

## FESHM 10200: LIFT PLANS

### Revision History

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## 1.0 INTRODUCTION AND SCOPE

This manual includes guidelines, rules, and requirements applicable to critical, planned engineered and pre-engineered production lifts and describes the planning and documentation required to perform those lifts. This manual applies to activities conducted on the Fermilab site and in Fermilab-leased spaces.

## 2.0 DEFINITIONS

**Boom Angle** – the angle above or below horizontal of the longitudinal axis of the base boom section.

### **Critical Lift** –

A lift that meets any of the following:

- Loss of control of the item being lifted would likely result in the declaration of an emergency.
- The load or item is unique and, if damaged, would be irreplaceable or not repairable and is vital to a system, facility or project operation.
- The cost to replace or repair the load item damaged would have a negative impact on facility, organizational, or DOE budgets to the extent that it would affect program commitments.
- Lifts made with more than one crane/forklift.
  - *Exception: a tandem lift with synchronized overhead cranes that utilize one controller, as long as the item being lifted does not meet any other critical lift criteria.*
- Lifts made near electrical, ground or overhead utilities.
- Lift involves non-routine or technically difficult rigging arrangement.
- Lifts over items that are considered critical to the lab.
- For steel erection, a lift shall be designated as a critical lift if:
  - The lift exceeds 75% of the rated capacity of the crane, or
  - The lift requires the use of more than one crane.

**Ordinary Lift** – a standard lift that does not meet the requirements of a Critical, Planned Engineered Lift or Pre-Engineered Production Lift.

**Planned Engineered Lift** – a lift in excess of the overhead crane’s rated load. Any planned engineered lift cannot exceed 125% of the crane’s load rating.

**Pre-Engineered Production Lift** - a “repetitive lift that is performed by production line personnel in the assembly or disassembly of components or systems” in which the items to be lifted are “identical in terms of dimensions, weight, center of gravity, load path, method of attachment to the lifting equipment, and selection of lifting equipment” and “all items can be lifted in adherence to a specific step-by-step procedure that eliminates rigging decisions or calculations by lift personnel”.

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

**Technical Approver** – a qualified person who verifies the lift plan, as a minimum, addresses and contains the appropriate information that complies with the technical requirements applicable to the personnel, equipment, and activity covered by the plan as required by this Manual.

## 3.0 RESPONSIBILITIES

### 3.1 Division/Section Head/Project Manager

The Division/Section Head/Project Manager, or designee, is responsible for implementing this program. Specifically, he/she is responsible for:

- Designating a “Lift Director” for each critical, planned engineered, pre-engineered production lift operation that will occur in their area.
- Ensuring completed Lift Plan documents are uploaded into Teamcenter.

### 3.2 ES&H Section

The ES&H Section is responsible for:

- Providing consultation services to division/section heads regarding safety of operations and training opportunities.

### 3.3 Fermilab Medical Office

The Fermilab Medical Office is responsible for:

- Maintaining the operator fit-for-duty exam parameters per ASME requirements and conducting the fit-for-duty exam.

### 3.4 Mechanical Safety Subcommittee

The Mechanical Safety Subcommittee (MSS) will serve in a consulting capacity to ES&H and D/S/P in all matters concerning the planning of lifts. The MSS is responsible for maintaining updates to this chapter.

### 3.5 Division Safety Officer (DSO)/Qualified Safety Representative

The Division Safety Officer (or designee) is responsible for:

- Acting as the “Qualified Safety Representative” of written lift plans.
- Verifying that the lift plan addresses and provides applicable administrative and physical controls to mitigate potential and identified hazards.
- Attending the critical lift meeting(s).
- Monitoring lift operations to ensure that they are performed safely.

### 3.6 Facilities Engineering Services Section (FESS) Crane Office/Technical Approver

The Facilities Engineering Services (FESS) Section’s Crane Office (or designee) (call x3434 to reach Work Central) is responsible for:

- Acting as the “Technical Approver” of lift plans.
  - Will verify that the lift plan, at a minimum, addresses and contains the appropriate information that complies with the technical requirements

- Maintaining copies of completed lift plan permits and documentation.

### 3.7 Lift Director (Person-In-Charge)

The Lift Director is responsible for ensuring that:

- Qualified personnel are assigned to operate equipment and perform hoisting and rigging tasks.
- A lift plan procedure and written hazard analysis is prepared as specified in this chapter.
- The lift plan procedure is properly approved before implementing.
  - Verifies the lift plan approvers are qualified in the area they approved and authorizes the plan implementation.
- Reviewing the hazard analysis and lift procedure with all persons involved in or affected by the lift before initiating the lift during the pre-lift meeting.
- Approved equipment and hardware are identified in the lift plan.
- Directing the operation of the lift in accordance with the hazard analysis, lift plan, and all appropriate rigging and lifting best practices.
- Involved personnel are familiar with, and follow, the lift plan procedure.
- A qualified person (other than the operator) is designated as the Person-In-Charge when the Lift Director is unable to be present for the lift.
- After the lift is completed, lift plan documentation is transmitted to the manager for whom the lift was done, and a copy is submitted to the FESS/FM Crane Office (for crane-related lifts), to FESS Transportation Services (for forklift-related lifts). The Lift Director should advise responsible personnel that this documentation is subject to audit for one year.

### 3.8 Qualified Operator

The Qualified Operator is responsible for:

- Meeting the requirements in FESHM 10100 and/or FESHM 10120. Having valid training for the equipment to be used in the operation.
- Following the lift plan, including specific instructions/procedures for attachment of the rigging gear to the load.
- Using proper rigging techniques.
- Safely operating the equipment. Wear hard hats and safety-toed shoes for all lifts and when handling the load. Other personal protective equipment such as gloves and safety glasses may be required to mitigate hazards.
- Following the equipment operating guidelines and the load charts.
- Ensuring that the load will not exceed the rated capacity of the equipment, except for approved planned engineered lifts.
- Abiding by any restrictions placed on the use of the equipment.
- Completing a medical fit-for-duty exam if involved in critical, pre-engineered, or planned engineered lifts.

## 4.0 PROGRAM DESCRIPTION

The purpose of this program is to ensure that all lifts are performed safely. This requires assigning appropriate personnel, and planning, preparing and performing lifts. They apply to workers (*including operators, riggers, signal persons, lift directors/persons-in-charge*), supervisors, load owners, ESH personnel, and the FESS Crane Office.

## 5.0 PROCEDURES

### 5.1 Lift Type Determination

The individual responsible for the item to be lifted is responsible for determining whether it be handled as a critical, planned engineered lift, pre-engineered production lift, or ordinary lift using the information provided in this document. The manager who designates a lift as a critical/planned engineered/pre-engineered production lift shall ensure that a Lift Director be assigned. Ordinary lifts do not require a written plan but should be approved by the supervisor in charge of the lift.

### 5.2 Ordinary Lifts

For ordinary lifts a written plan beyond normal site work planning and control documents is not required, though may be desirable for more complex lifts.

A designated leader must be present at the lift site during the entire lifting operation. If the lift is being made by only one person, that person assumes all responsibilities of the designated leader. Designation may be by written instructions or specific verbal instructions for the particular job.

The designated leader will ensure:

- Personnel involved understand how the lift is to be made.
- That personnel involved are current in training and qualification.
- The lift site has been surveyed for hazardous/unsafe conditions.
- That the lifting equipment, rigging and other accessories are properly selected such that their rated capacities are not exceeded.
- All hoists/cranes/lift trucks are within the inspection interval.
- That a preoperational check of all lifting equipment and rigging is performed.
- That equipment is properly set up and positioned.
- That hoisting routes minimize exposure to personnel and critical equipment from the hoisted load and that only essential personnel are allowed within the fall zone.
- That a signal person is assigned, if required, and is identified to the operator.
- That the load hook is directly over the center of gravity of the load to the extent possible. Check load lines after strain is put on them but before the load is lifted clear of the ground; if load lines are not plumb, reposition the slings or equipment so that the lines are plumb before continuing.
- That the lifting operations is completed safely and efficiently.
- That the job is stopped when any potentially unsafe condition is recognized.

The normal working procedure shall include the following:

- a) Identify the load to be moved and its intrinsic characteristics as weight, dimensions, center of gravity, its ability to support imposed lifting forces, loose materials, whether it contains any hazardous or toxic materials.
- b) Validate the load paths and clearances.
- c) Identify lifting equipment and rigging to be used by type and rated capacity.
- d) Evaluate the work area and conditions impacting crane setup, operations.
- e) Identify any special site-specific operating procedures and special instructions.

### 5.3 Critical Lift Plan Content

A Critical Lift designation will require the following:

- Documented step-by-step instructions (see Section 5.4)
- Sign-off approvals from the lift director, technical approver, ESH representative, Division/Section/Project management, and the qualified operator.
- Independent pre-identification of load weight, load center of gravity, lift attachment points, and lifting hardware minimum capacities (slings, below-the-hook lifting devices, shackles, etc.) that will be used for the lift or series of lifts.
- Independent pre-identification of crane(s) or fork lift(s) with minimum capacities identified for configuration to be used.
- Evaluation of hazards associated with the lift that may include, but is not limited to, environmental, ground support, power lines, and physical obstructions.
- Pre-identified special limiting or stop-work conditions.

### 5.4 Critical Lift Equipment and Hardware

Before making a critical lift, the Lift Director shall ensure that equipment (cranes, hoists, forklift trucks, rigging etc.) annual inspections are current, a pre-use inspection has been performed and that rated-capacity/proof/load tests have been performed for slings, rigging, rigging hardware, and below-the-hook devices. Coordinate through FESS Crane Office. (Exceptions apply to manufacturer-installed rigging hardware. See Section 5.4.1.1.) The Lift Director shall confirm through communications with management or reviewed documents that personnel performing the lift are currently qualified for the assigned task(s).

#### 5.4.1. Manufacturer-Installed Rigging Hardware on Engineered Equipment

Engineered equipment with manufacturer-installed rigging hardware (eyebolts, swivel hoist rings, etc.) should be purchased with load-test documentation supplied. Rigging hardware on engineered equipment, installed by the equipment manufacturer, without test documentation, may be used if approved by a rigging specialist or qualified engineer and inspected by a qualified inspector before use.

### 5.4.2. Rigging for Critical Lifts

The rigging hardware components (slings, shackles, chain, below the hook lifting devices) to be used in critical lifts shall be rated-capacity/ load tested as specified in the applicable American Society of Mechanical Engineers (ASME) Standards, DOE-STD-1090-2011, and OSHA. Rigging components that have been load tested shall be marked or tagged by the user, a third party, or the manufacturer to verify the rated-capacity/ load test. Documentation shall be traceable to the rigging component. Traceability may be accomplished by placing a tag or other permanent marking on the hardware. The manufacturer, the user, or a third party may perform load/proof tests. Tags or other permanent marking fulfill documentation requirements without paperwork, except for below-the-hook lifting devices (see FESHM Chapter 10110, *Below-the-Hook Lifting Devices*) and forklift attachments (see FESHM Chapter 10120, *Powered Industrial Trucks*), which require additional documentation.

### 5.4.3. Rigging Requirements for Critical Lifts

Each rigging component shall be qualified in accordance with Section 5.4.2. Rigging for critical lifts may include the following and shall meet the requirements found in the referenced chapter (including testing and marking requirements).

1. Slings and rigging hardware (including wire rope slings, alloy chain slings, metal mesh slings, synthetic web slings, synthetic rope slings, synthetic round slings, rigging blocks, shackles, eyebolts, rings/links/swivels, swivel hoist rings, and turnbuckles) shall meet the requirements of FESHM Chapter 10130, *Slings and Rigging Hardware*, ASME B30.9, *Slings*, ASME B30.26, *Rigging Hardware*, and DOE Standard 1090-2011, Sections 10 and 11.
2. Below-the-Hook Lifting Devices shall meet the requirements of FESHM Chapter 10110, *Below-the-Hook Lifting Devices*, ASME B30.20, *Below-the-Hook Lifting Devices*, BTH-1, *Design of Below-the-Hook Lifting Devices* and DOE Standards 1090-2011, Section 12.
3. Dynamometers and Precision Load-Position Devices shall be load tested and calibrated prior to the critical lift. See DOE Standard 1090-2011, Section 11.

## 5.5 Critical Lift Plan

A step-by-step plan or work instructions shall be prepared by the Lift Director and approved by the technical approver (FESS Crane Office SME), contractor supervisor (if applicable), qualified crane operator, qualified safety representative (ESH representative), and Division/Section Head (see Section 5.8). Critical lift plans shall be stand-alone documents with all required information and approvals. The Lift Director shall have the critical lift plan at the work location during the lift(s).

Critical lift plans shall contain documented step-by-step instructions and drawings (see example drawings and the Lift Plan Development Guide in the Technical Appendix) containing:

1. Identity of the item(s) to be lifted.
2. Weight of the item and total weight of the load (For mobile cranes, see the manufacturer's instructions regarding components and attachments that must be considered as part of the load).
3. A list that specifies each specific piece of equipment (e.g., crane, hoist, fork truck), accessory, and rigging component (e.g., slings, shackles, spreader bars, yokes) to be used



- for the lift. This list shall identify each piece of equipment by type, size, and rated capacity. When a lift plan identifies multiple cranes, forklifts, or rigging components that may be used for the lift(s), the plan shall require verification of the specific ones used for the lift(s).
4. Identification of hazards associated with the lift that may include but are not limited to environmental, ground support, physical obstructions, power lines, crush/pinch points/struck-by hazard, etc.
  5. Identification of essential personnel that may be permitted in the fall zone to perform work that cannot be done otherwise (such as rigging or guiding the load).
  6. Designated checkpoints or hold points and estimated instrument readings, as relevant, so that job progress can be checked against the plan.
  7. Hold points or sign-off points for personnel assigned to witness the work. Sign-offs (initial/date) in the plan as key steps are completed or validated.
  8. Special precautions, if any (such as mats for mobile cranes).
  9. Rigging sketch(s), which include the following: (See examples in Technical Appendix)
    - a. Dimensions of item to be lifted, including center of gravity
    - b. Lift point identification
    - c. Method(s) of attachment and hitch configuration for slings
    - d. Capacity and tension on slings, rigging hardware, and lifting devices at the configuration shown
    - e. Sling angles
    - f. Accessories used (softeners, dunnage, etc.)
    - g. Other factors affecting the equipment capacity such as, but not limited to, D/d ratio or temperature when applicable
    - h. Rated capacity of the cranes or forklifts in the configuration(s) in which it will be used. For mobile cranes, many factors affect rated capacity, including boom length, boom angle, and work area (radius). Forklift attachment(s) that effect capacity shall be identified.
    - i. A Pre-identified load-path sketch that shows the load path and height at key points in the job. For lifts with mobile cranes, include the crane position(s) relative to the load and relative to surrounding obstructions. Where appropriate, include floor or soil-loading diagrams.
    - j. A note(s) indicating lifting, travel speed, and height limitations, when applicable. This may be noted on the load-path sketch or on a separate sketch.
  10. Approvals by Lift Director, technical approver, qualified operator, qualified safety representative, and Division/Section Head.
  11. A list of required personnel assignments and/or responsibilities.
  12. Verification of personnel qualifications (this may be accomplished via communications with management or reviewing documents).
  13. The Lift Plan permit will require sign-off to document verification that equipment (cranes and forklifts), rigging, hardware, and below-the-hook lifting device inspections, periodic and pre-use, are current and have been subjected to testing as required in the applicable chapter.
  14. Verification that installed lifting or attachment points have been inspected.

15. Pre-identified stop-work conditions such as, but not limited to, weather or other conditions that would require termination of the lift.
16. Requirement to perform operational test of functions of the crane through the full range of movements that will be used to perform the lift(s). The test shall be performed with the crane set up in the exact configuration as will be used to perform the lift or series of lifts with no load on the hook.
17. Documentation of lift and pre-job meeting.
18. Copies of any completed JULIE form(s) or ground scans when applicable to the lifting activity for mobile cranes and forklifts. Use the E-JULIE form: <http://fess-ogfp.fnal.gov:8095/eJulie>, or call x5000.

**NOTE:** *Although individual plans are prepared for one-time critical lifts, more general (multi-use) plans may be employed to accomplish recurring critical lifts. For example, a general plan may be used to lift an item or series of similar items that are handled repeatedly in the same manner. Several or multiple lifts of various loads may be contained in one critical lift plan.*

## 5.6 Planned Engineered Lifts

Planned engineered lifts shall be planned as critical lifts in accordance with ASME B30.2, ASME B30.17 and ASME B30.16.

### 5.6.1. Planned Engineered Lift Requirements

The division/section head/project manager prior to the lift taking place must approve documented planned engineered lifts. Only two (2) lifts per crane are allowed in a 12-month continuous time period. Every planned-engineered lift will be treated as a special and separate event.

The following procedures will be followed before the lift is executed:

- 1) Planned engineered lifts are limited to powered cranes having a load rating of 5 tons and above and shall not exceed 125% of rated capacity. Division Safety Officer (DSO) shall be notified if a lift will exceed 100 percent of rated load.
- 2) The division/section will advise FESS Crane Office, in writing, of the planned-engineered lift.
- 3) The division/section shall prepare a hazard analysis (per [FESHM 2060](#)) and lift plan that identifies the Person-in-Charge and the procedures to be used to perform the lift and all safety hazards associated with the lift. A copy of the plan (including the HA and lift plan) shall be sent to FESS Crane Office prior to the planned engineering lift taking place.
- 4) A written review of the crane service history will be prepared, including reference to previous planned-engineered lifts, structural repairs, and modifications of the original design.
- 5) FESS Crane Office shall review the design of the crane-supporting structure and the conditions of the crane supports. Any deterioration or damage must be taken into consideration in design calculations for the load to be lifted. They will determine the maximum load that can safely be lifted.
- 6) The division/section and FESS Crane Office shall meet to assure that the lift and its limitations are understood.
- 7) Prior to the lift, the crane will be inspected as follows:
  - a. Inspect for deformed, cracked or corroded members.

- b. Loose or missing bolts, nuts, pins, or rivets.
  - c. Cracked or worn sheaves and drums.
  - d. Worn, cracked, or distorted parts such as pins, bearings, wheels, shafts, gears, rollers, locking and clamping devices, bumpers and stops.
  - e. Excessive wear of brake system parts.
  - f. Excessive wear of chain drive sprockets and excessive chain stretch.
  - g. Deterioration of controllers, master switches, contacts, limit switches, and push-button stations, but not limited to those items.
  - h. Motion limit devices that interrupt power or cause a warning to be activated for proper performance. Each motion shall be inched or operated at low speeds into the limit device with no load on the crane.
  - i. Rope reeving for compliance with recommendations of the crane manufacturer.
  - j. Function labels for legibility and replacement.
- 8) The operator shall test the crane at the planned-engineered load by lifting the load to ensure the entire weight bears on the crane and rigging components and setting the brakes. The lift will be continued ONLY if the brake stops and holds the load. Any failure to hold the load must be corrected before continuing with the lift.
- 9) A record of the planned-engineered lift, including calculations, inspections, and all distances moved, will be provided to FESS Crane Office and will be made available upon request to appointed personnel.
- 10) The crane manufacturer shall be consulted if a planned engineering lift exceeds the number allowed in a continuous twelve-month period or exceeds 125 percent of rated load. The crane shall be inspected in accordance with item 7 above after every planned engineering lift is completed and prior to being used for lifting any other load.

### **5.6.2. Planned Engineered Lift Special Precautions**

Special precautions to be considered for Planned Engineered Lifts include pre-identification of load weight, load center of gravity, lift attachment points, the use of custom designed lifting hardware, and minimum lifting hardware capacities (slings, below-the-hook lifting devices, etc.) that will be used for the lift or series of lifts. Special precautions require the manufacturer's requirements or company procedures to be followed.

### **5.6.3. Planned Engineered Lift – Post Lift Requirements**

Following completion of a planned engineered lift, the lifting equipment shall undergo a post-lift inspection.

## **5.7 Pre-Engineered Production Lift**

Pre-engineered production lifts shall be planned per the following requirements.

### **5.7.1. Pre-Engineered Production Lift Requirements**

- A step-by-step procedure (Lift Plan) must be developed and approved for each pre-engineered production lift.
- The procedure must be verified before its first use in the actual production process using walkthroughs to ensure that the steps are appropriate and correct. Any discrepancies found

during this process must be corrected and verification process repeated until the procedure is correct.

- The procedure shall be reviewed and approved after the procedure has been verified (see section 5.8 for approval requirements).
- Approved procedures shall be reviewed at least annually to ensure the information and instructions are technically accurate and that appropriate human-factor considerations have been included.
  - Applicable procedures must be reviewed after an incident.
- During each review, procedures should be compared to source documents to verify their accuracy.
- A copy of the current issue of the approved procedure shall be available in the work area when the operation is performed.

Deviations from the approved procedure are not permitted, except for emergencies. During emergency conditions, personnel may return the load down to a safe and stable condition, when possible, prior to initiating a procedure change.

#### **5.7.2. Pre-Engineered Production Lift Training Requirements**

- Specialized training shall be conducted for personnel involved in performing pre-engineered production lifts. It shall include:
  - Thorough coverage of all aspects of the procedure and assigned responsibilities for the lift.
  - A demonstration by the individual of operational competence in the performance of all assigned duties associate with the lift.
- Training shall be documented as On-the-Job training on the individual's ITNA. Training on a procedure shall be repeated periodically or when a modification to the procedure results in a significant change in the operation.

### **5.8 Lift Plan Approval**

Critical, Planned Engineered, and Pre-Engineered Production lift plans or work instructions should be approved, signed and dated by the following:

1. Lift Director
2. Technical Approver (FESS Crane Office SME)
3. Contractor Supervisor (if applicable)
4. Qualified Operator(s)
5. Qualified Safety Representative – ES&H Representative
6. Division/Section Head

#### **5.8.1. Lift Plan Field Revisions**

Lift plan or work instruction field revisions shall be accomplished by drawing a single line through the original (deleted) text and inserting the field revision close to the deleted text. The field revision shall be initialed and dated by the person(s) making the revision. Text shall not be obliterated by the use of correction fluid, correction tape, scribbling, erasure, or any other method. Field revisions should be approved as required by the responsible contractor's plans. Field revisions must be

confirmed by written record (e.g. email). As a minimum, lift plan field revisions shall be signed and dated in the margin of each revised page by all of the following:

1. Lift Director
2. Technical Approver (FESS Crane Office SME)
3. Contractor Supervisor (if applicable)
4. Qualified Operator(s)
5. Qualified Safety Representative – ES&H Representative

### **5.8.2. Pre-lift and Field Revision Review Meetings**

Before performing critical, planned engineered, or pre-engineered production lifts and immediately following a field revision, participating personnel shall meet to accomplish the following:

- Review the lift plan or field revision.
- Discuss any hazards, controls, hold points, coordination with other work groups, unique conditions, and emergency contingencies.
- Resolve questions before beginning work.

## **5.9 Lift Documentation and Record Retention**

As a minimum, documentation of each pre-lift and field revision meeting shall include an attendance roster showing the meeting time and date and a list of attendees. The Lift Director shall retain meeting documentation until the lift is satisfactorily completed. When the job is finished, the Lift Director shall transmit the lift documentation to the division/section for whom the lift was done, and a copy must be sent to the FESS Crane Office (for crane-related lifts) and FESS Transportation Services (for forklift-related lifts). This documentation is subject to audit for one year after the lift is completed.

Documentation of critical, planned engineered and pre-engineered production lifts shall include the following:

- The lift plan, recording job completion with approval signatures and hold point sign-offs as applicable. The lift plan shall include documentation of the pre-lift meeting.
- Documentation of the pre-lift meeting; containing, at a minimum, the meeting date and list of attendees.
- Any additional documentation deemed appropriate by management.

## **6.0 REFERENCES**

American Society of Mechanical Engineers (ASME):

- B30.2 – Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
- B30.5 – Mobile & Locomotive Cranes
- B30.9 – Slings
- B30.10 – Hooks

- B30.16 – Overhead Hoists (Underhung)
- B30.17 – Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
- B30.20 – Below-the-Hook Lifting Devices
- B30.22 – Articulating Boom Cranes
- B30.23 – Personnel Lifting Systems (subpart of the Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings)

Occupational Safety and Health Administration (OSHA):

- 29 CFR 1910.178 – Powered Industrial Trucks
- 29 CFR 1910.179 – Overhead and Gantry Cranes
- 29 CFR 1910.180 – Crawler Locomotive & Truck Cranes
- 29 CFR 1910.184 – Slings
- 29 CFR 1926.251 – Rigging Equipment for Material Handling
- 29 CFR 1926.554 – Overhead Hoists
- 29 CFR 1926.550 – Cranes and Derricks

Department of Energy Standard, DOE-STD-1090-2011 – Hoisting and Rigging

Fermilab Environment, Safety and Health Manual (FESHM)

- FESHM 10100 – Overhead Cranes and Hoists
- FESHM 10110 – Below-the-Hook Lifting Devices
- FESHM 10120 – Powered Industrial Trucks (PIT's)
- FESHM 10130 – Slings and Rigging Hardware
- FESHM 10140 – Mobile Cranes
- FESHM 10190 – Crane Personnel Lifting Platforms

## 7.0 TECHNICAL APPENDICES

### 7.1 Lift Plan Development Guide

#### Mobile, Bridge, Gantry Cranes and Forklift Lift Planning Recommendations

Critical, Planned Engineered or Pre-Engineered Production Lift Plans require more extensive planning and oversight by qualified persons and are thus, a more formal approach to planning. A lift plan shall be prepared and approved by qualified persons to minimize the potential of a crane failure (stability or structural). Depending on the complexity of the crane lift, the formal lift plan may involve several pages (including drawings of the crane and/or the load, load charts, crane set-up, etc.) to document the necessary information pertaining to the crane's configuration, accurate load and rigging information, and the crane's rated capacity.

This attachment should be used as a guide to assist the lift plan author in evaluating specific factors of a lift. Mandatory requirements shall always be followed as defined in this FESHM Chapter, Occupational Safety and Health Administration (OSHA) regulations, and the American Society for Mechanical Engineers (ASME) B30 standards. The lift plan should be formatted to include all the underlined header topic items for standardized procedural/plan formatting and uniformity. All necessary subject matter information shall be included in the lift plan and a clear and prescribed representation given as to the direct significance it represents to the lift development. Other essential subject matter items may be required depending on the circumstances of each lift.

#### Approvals

At a minimum, the lift plan shall be signed and dated by the following people:

- Lift Director
- Technical approver (Fermilab Crane Office SME)
- Contractor Supervisor (if applicable)
- Qualified Operator
- Qualified Safety Representative – ES&H Representative
- Division/Section Head or Project Manager

The lift plan is to be approved as required by the responsible contractor's processes and procedures, which may require additional signatures.

#### PURPOSE/SCOPE OF JOB

The purpose of this procedure is to provide hoisting and rigging instructions for:

*Give a description of the load to be lifted and any other relevant information required to make the lift, including adjacent equipment, trucks/trailers, buildings or structures that might have an effect on the lift or placement of the load.*

#### REFERENCES

All references should be retrievable. If the information is not retrievable then the information should be attached to the lift plan.

- FESHM
- Design calculations of the lifted item
- Drawings of added value to assist with making the lift
- Vendor instructions and facility/operations procedures
- Soil test reports
- Applicable facility or organizational specific requirements
- Other related documents that may provide information

### **PERSONNEL REQUIREMENT**

Each company or contractor should have a program in place to ensure that the required training is provided and the training records are available. These personnel should include:

- Riggers, Truck driver(s) as needed
- Crane Operator(s)/Forklift Operator(s) as needed
- Signal person(s) or flagman(s)
- Lift Director—an individual with adequate hoisting and rigging experience selected by the Division/Section/Project to advise and supervise hoisting and rigging activities

### **MATERIALS TOOLS AND EQUIPMENT**

All the required rigging hardware, lifting devices, the lifted item, tools, and equipment need to be identified (listed) here and may be called on the rigging sketch(s). The lift plan should require verification of code compliance for certain items such as lifting devices (to be labeled in accordance with ASME B30.20) and rigging hardware (to be in accordance with ASME B30.26).

#### **Equipment:**

- Crane/forklift identified by type and size
- Truck/trailer, as required
- Type, size, and rated capacity identified for all equipment and hardware
- Department of Transportation (DOT)/Safety Analysis Report for Packaging (SARP) tie-down requirements, if any

#### **Multiple crane lifts**

Lifting one load simultaneously with several cranes is considered beyond the scope of normal crane operations. This activity greatly increases the danger of both overloading and side loading a crane. It has been viewed as acceptable to undertake such lifts if a crane's working rating is reduced by approximately 25%. Such a reduction can give a false sense of security and does not ensure the success of a tandem lift if proper procedures are not followed. No simple checklist can provide a user with sufficient background to safely attempt a tandem lift. A formal lift plan (critical, planned engineered or pre-engineered production) shall be written for all two crane lifts. The plan shall identify the weight and center of gravity. The following factors are critical in evaluating tandem lifting. This list is intended to supplement the factors listed for a heavy lifting with a single crane. These factors are only an aid for qualified personnel in carrying out such lifts.



**Things that should be considered are:**

- Will the load be shared in proportion to each crane's rated capacity?
- How will the load distribution between cranes be controlled?
- Will electronic load indicating or load limiting systems be available to monitor the load on the cranes?
- If plans require cranes to carry equal loads can the rigging be set up to insure load equalization between the cranes?
- Will the swing brakes and locks be released on all cranes to help prevent side loading when lifting?
- Will all crane booms face a parallel direction when lifting to prevent side loading if booming (luffing) is required?
- Has one person been assigned to monitor the plum condition of each cranes hoist line during the lift?
- Will all operators have visual contact with the Flagman during the entire lift?
- Is some crane de-rating necessary to compensate for the inability to eliminate all coordination problems with equipment or control procedures?
- Has the selection of crane movements of each crane during the lifting operation been determined?
- No motion should be combined with travel. The cranes can hoist together as needed, and any time that one crane swings, travels, or luffs it will be necessary for the other crane to move synchronously in order to keep the load lines plumb.
- Ideal situation using two cranes would be a lift of uniform weight, using identical cranes which are symmetrically attached. Each crane would be equally loaded, load lines kept plumb, and they will remain equally loaded while in the air. The cranes will remain within their rated radius.

**PRECAUTIONS AND LIMITATIONS**

Generally, all of the following precautions should be included in the lift plan. Always emphasize and include in the lift plan the statement that "If this procedure cannot be performed as written, stop work. Return equipment to safe configuration and inform the Lift Director that the procedure cannot be performed as written, and a revision or field change notice is required."

- Rope off or barricade area to define the lift area as directed by the Lift Director to prevent the entry of unauthorized personnel.
- No personnel at any time shall be permitted to position themselves under the load.
- Ensure all rigging hardware and equipment is verified for operation and use at the low temperatures as identified in this chapter and ASME B30.26.
- Special requirements, and/or manufacturer's requirements or other required information pertaining to the lift has been considered.
- Evacuation routes, contingency plans, emergency procedures have been determined.
- Points of no return in the lift process should be defined. These points should clearly identify the actions to take to place beyond these points to place the load in a safe configuration (i.e. lifting over the edge of a hole or building roof). Before this point the safe condition maybe setting the load on the roof on dunnage after that point it will require it going to the ground or even leaving it suspended.

**PREREQUISITES**

Prior to making a lift, a functional/operational test shall be performed on all functions of the crane through the full range of movements that will be used to perform the lift. The test shall be performed with the crane set up in the exact configuration as will be used to perform the lift or series of lifts with no load on the hook.

For mobile cranes physically take the measurement from the crane's center of rotation to the load's center of gravity. This measurement can be checked against the cranes load moment indicator (LMI) system.

Identify power lines and obstructions in swing radius, load, and travel path of the crane. If present, verify FESS High Voltage Engineering group is notified prior to the day of the lift.

Assign a qualified signal person to verify required electrical clearance is maintained.

The work package or work instructions are complete and understood by all involved personnel involved with the lift.

Weather conditions have been considered, e.g., wind, ice, snow, electrical storms.

Maximum wind speed has been identified.

Has the minimum clearance between the load and the boom during the lift been checked?

Have all the rigging and apparatuses been considered in the weight calculations?

Have all saddles, chains, binders, bolts, welds, and other securing devices been freed from the load before lifting is attempted?

Have softeners been utilized to protect corners?

Is there anything inside the load that could shift during the lift?

Will the lifting beams and other rigging hardware remain safely clear of the boom, the load, and other objects during the lift?

Correct crane(s)/forklift truck(s) is/are identified and have been inspected. Load, foundation, and crane set-up verified.

Outrigger pads and mats for mobile or crawler cranes are to be selected based upon manufacturer specifications.

Lifting points or attachment points have been inspected. Verification should be made of the lift points on engineered equipment with manufacturer-installed rigging hardware (eyebolts, swivel hoist rings, etc.).

The operator's manual has been verified for boom extensions, block, ball, number of parts of line, and rigging accessories weight.

When more than one crane will support the load, the intended share of load throughout the lift for each crane has been accounted for in the above check.

Sling loading has been calculated (reference sketches)

Underground obstacles such as voids and pipes that would affect safe operation of the crane and assisting equipment have been identified and evaluated as not to be a hazard.

Loads outside the fork truck's load center, the forklift manufacturer's instructions must be consulted. If the manufacturer's instructions are not available, field calculations may be used to estimate the reduced lifting capacity.

Have the shackle pins been checked to assure they fit the holes provided? Are the dimensions of the lifting lugs-pad eyes consistent with the shackles proposed? Will there be clearance when the shackle turns from horizontal to vertical?

Has the appropriate design safety factor been used for designing the lifting lugs?

Does the crane(s) have to travel with the load? Is the travel path compacted properly?

Has the travel and swing path been looked at for obstructions?

Has the transport route been checked for overhead obstructions?

### **Landing the lifted load**

Is there adequate space for delivery/removal of the load transport vehicle without endangering operating personnel?

Will the lifted load remain clear of all obstructions throughout the lifting path?

Can rigging personnel control and manipulate the lifted load throughout the entire lifting path without exposing themselves to undue danger?

Have all loose objects been secured or removed to prevent falling from the load during the lift?

Has the load been prepared for placing in its final location by clearing bolt holes, removing temporary brackets, proper cribbing, etc.?

Has the landing structure been verified to be in compliance (per FESHM 5100)?

## **LIFT INSTRUCTIONS**

- Provide a detailed description of the exact lifting operation including all aspects of the lift succession from start to completion.
- Verify item can be installed in the field as planned, i.e., physically look at the field condition, photographs, and drawings. Verify that dowels/pins/bolts in the field mate/match up with the equipment to be installed.
- Reference information may need to be obtained from the planner, system engineer, rigging engineer, or the FESS Crane Office SME to ensure the work sequence is detailed as required to support the riggers/crane operator completing the lifting operations and provide information in the pre-job meeting.
- Attach additional pages as necessary of written direction, sketches, and drawings as necessary to ensure this lift instruction can be followed in the field.
- Verification of hold points and check points should be established for sign off to provide the documented record of the lift. This includes the assigning of the Lift Director by the individual responsible for the lift.

## **PRE-LIFT MEETING**

A pre-lift or pre-job meeting shall be held with all personnel involved in the lift and a roster with names of attendees and dates shall be attached as part of this lift plan document (see Lift Plan Permit).

## **SKETCHES**

Need to show the equipment and rigging hardware in the configuration it will be used to make the lift(s). Sketches do not have to be drawn to scale, but should show the following as a minimum:

- Dimensions of item to be lifted
- Dimensions of the lifting pick points
- The center of gravity is identified; how was it determined and is it marked on the load?
- Lift points shall be identified
- Method(s) of attachment and hitch configuration for slings are identified
- Capacity and tension on slings, rigging hardware, and lifting devices at the configuration shown have been calculated
- Sling angles are identified
- Accessories used (softeners, dunnage etc.)

Other factors affecting the equipment capacity such as, but not limited to, D/d ratio or temperature ratings on rigging hardware are identified when applicable.

Rated capacity of the cranes or forklifts in the configuration(s) in which it will be used.

For mobile cranes, many factors affect rated capacity, including boom length, boom angle, and work area (radius). Forklift attachment(s) that effect capacity shall be identified.

Load path and height when applicable. For lifts with mobile cranes, include the crane position(s) relative to the load and relative to surrounding obstructions. Where appropriate, include floor or soil-loading diagrams.

A note(s) indicating lifting, travel speed, and height limitations when applicable. This may be noted on the load-path sketch or in the lift plan document.

Attachment points (quantity, spacing distance, size, and type). Engineered lifting attachment points must identify configuration. Identify the pin diameter for applicable lifting bails and whole size for lifting lugs. Non-engineered lifting attachment points shall be identified and show a completed analysis to ensure structural integrity during the lifting operation:

- Known boom tip height, boom angle, boom length, lift radius
- Crane or forklift configuration
- Load deductions are known and listed

## 7.2 Forklift Travel Path Sketch Example

Location of item: Warehouse 2

Destination: Relocate Crate to Provide Access for Loading onto Shipping Container

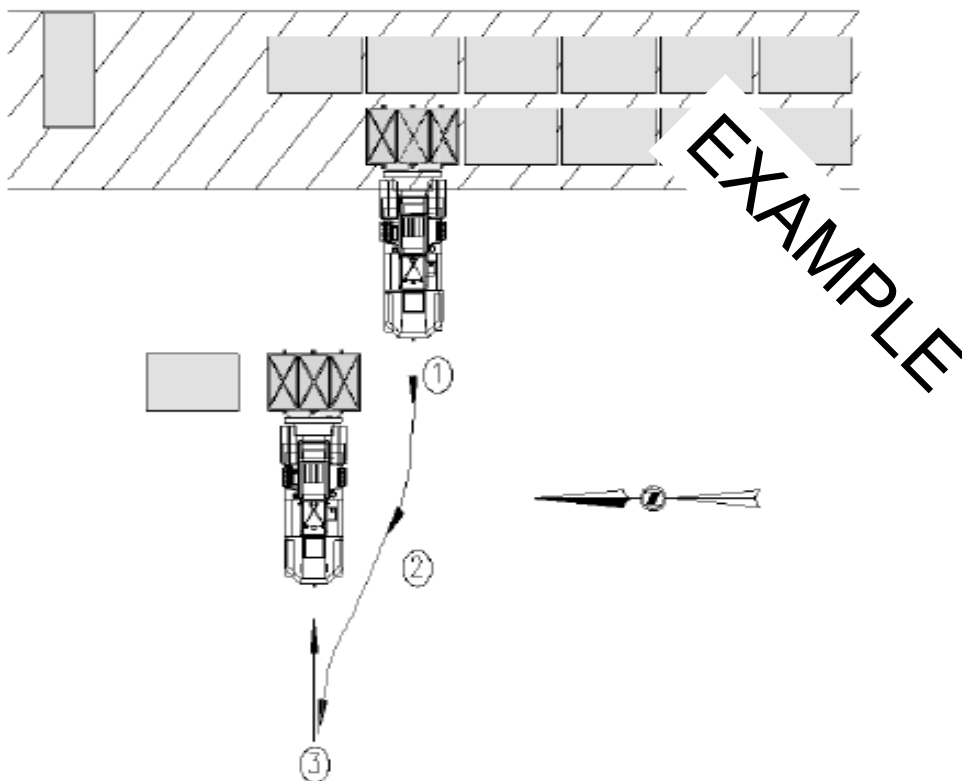
Crate Dimensions: 16'0" long, 9'0" wide, 10'8" high

Crate weight: 10,900 lbs

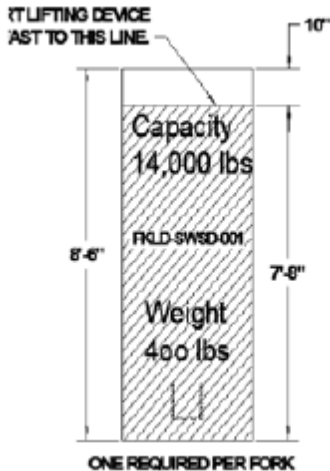
Estimated center of gravity is at geometric center of crate

Forklift: Hyster Model 5500 equipped with Forklift Lifting Device: PD12345 (one on each fork) capacity 14,000 lbs each, weight 400 lbs each

1. Pick up crate and back north approximately 10 feet.
2. Back North East approximately 15 feet.
3. Move forward to align crate as directed by Person-In-Charge. Leave at least 5 feet between crates.



**7.3 Forklift Loading & Lifting Point Reference Sketch Example**

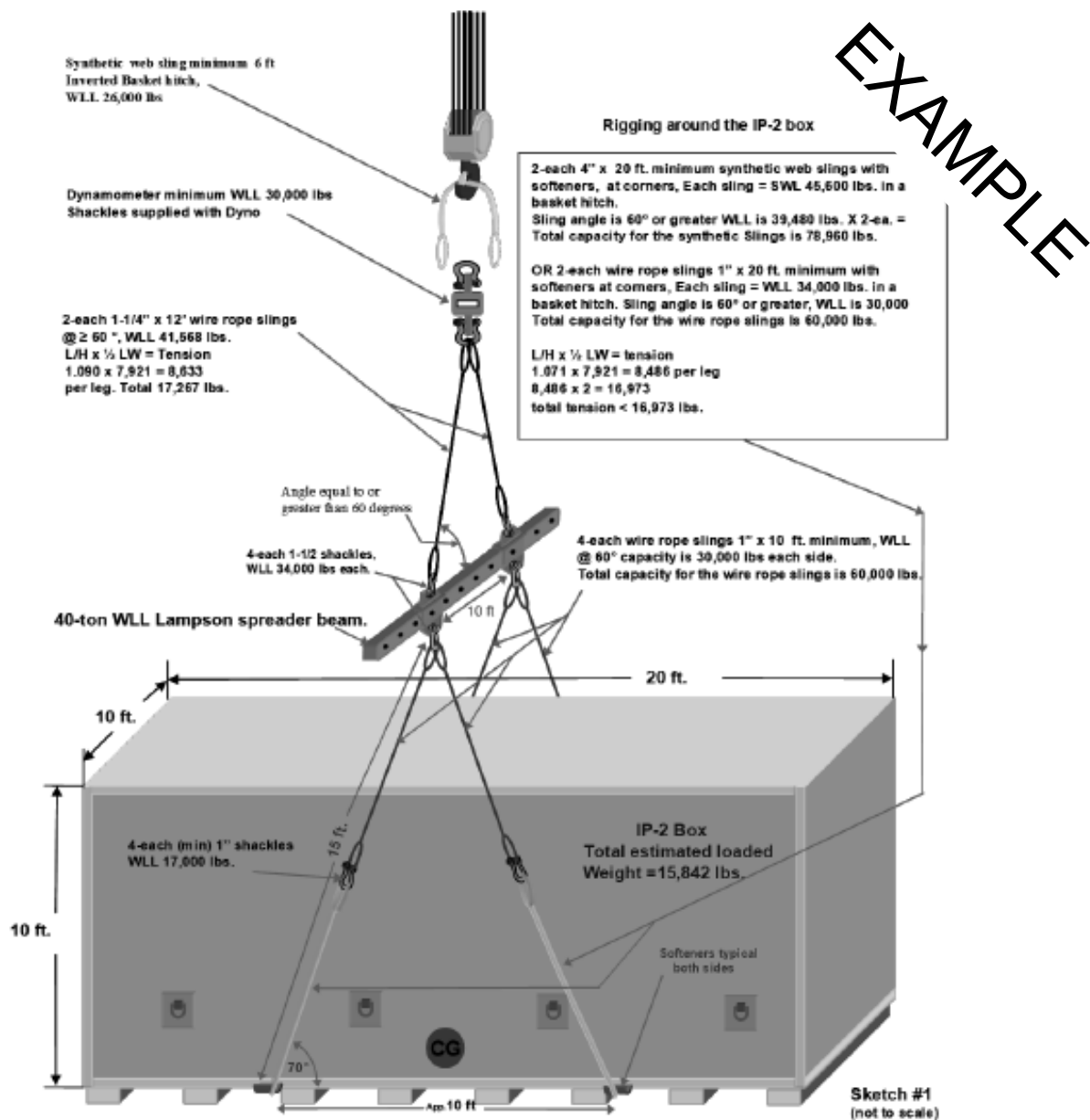


Location of box: Warehouse 2  
 Destination: Relocate Crate to Provide Access for Loading onto Shipping Container  
 Crate Dimensions: 16'0" long, 9'0" wide, 10'8" high  
 Crate weight: 10,900 lbs  
 Forklift: Hyster Model 5500 equipped with Forklift Lifting Device: PD12345 (one on each fork) capacity 14,000 lbs each, weight 400 lbs each  
 Estimated center of gravity is at geometric center of crate  
 Forklift Capacity with PD12345 installed 40,000 @ 51 inches from face of fork  
 Capacity at load center of 58 inches  
 $Capacity\ at\ 58'' = (51/58) * 40,000\ lbs = 35,172\ lbs$   
 $35,172\ lbs > 10,900\ lbs$



**7.4 Rigging Sketch Example**

Exact orientation and equipment location of the crane, load and IP-2 box container shall be determined by the Lift Director. Always refer to the Mobile crane load capacity chart for allowable crane and rigging hardware load deductions and the cranes lifting capacity parameters. Do not exceed the crane capacity load chart.





**7.5 Load Path/Crane Capacity Parameters Example**

Exact orientation and equipment location shall be determined by the Lift Director. The crane can be repositioned for lifting the glove boxes or the loaded IP-2 boxes. The glove boxes will be rolled outside and lifted (1<sup>st</sup> lift) and set onto wrapping material. Once wrapped and secured, lifted (2<sup>nd</sup> lift) again and placed into the designated IP-2 box. Once the IP-2 box cribbing and lid is secured, each IP-2 box (3<sup>rd</sup> lift) will be loaded, one per shipment onto trailer HO-64-05716 and secured for shipment.

