FESHM Chapter 2060: Work Planning and Hazard Analysis](#)) or written lift plan (See [FESHM Chapter 10200: Lift Plans](#)), if one exists. The lift shall be stopped if any unsafe condition arises, and the supervisor and Division Safety Officer (DSO) shall be notified and consulted for guidance on how to proceed.

3.7 The Task Manager/Construction Coordinator (TM/CC)

The TM/CC is responsible for:

- Reviewing the crane operator qualifications and training of subcontractor workers prior to use.

4.0 PROGRAM DESCRIPTION

4.1 Training

4.1.1. Operator Training for Fermilab Employees – Initial Training Course

- a. Operators are required to be initially trained and re-qualified every 3 years. The training consists of three phases:
 - 1) Classroom.
 - 2) Evaluation.
 - 3) On the Job Training (OJT).
- b. Supervisors may “waive” the OJT requirement for operators who use the equipment on a frequent basis. Operators who fail the performance evaluation may be required to complete additional OJT.
- c. Operators who fail the performance evaluation shall NOT operate a crane without supervision until they have successfully completed the evaluation.
- d. Qualifications for operators are listed in ASME B30.2 section 2-3.1.4.
- e. If warranted, at their discretion, supervisors may require re-evaluation of already qualified operators.
- f. The specific portions of the training are as follow:
 - 1) Classroom - This phase of the program will be presented as needed. Coordination and scheduling will be the responsibility of the ES&H Section and WDRS Professional Development and Learning Group. The training is currently provided by an outside contractor and is sixteen (16) hours in length held over two days. It includes classroom training, field exercise, and a written exam. Prospective operators must successfully complete the written exam and field exercise before continuing with the remainder of the qualification process. Operators are NOT allowed to test-out of the initial phase since this is the only opportunity for all operators to be exposed to the same material, changes to the program and lab policies, lessons learned, etc.
 - 2) Performance Evaluation - The evaluation is completed after the classroom and every three years thereafter. It is conducted by a qualified and designated person within the D/S/P. The Crane Operator Performance Evaluation form must be used to document the completion of this phase. If the operator does not pass the evaluation, appropriate remedial training and OJT should be provided before attempting the evaluation again. The evaluation form must be completed by the evaluator and signed by both the evaluator and the operator's supervisor.
 - 3) Practical (OJT) - D/S/P will designate OJT trainers (supervisors or senior operators) and present this portion within their respective areas. This

training may consist of demonstrations, supervised exercises and coaching with the type of equipment to be operated and within the work environment where work activities take place. The Operator will be fully aware of all safety features of the equipment and safety-related activities surrounding the work.

- 4) Providing that the operator has completed the classroom training successfully, the supervisor may waive the evaluation of the qualification process for experienced operators but shall document and justify the waiver on the Crane Operator Performance Evaluation form and forward it to WDRS Professional Development and Learning group for the record.

4.1.2. Refresher training

- a. Crane operator training refresher training is required every three (3) years. Refresher training consists of an eight (8) hour classroom session (currently provided by a contractor) and performance evaluation (provided by a Fermilab Evaluator). If the Evaluator determines that more experience is required by the operator, then additional training and/or OJT will be required. Evaluation may be waived by the supervisor and shall be documented on the Crane Operator Performance Evaluation Form.
- b. Refresher training must be completed within 120 days of the expiration of the previous training.

4.1.3. Incidental Operator Qualification- Non-Employee Operator

- Non-employees, such as subcontractors and users/visitors may operate cranes in the course of their work activities provided they have completed the appropriate qualifications and training.
- Subcontractor crane operator(s) must provide documentation of their qualifications and training to the TM/CC prior to use.
 - 1) Permission to use the crane is also required from the landlord division/section. Subcontractor use of cranes should be included in the Procurement exhibits and must be in the written hazard analysis.
- The landlord division/section is responsible for ensuring any visiting scientist who will operate their cranes has completed the appropriate crane operator training and qualifications prior to use.

4.1.4. Crane Operator Evaluator

- a. Crane Operator Evaluators will be selected by the D/S/P Head. ES&H Section and FESS Crane Office will set up on-the-job training and an evaluation of the evaluator to ensure that the lab's crane evaluations are standardized and rigorous.

4.2 Control of Cranes and Hoists

- 1) The division/section/project (D/S/P) that owns the crane or hoist should develop means to restrict crane and/or hoist use by unqualified personnel (e.g., restricting access, locking

crane controls or hoist chains, or other appropriate measures - generally by use of administrative configuration locks (See [FESHM 2100: *Fermilab Energy Control Program \(Lockout/Tagout\)*](#) for Administrative Control lockout procedures).

- 2) The D/S/P may, through the line management, restrict the use of cranes and hoists to individuals who have received supplemental training on the use and operation of any specific crane or hoist.

4.3 Inspection, Maintenance, and Repair

- 1) Each D/S/P is responsible for assuring cranes and hoists are inspected frequently (monthly), periodically (annually), and maintained/repared as necessary. If a crane is not inspected annually or monthly because of lack of use or location in an inaccessible area, then it must be inspected before it is placed back in service.
- 2) Contracts
 - a. FESS maintains inspection and repair contracts to assist the division/section in accomplishing these activities.
 - b. Each D/S/P shall advise FESS of times when the equipment will be available for inspection. The inspection and repairs shall be completed by a qualified crane inspection organization.
 - c. FESS is responsible for providing qualified crane service contractors to perform the inspection, maintenance and repair of all cranes and hoists. FESS maintains all records regarding the inspection and maintenance of cranes and hoists.
- 3) Pre-Use Inspection

The **daily inspection** is a non-recorded visual inspection meant to be a pre-operational check to detect discrepancies that are obvious to the naked eye. Operators shall visually inspect such items as the following:

 - a. Controls and operating mechanisms.
 - b. If the crane has not been in regular service, the hoist upper limit switch requires functional verification prior to or in the beginning of the shift when the crane will be used.
 - c. Lines, valves and other parts of air systems for leakage.
 - d. Hooks for cracks, deformations, and damage from chemicals.
 - e. Hoist rope for significant wear, kinking, crushing, bird-caging, and corrosion.
 - f. Hook latch for proper operation, if used.

- 4) Frequent (Monthly) Inspection

A **frequent inspection** is more stringent than the daily pre-operational check and can be used as a substitute for the daily inspection on cranes that are used infrequently. As an example, a crane is used infrequently and the last time the crane was in use was ninety days ago. A crane operator using the crane would be required to coordinate with FESS to have the crane inspected prior to use. Because of the stringent nature of the monthly inspection, this inspection counts as the monthly and the daily. A record must be kept of the monthly inspection.

The monthly inspection record must be submitted by the crane inspection contractor to the FESS Crane Office to be filed with crane maintenance, inspection and repair records.

5) Periodic (Annual) Inspection

Periodic inspection is required once per year. It shall meet OSHA and ASME periodic inspection requirements. The inspection record will be maintained by the FESS Crane Office.

6) Crane/Structure Modification

Structure modifications or extensive repairs to cranes and new crane/hoists that may impact the load capacity of the building structural components shall be reviewed by FESS before proceeding with the reviewed application.

FESS shall review the drawings and technical specifications for all new cranes and modification to existing cranes in consultation with the landlord D/S/P.

4.4 New, Re-installed, Altered, Repaired and Modified Cranes and Hoists

1) Operational Tests

New, re-installed, altered, repaired, and modified cranes shall be tested by the qualified person prior to initial use to comply with current standards. A qualified Fermilab employee will supervise subcontractors conducting operational tests. The following functional test shall be conducted:

- a. lifting and lowering;
- b. trolley travel;
- c. bridge travel;
- d. hoist-limit devices;
- e. travel-limiting devices;
- f. locking and indicating devices, if provided.

Note: Operational testing of altered, repaired, and modified cranes may be limited to the functions affected by the alteration, repair, or modification, as determined by the qualified person.

2) Load Tests

- a. New, re-installed, altered, repaired and modified cranes shall be load tested prior to initial use as determined by the qualified person.
- b. A load test performed at Fermilab shall not be less than 100% of the rated load of the crane or more than 125% of the rated load of the crane.

4.5 Crane Damage

- 1) When a crane is damaged, potentially damaged or fails operational testing, it shall be tagged and locked out of service by the D/S/P responsible for the crane (See [FESHM 2100](#) for Administrative Lockout procedures). The incident must be reported immediately to the FESS Crane Office (x3434) or the Division Safety Officer.
- 2) Incidents resulting in damage or potential damage to a crane shall be investigated and adequately documented by the responsible D/S/P.
- 3) The crane shall not be returned to service until it is inspected, repaired, and acceptance testing is completed in accordance with Operational Tests, see Section 4.4.

4.6 Cranes as Work Platforms

Certain mechanical or operating systems, such as lighting equipment and sprinkler heads, require periodic maintenance or servicing. These activities require the use of bucket trucks or elevated work platforms to reach the work area.

Using a crane platform may be a suitable alternative method to perform maintenance activities. Workers using the crane as a work platform face several hazards, which include mechanical pinch points, overhead hazards and electrical shock and fall hazards. Prior to starting work from a crane platform, the crane platform and the specific work activity must be evaluated, and potential hazards identified.

A hazard analysis in accordance with [FESHM 2060: Work Planning and Hazard Analysis](#) shall be performed and the actions or precautions taken must address the hazards and the conditions stated below:

- a. No work may be performed from a suspended load or hook except for using an approved man-basket for maintenance or rescue activity (See [FESHM 10190: Crane Personnel Lifting Platforms](#)).
- b. Fall protection and standard guardrails shall be provided and used.
- c. Ladders shall not be erected and/or used on cranes to gain access to areas that are not directly accessible from a crane without the use of a ladder.
- d. Only a qualified electrician shall be permitted to perform work on or near electrical equipment from the crane (See [FESHM 9120: AC Electrical Power Distribution Safety](#)).
- e. Machinery and live electrical equipment shall be guarded.
- f. Work from cranes shall be performed only when a crane is stationary.
- g. Crane operators shall be notified before work is performed from a crane.
- h. Crane shall not be moved until all employees on the crane are in locations where they will not be exposed to injury.
- i. Rail stops or other suitable methods shall be used to prevent a crane from being struck, whenever other cranes are in operation on the same runway.
- j. Signs, which indicate work is being performed, shall be posted whenever work is performed from a crane (on the crane or from a man-basket hanging below the crane). Such signs shall be visible from the floor.
- k. Lockout/Tag-Out procedures shall be implemented, as appropriate, when work is being performed from a crane.
- l. Safe egress to and from a crane shall be provided.
- m. Work performed from a man-basket hanging below the crane is permitted only if ASME B30.23 is followed and that both the crane and man-basket are inspected prior to work being performed. See [FESHM 10190](#) for details.

4.7 Recordkeeping

- 1) The WDRS Professional Development and Learning will maintain all training records. D/S/Ps may retain copies, but the original completed Crane Operator Performance Evaluation form will be forwarded to WDRS Professional Development and Learning. Completion of each phase of the training will be entered into the TRAIN database.

- Waived and OJT and performance evaluations shall be documented by the supervisor on the appropriate form.
- 2) Documented inspection records, repairs, upgrades, modifications, or additions to overhead cranes will be kept on file by FESS.

5.0 REFERENCES

Hoisting and rigging equipment and all design, installation, inspection, testing, and operations activities shall be in accordance with Fermilab [Prime Contract No. DE-AC02-07CH11359](#) with the conformed contract through Modification No. 302 from June 10, 2022. Attachment J.9 Appendix I DOE Directives. For cranes, hoists, monorails, jib cranes and rigging activities, these regulations (available in the library) are:

- 29 CFR 1910, Subpart N – Materials Handling and Storage
- ASME B30.10 (Hooks)
- ASME B30.11 (Monorails and Underhung Cranes)
- ASME B30.16 (Overhead Hoists (Underhung))
- ASME B30.17 (Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist))
- ASME B30.2 (Overhead and gantry cranes)
- ASME B30.21 (Manually Lever Operated Hoists)
- ASME B30.23 (Personnel Lifting Systems)
- ASME PASE (Portable Automotive Service Equipment)
- DOE Hoisting and Rigging Manual, DOE-STD-1090-2011

6.0 TECHNICAL APPENDICES

6.1 Shop Cranes

This section applies to shop cranes (a.k.a. engine hoists) of 8,000-lb capacity or less. Shop cranes have a pair of laterally spaced legs, an upright mast, pivoting boom with a boom extension and hook, and a hydraulic unit. The hydraulic unit moves the boom up and down at a pivot point to raise, remove, transport in a lowered position, and replacing automotive engines, transmissions, etc.

6.1.1. Operator Training Requirements

Department level on-the-job training is required to operate shop cranes. This will include a review of the operating instructions and safety precautions provided by the shop crane manufacturer.

6.1.2. Operation Expectations

Operation of shop cranes may only be done by operators who have an understanding of the product, its operating characteristics, and safety operating instructions before use. The shop crane must never be loaded beyond its rated capacity (except for proof tests) for each specified boom and leg position.

If necessary to leave a suspended load unattended, the immediate area (around 36 inches) around the shop crane shall be posted or barricaded to restrict entry of unauthorized personnel.

6.1.3. Inspection, Maintenance, and Repair Requirements

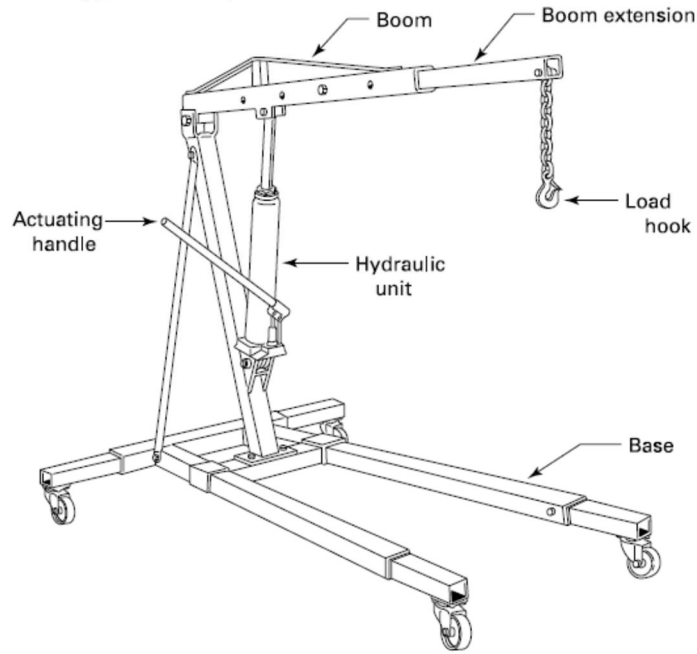
A visual inspection must be made before each use of a shop crane by checking for abnormal conditions (e.g. cracked welds, leaks, and damaged, loose, or missing parts). The shop crane must be marked with the rated capacity for each specified boom and leg position.

Tag the shop crane out if any defects are found and report the issue to the supervisor and FESS Crane Office.

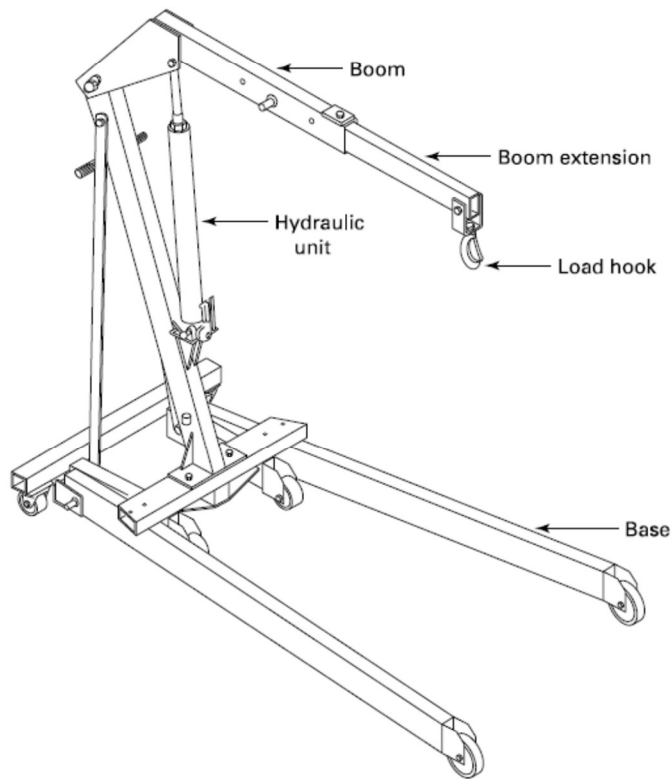
The shop crane must be inspected immediately if it is believed to have been subjected to an abnormal load or shock. This inspection must be scheduled through the FESS Crane Office.

An annual inspection of the shop crane will be made by the FESS Crane Office. All maintenance and repairs will be performed by a qualified person selected by the FESS Crane Office.

6.1.4. Figures of Typical Shop Cranes



(a)



(b)

6.2 Roust-A-Bouts

This section applies to Roust-A-Bouts.

6.2.1. Operator Training Requirements

Department level on-the-job training is required to operate Roust-A-Bouts and must include a review of the manufacturer's operating instructions and safety precautions.

6.2.2. Operation Expectations

Operation of Roust-A-Bouts may only be by operators who have an understanding of the product, its operating characteristics, and safety operating instructions before use.

6.2.3. Inspection, Maintenance, and Repair Requirements

A visual inspection must be made before each use of a material lift by following the manufacturer's recommendations (e.g. cable frays or kinks, bends in the forks, legs or base, winch operating freely, and other damaged, loose, or missing parts). Any signs of damage or defect must be reported to the area supervisor. The affected machine must be tagged out of service and FESS Crane Office shall be contacted to coordinate repairs of the machine.

An annual inspection of the shop crane will be made by the FESS Crane Office. All maintenance and repairs will be performed by a qualified person selected by the FESS Crane Office.

6.2.4. Figure of a Roust-A-Bout

