6. Critical Lift

This Chapter Describes Hazardous Operations.

Contents

1.0 PURPOSE OF DOCUMENT

This document provides the instructions needed to safely conduct Critical Lifts at Dryden Flight Research Center.

2.0 SCOPE & APPLICABILITY

This document pertains to all critical lifts conducted at DFRC and while on deployment in support of a project or mission. It is applicable to lifts conducted by both civil servants and contractor personnel.

3.0 CHAPTER OBJECTIVES

A Critical Lift operation is a hazardous activity during which failure/loss of control could result in loss of life, loss of or damage to flight hardware, or a lift involving special high dollar items such as spacecraft, one-of-a-kind articles, or major facility components the loss of which would have serious programmatic or institutional impact.

The following are the objectives of the document:

A. Ensure that the objectives of Critical Lifts are achieved
B. Ensure the proper reviews are conducted to minimize the occurrence of incidents during a Critical Lift operation
C. Protect lives and property during Critical Lift operations

4.0 RELEVANT DOCUMENTS

4.1. Authority Documents

29 CFR 1910.180	Crawler Locomotive & Truck Cranes
29 CFR 1910.179	Overhead and Gantry Cranes
29 CFR 1910.184	Slings
29 CFR 1926.554	Overhead Hoists
29 CFR 1926.550	Cranes and Derricks
NASA-STD-8719.9	Standard for Lifting Devices and Equipment
EM 385-1-1	US Army Corps of Engineers Safety & Health Requirements Manual
NPR 8715.3	NASA Safety Manual, Chapter 8, Facility Safety

4.2. Referenced Documents

ASME/ANSI	B30.2	Overhead and Gantry Cranes
ASME/ANSI	B30.5	Mobile & Locomotive Cranes
ASME/ANSI	B30.9	Slings
ASME/ANSI	B30.10	Hooks
ASME/ANSI	B30.16	Overhead Hoist
Form DFRC 230		Critical Lift Process Approval
Form FD 8		Crane Operation Approval

5.0 WAIVER AUTHORITY

If a requirement cannot be met within the procedures of this document, a safety variance shall be prepared in accordance with NPR 8715.3 and processed through the Lifting Devices & Equipment Manager (LDEM).

6.0 ABBREVIATIONS, ACRONYMS, & DEFINITIONS

6.1. Abbreviations – None

6.2. Acronyms

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
DOT	Department of Transportation
HVAC	Heating, Venting & Air Conditioning
LDEM	Lifting Devices & Equipment Manager
OSHA	Occupational Safety & Health Administration
EM	Engineering Manual

6.3. Definitions

Aerospace Critical Lift	The lifting of special high dollar, one-of-a-kind articles such as spacecraft, aircraft, aircraft parts, or support equipment whose loss would have serious programmatic impact.

Crane Operator	Crane Operators use cranes for lifting and moving objects such as aircraft, parts of aircraft, buildings, building equipment, and machinery (etc.).
Crane Rigger	A Crane Rigger is an individual who understands and comprehends the intricacies of lifting equipment for the movement, positioning, and placement of loads.
Critical Lifts	1) NASA-STD-8719.9: Standard for Lifting Devices and Equipment. Critical Lifts are lifts where failure/loss of control could result in loss of life, loss of, or damage to flight hardware, or a lift involving special high dollar items such as spacecraft, one-of-a-kind articles, or major facility components whose loss would have serious programmatic or institutional impact. Critical Lifts also include the lifting of personnel with a crane, lifts where personnel are required to work under a suspended load, and operations with special personnel and equipment safety concerns beyond normal lifting hazards**.** 2) Army Corps of Engineers Requirements Manual, EM 385-1-1: (facility use suggested in NPR 8715.3, 8.4.4). A Critical Lift is a non-routine lift requiring detailed planning and additional or unusual safety precautions. Critical Lifts include lifts which require the load to be lifted, swung, or placed out of the view of the operator; lifts made with more than one crane; lifts involving non-routine or technically difficult rigging arrangement; hoisting personnel with a crane or derrick; or any lift which the lift or crane operator believes should be considered critical.
Critical Lift Review Meeting	A meeting to review of the specific Lift Plan (procedure and associated hazard analysis).
Facility Critical Lifts	The lifting of special high dollar one-of-a-kind articles, such as major facility components, HVAC, antennas, or any other items relating to facilities whose loss would have serious programmatic impact.
Hazard Analysis Report	A system safety document that provides the results of a hazard analyses performed on a system or activity, in this case, for a Critical Lift.
Lifting Devices and Equipment Manager (LDEM)	The installation’s designated person, in writing, who is responsible for the overall management of the lifting devices and equipment program. Duties include advising management on lifting device and equipment issues, coordinating with appropriate personnel and providing direction on lifting device procedures and safety issues.

Lift Plan	A Lift Plan is a document that specifies the requirements and resources required to perform a Critical Lift. This plan contains the lifting procedure as well as the Hazard Analysis Report. These documents and form DFRC 230 or FD 8 (facility lift) are bundled as one document.
Lessons Learned Point of Contact (POC)	Individual within Code S who is responsible for documenting Project lessons learned at the Center.
Non-Critical Lifts	Non-critical lift is a lift involving routine lifting operations governed by standard industry rules and practices except as supplemented with unique NASA testing, operations, maintenance, inspection, and personnel licensing requirements contained in NASA documents.
Operational Hazard Analysis	Identification and evaluation of existing and potential hazards and the recommended mitigation for the hazard sources found. The Project Operations Engineer usually performs this analysis; however, a contractor may do so for facility lifts.
Physical Examination	A medical examination to DOT standards for Crane Operators and Riggers.
Rated Capacity	Maximum capacity of a particular crane in its working configuration. This will be determined by the manufacturer's engineered/approved load charts, which must be located within the operator's reach in the cab of the crane.
Suspended Load Operations	The lifting of a load using a crane or hoist when personnel have any part of their body beneath the suspended load. Follow NASA-STD-8719.9 for suspended load operations.

7.0 AEROSPACE CRITICAL LIFTS

This section provides procedures, documentation, and hazard analysis requirements for aerospace equipment lifting operations for Critical Lifts by the definition in NASA-STD-8719.9. The form to document Critical Lifts is DFRC 230, Critical Lift Process Approval.

7.1. Roles And Responsibilities

7.1.1. Project Managers

Project Managers who are required to make a Critical Lift shall ensure that procedures and precautions listed in this document, as well as those basic requirements of Non-Critical Lifts, are followed. Project Managers or Operations Engineers will ascertain whether the Critical Lift requirements of NASA-STD-8719.9 are applicable to a lift.

7.1.2. Lift Supervisor

A Lift Supervisor shall be assigned for each lift. This individual can be an OPS Engineer, Crew Chief, or Lead. Responsibilities include

A. Reading and understanding the lift plan.

B. Ensuring that each employee is trained for his or her position.

C. Determining that required inspections for the crane are current.

D. Determining that lift hardware (such as slings and shackles, etc.) has the proper rating and has a current load test tag on them.

E. Ensuring that lift area is secure, all traffic is re-routed, and unauthorized persons are not allowed to enter area during lift.

7.1.3. Safety Representative

A Safety Representative, who is not part of the lifting crew, will be notified and present to monitor the lift. The Safety Representative may be one of the following:

A. Lifting Devices & Equipment Manager (LDEM)

B. Safety, Health, and Environmental Office Representative

C. Quality Assurance/Inspection Office Representative

The Safety Representative must understand all the Critical Lift procedures. Responsibilities include

A. Reading and understanding the lift plan

B. Verifying proper certifications on the crane and hardware

C. Reviewing hazard analysis

D. Attending the critical lift meeting

E. Monitoring the critical lift

The Safety Representative is authorized to question any Critical Lift-related activity and stop the activity at any point.

7.2. Planning

The LDEM and Safety Representative will be notified of the planning meetings.

7.2.1. Critical Lift Plan

A Critical Lift Plan is comprised of a Critical Life Procedure and a Critical Lift Hazard Report. The person requiring the lift, such as the

Project Manager or Operations Engineer, will prepare a lifting procedure and perform a Critical Lift Hazard Analysis. This document will be brought to the Critical Lift Review Meeting. Copies shall be provided to the LDEM and Safety Representative prior to the Critical Lift Review Meeting.

7.2.1.1. Critical Lift Procedure

A Critical Lift Procedure, which is part of the Critical Lift Plan, is completed for a specific lift operation whenever a Critical Lift is conducted at Dryden or at an off-site location under Dryden management (e.g., when on deployment). It is signed by the Safety Representative and the responsible project personnel (Project Manager / Operations Engineer, and other personnel listed on form DFRC 230.

7.2.1.2. Hazard Analysis Report

A detailed Hazard Analysis Report of the Critical Lift operation shall be prepared by the project.

7.2.2. Approval Documentation

A. If a Critical Lift at Dryden is within the parameters of NASA-STD-8719.9, the lift will be documented with the use of form DFRC 230, Critical Lift Process Approval.

B. A Critical Lift Hazard Analysis Report

7.2.3. Multiple Lifts

If multiple lifts are planned within a short period of time (five or fewer days) of the initial configuration, they will all be planned during the Critical Lift Planning Meeting and be noted in the Lift Procedure. Only one Critical Lift Review Meeting is required for this series of lifts; however, a safety meeting will be held immediately prior to each lift.

7.2.4. Rented or Leased Cranes

A. Rented or leased cranes are exempt from following NASA-STD-8719.9 for Non-Critical Lifts. If the lift is identified as a Critical Lift, the NASA Standard will apply.

B. If a rented or leased crane is operated by either a civil service employee or a Dryden on-site contractor, that operator must practice with a dummy load near capacity of the intended lift to get familiar with the unit.

7.3. Prior to Lift

7.3.1. Critical Lift Review Meeting

The purpose of the Critical Lift Review Meeting is to ensure that the project team is prepared to conduct the lift. Discussion topics include requirements, the lift procedure, and the hazard analysis. The Lift Plan, comprised of the Lifting Procedure and Critical Lift Hazard Report, must be brought to this meeting and reviewed for proper preparation.

This meeting can be held two to three days prior to the lift, but may be held up to two weeks prior for complicated lifts. The meeting may not be held later than the day prior to the lift. This review is documented on form DFRC 230.

The following individuals will be present:

1. Lifting Devices & Equipment Manager
2. Safety, Health, and Environmental
3. Quality Assurance/Inspection
4. Lift Supervisor
5. Crane Operator

7.3.2. Document Review

The following documentation will be reviewed by the Safety Representative:

Proof of current

- Crane Operator physical
- Crane Operator license/training certificate
- Crane inspection verification
- Sling and associated hardware load test inspection tags

7.4. Day of Lift

7.4.1. Pre-lift Safety Meeting

Each day of a Critical Lift, a Pre-Lift Safety meeting will be held. The Project Manager or Operations Engineer and the Safety representative will attend along with all lift participants. For pre-planned multiple lifts, a safety meeting shall be performed prior to each lift.

This is the equivalent of a Crew Briefing. The purpose of the meeting is to review the procedure, the hazards, the responsibilities of each team member, and the Critical Lift requirements.

The following requirements shall be addressed:

- That Lift Plan will be followed as approved
    - If changes are made in real time, the Operations Engineer will sign these changes.
- Lift items must have tag lines at both ends for controllability
- Hardhats and steel-toed shoes/boots are mandatory for all individuals
- No unauthorized personnel will enter the area
- Gloves will be use as necessary, i.e., for holding tag lines.
- Personnel shall not be located under suspended or moving loads unless the operation adheres to the OSHA-approved NASA alternative Standard for Suspended Load Operations. (See NASA-STD-8719.9, appendix A).
- Lifts over 75% of the rated capacity of a mobile crane are not allowed for critical lifts.

7.4.2. Safety Oversight

A Safety Representative will be present during the Critical Lift to observe the operation.

7.5. Problems and Lessons Learned Debrief

Should significant issues or problems arise during the lift, a debriefing will be held to discuss the problems and lessons learned. Any adverse lessons learned shall be documented by the Project Manager or Operations Engineer in a Memo for Record and a copy provided to the Chief of Code SH, Safety, Health, and Environmental Office, and the Code S Lessons Learned POC.

8.0 FACILITY CRITICAL LIFTS

This section applies to facility Critical Lifts. It provides procedures, documentation, and hazard analysis requirements for facility lifting operations for Critical Lifts by their definitions in EM 385-1-1 and NASA-STD-8719.9. For facility lifts, the form to document critical lifts is FD 8, Crane Operation Approval. Generally, facility lifts will use EM 385-1-1, US Army Corps of Engineers Safety, and Health Requirements Manual as a guide

unless the lift also falls within the parameters of the NASA Standard, then the NASA Standard shall also apply. When in conflict, the NASA standard becomes the authority document.

8.1. Roles and Responsibilities

8.1.1. Facility Project Managers

Facility Project Managers with a Critical Lift requirement shall ensure that procedures and precautions listed in this document, as well as those basic requirements of Non-Critical Lifts, are followed. The Facility Project Manager shall ascertain whether EM 385-1-1, NASA-STD-8719.9, or both apply to the lift.

8.1.2. Lift Supervisor

A Lift Supervisor will be assigned for each lift. This individual can be a Project Manager, Site Inspector, Lead, or Foreman. Responsibilities include

A. Reading and understanding the lift plan
B. Ensuring that each participant is trained for his or her position and that all employees understand the safety procedures to be followed
C. Determining that required inspections are current for the crane
D. Determining that lift hardware has the proper rating (i.e., slings, shackles, etc.)
E. Ensuring that the lift area is secure, all traffic is re-routed, and unauthorized persons are not allowed to enter area during lift

8.1.3. Safety Representative

The Safety Representative, who is not part of the lifting crew, will participate in reviews and be present to monitor the lift. The Safety Representative may be one of the following

A. Lifting Devices & Equipment Manager (LDEM)
B. Safety, Health, and Environmental (Code SH) Office

The Safety Representative must understand all the critical lift procedures. Responsibilities include

A. Reading and understanding the lift plan
B. Verifying crane inspection
C. Reviewing hazard analysis
D. Attending the Critical Lift Meeting

E. Attending the Pre-Lift Safety Meeting

F. Monitoring the critical lift

8.2. Planning

The LDEM will be notified of the planning meetings.

8.2.1. Critical Lift Plan

Before making a Critical Lift, a Critical Lift Plan shall be prepared by the Facility Project Manager, Crane Operator, Lift Supervisor, or Rigger. A Critical Lift Hazard Analysis shall be performed and a report included as part of the Critical Lift Plan. The plan shall be documented and a copy will be provided to Dryden's LDM and the Safety Representative.

8.2.1.1. Content of Critical Lift Plan

A. The plan shall specify the exact size and weight of the load to be lifted and all crane and rigging components which add to the weight. The manufacturer's maximum load limits for the entire range of the lift as listed in the load charts shall also be specified.

B. The plan shall specify the lift geometry and procedures including the crane position, height of the lift, the load radius, and the boom length and angle for the entire range of the lift.

C. The plan shall designate the Crane Operator, Lift Supervisor, and Rigger, and state their qualifications.

D. The plan shall include a rigging plan that shows the lifts points and describes rigging procedures and hardware requirements.

E. The plan shall describe the ground conditions, outrigger or crawler track requirements, and, if necessary, the design of mats necessary to achieve a level, stable foundation of sufficient bearing capacity for the lift. For floating cranes or derricks, the plan shall describe the operating base (platform) condition and any potential list.

F. The plan shall list environmental conditions under which lift operations are to be stopped.

G. The plan shall specify coordination and communication requirements for the lift operation.

H. For tandem or tailing crane lifts, the plan shall specify the make and model of the cranes; the line, boom, and swing speeds; and requirements for an equalizer beam.

8.2.1.2. Critical Lift Procedure

A Critical Lift Procedure, which is part of the Critical Lift Plan, is completed for a specific lift operation whenever a Critical Lift is conducted at Dryden or at an off-site location under Dryden management (e.g., when on deployment). It is signed by the Safety Representative and the responsible project personnel (Project Manager / Operations Engineer, and personnel listed on form FD-8).

8.2.1.3. Hazard Analysis Report

A detailed Hazard Analysis Report of the Critical Lift operation shall be submitted by the Project Manager/Operations Engineer.

8.2.2. Approval Documentation

A. If a Critical Lift at Dryden is within the parameters of EM 385-1 and also within the parameters of NASA-STD-8719.9, the lift will be documented with the use of form FD-8, Crane Operation Approval.

B. A Critical Lift Hazard Analysis Report.

8.2.3. Multiple Lifts

If multiple lifts are planned within a short period of time (five or fewer days) of the initial configuration, they will all be planned during the Critical Lift Planning Meeting and be noted in the Lift Procedure. Only one Critical Lift Review Meeting is required for this series of lifts; however, a safety meeting shall be held immediately prior to each lift.

8.2.4. Rented or Leased Cranes

Rented or leased cranes are exempt from following NASA-STD-8719.9 for Non-Critical Lifts, but if the lift is identified as a Critical Lift, the NASA Standard applies.

8.3. Prior to Lift

8.3.1. Critical Lift Review Meeting

The purpose of the Critical Lift Review Meeting is to ensure that the project team is prepared to conduct the lift. Discussion topics include requirements, the lift procedure, and the hazard analysis. The Lift Plan, comprised of the Lifting Procedure and Critical Lift Hazard Report, must be brought to this meeting and reviewed for proper preparation.

This meeting can be held two to three days prior to the lift, but may be held up to two weeks prior for complicated lifts. The meeting may not be held later than the day prior to the lift. This review is documented on form FD-8.

The following individuals will be present:

1. Lifting Devices & Equipment Manager
2. Safety, Health, and Environmental
3. Lift Supervisor
4. Crane Operator

8.3.2. Safety Representative documentation review

The following documentation shall be reviewed by the Safety Representative:

Proof of

- Crane operator physical
- Current operator license/training certificate
- Crane inspection verification

8.4. Day of Lift

8.4.1. Pre-Lift Safety Meeting

Each day of a Critical Lift, a Pre-Lift Safety meeting will be held. The Project Manager or Operations Engineer and the Safety representative shall attend along with all lift participants. For pre-planned multiple lifts, a safety meeting will be performed prior to each lift.

A pre-lift safety meeting shall be conducted with all involved individuals to discuss the following issues:

- That the lift plan shall be followed as approved
    - If changes are made in real-time, the Lift Supervisor will sign these changes
- Lift items must have tag lines at both ends for controllability
- Hardhats and steel-toed boots are mandatory for all individuals
- No unauthorized personnel shall enter the area
- No personnel under load while suspended by crane. See NASA-STD-8719.9 Appendix A for suspended load operations).
- Gloves shall be used as necessary, i.e., for holding tag lines).
- For preplanned multiple lifts, a safety meeting will be performed prior to every lift.

8.4.2. Safety Oversight

A Safety Representative shall be present during the Critical Lift to observe the operation.

8.5. Problems and lessons Learned Debrief

Should significant issues or problems arise during the lift, a debriefing will be held to discuss the problems and lessons learned. Any adverse lessons learned will be documented by the Project Manager or Operations Engineer in a Memo for Record and a copy provided to the Chief of Code SH, Safety, Health, and Environmental Office, and the Code S Lessons Learned POC.

9.0 OPERATOR REQUIREMENTS

9.1. Certification Training

There are two levels of operator certification training: Non-Critical Lift and Critical Lift. This training is offered to both Dryden civil service employees and on-site contractors. Off-site contractors do not need to be certified under DFRC's Critical Lift Program; they are certified by the State. Crane Operator and Rigger assignments will be made by supervisors.

There are two types of certifications: Crane Operator and Critical Lift Operator.

A. Non-Critical Lift Operator training is required every two calendar years.

B. Critical Lift and Crane Operator training is also required every two calendar years. The scope is expanded to include training in the specific hazards and special procedures associated with Critical Lifts.

C. Critical Lift Operators must also be Crane Operator certified.

D. Crane and Critical Lift certification will be documented and tracked in Dryden's Industrial Equipment database.

E. Critical Lift Operator's qualification card shall be annotated as "Critical Lift" qualified.

F. Operators shall demonstrate proficiency and operating finesse with mobile or overhead cranes to the on-site aerospace ground equipment contractor who provides training and certification in conjunction with the Critical Lift trainer.

G. Regarding Crane Riggers, no training is required for the use of aircraft pre-made slings (i.e., canopies, ejection seats, or aircraft engines) in support of lifts. Training is required for all other rigging operations.

For detailed instructions of Critical Lifts and inspection requirements, use NASA-STD-8719.9. This document can be found on line at NASA Online Directives Information System (http://nodis3.gsfc.nasa.gov/library/main_lib.html) or from Dryden's LDEM.

9.2. Medical Requirements

DOT physical examinations are required for both Crane Operators and Riggers. A physical examination is required at least every two years.

A. Physicals are required for both crane operators and riggers per NASA-STD-8719.9. This physical may be performed by Dryden's Medical Officer or by the employee's personal doctor.

B. If the employee uses their own doctor, they shall take the signed DOT card to Dryden's doctor who will authorize their NASA operator's card by signing it.

C. The employee shall have his/her operator's card on their person when operating a crane.

D. It is the employee's responsibility to self-disclose a medical condition that would disqualify them that arises between physical renewals. This will be reported to Dryden's medical doctor.

E. Both Crane Operators and Riggers shall carry their medical certificate on their person during lifts.

10.0 METRICS & TREND ANALYSIS

Metrics for this procedure are incorporated in the procedures and metrics of other codes (i.e., they are related to generic incidents). See Chapter 1, Program; paragraph 8, Metrics & Trend Analysis for additional information.

11.0 MANAGEMENT RECORDS & RECORDS RETENTION

The management records for this procedure include the following.

- Training and certification records for Crane Operators and Riggers
- Approved forms DFRC 230 and FD-8
- Critical Lift Plans

	Record Name	Location of Original	Retention
A.	Training and certification records	Dryden's Industrial Equipment Database	Training certification records will be retained per NPR 1441.1
B.	Form DFRC 230	Project file	Duration of Project
C.	Form FD-8	Project file	Duration of Project
D.	Critical Lift Plan	Project file	Duration of Project

Following Project completion, items B and C will be stored per NPR 1441.1 for seven (7) years.

The training contractor shall maintain an electronic database of employees' industrial equipment training records. This database will be accessible to the supervisor, employee, and authorized inspectors. Training records (historical database) will be maintained for one (1) year after the employee terminates or fails to renew the training. (See NPD 1441.1, Records Retention Schedule 3; 33 [3400] N 15-38, G Technical Training.) On-site contractors may utilize this system, or they may maintain training records for their own employees.

Specific Critical Lift procedures submitted prior to each lift shall be kept by the project for the duration of the.

Chapter 6 History Log

This page is for informational purposes and does not have to be retained with the document.

Status Change	Document Revision	Effective Date	Page	Description of Change
Baseline		7-9-04		Replaces DCP-S-028.