NASA Glenn Safety Manual

CHAPTER 20 - CRANES AND LIFTING DEVICES

Revision Date: 1/03 (Technical Change)

20.1 SCOPE

This chapter describes general safe practices relating to all overhead cranes, mobile cranes, and lifting devices. Specific safety considerations are included for all the various types of lifting systems and components located at the NASA Glenn Research Center at Lewis Field and Plum Brook Station. The information for this chapter was derived primarily from NASA Standard for Lifting Devices and Equipment 8719.9. Additional references are listed in section 20.8 at the end of the chapter.

20.2 APPLICABILITY

The provisions, responsibilities, and requirements as set forth in this chapter apply to all NASA Glenn Research Center at Lewis Field and Plum Brook (GRC) employees, all on-site NASA contractors and on-site contractor employees, other Government agency employees, and other organizations that perform lifting activities within the confines of the GRC. This chapter also applies to overhead cranes, mobile cranes, hoists, personnel-lifting devices, and slings or lifting fixtures used at GRC.

20.3 RESPONSIBILITIES

All personnel at GRC who design, fabricate, construct, maintain, repair, and operate overhead cranes, mobile cranes, and lifting devices are responsible for understanding this chapter and conforming to its practices and provisions.

20.3.1 Glenn Safety Office

a. The Glenn Safety Office Chief is the designated Authority Having Jurisdiction (AHJ.)
b. The Glenn Safety Office Chief has the overall management responsibility for planning, direction, and execution of a Crane and Lifting Device Safety Program for GRC, in accordance with the criteria established in NASA STANDARD FOR LIFTING DEVICES AND EQUIPMENT 8719.9
c. The GSO provides guidance and direction for center-wide activities that involve crane and lifting device safety.
d. The GSO is responsible for oversight of the Crane Operator Certification Program.

20.3.2 Supervisors

Supervisors are responsible for ensuring proper maintenance and operations of crane and lifting devices under their authority and jurisdiction. Supervisors shall also ensure that qualified operators have the necessary resources to properly operate cranes and lifting devices in a safe manner and in accordance with the requirements of this chapter and the GRC Safety Program.

20.3.3 Employees

All employees at the GRC are responsible for understanding and conforming to the policies, safe practices, and provisions of this Chapter.

20.3.4 Facilities and Test Engineering Division

The Facilities and Test Engineering Division is responsible for the maintenance, inspection, and testing of and record keeping for all NASA-owned lifting devices and equipment at GRC. This includes fixtures fabricated for use on NASA equipment.

20.3.5 Competent Person

The competent person is an individual who, by way of training and/or experience, is knowledgeable of applicable standards, is capable of identifying workplace hazards relating to the specific operation, is designated by the contracting manager, and has authority to take appropriate actions. The competent person may not be the lifting device operator but can assign the designated person to operate a lifting device provided the training requirements have been met in accordance with 20.5.1 of this chapter. The competent person shall be listed on the applicable Site Specific Health and Safety Plan (HASP). See Chapter 17 of the Glenn Safety Manual for HASP requirements.

20.4 GENERAL SAFETY REQUIREMENTS

20.4.1 Critical and Non-Critical Lifts

Hoisting operations conducted at GRC are divided into two categories, critical and non-critical lifts. Critical lifts include the lifting of personnel, space-flight hardware, one-of-a-kind articles, or major facility components whose loss would have serious programmatic impact. Non-critical lifts involve routine minimal hazard lifting operations and are governed by standard industry rules and practices except where indicated by this chapter.

20.4.2 Design and Maintenance

The design, fabrication, installation, maintenance, repair, inspection, and testing of overhead crane and hoist systems and lifting devices shall be done in accordance with the regulations and procedures of the Occupational Safety and Health Standards, 29 CFR 1910, Subpart N; the American National Standards Institute (ANSI); the Crane Manufacturers Association of America, Inc. (CMAA). and, from NASA Standard for Lifting Devices and Equipment 8719.9.

20.5 SPECIFIC SAFETY REQUIREMENTS

20.5.1 Personnel Crane Certification Program

Only certified (licensed) and trained operators shall be authorized to use/operate cranes, mobile cranes, or hoists at GRC. Certification also shall include riggers and flagmen. This license shall be in the possession of the operator.

- **Off Site Contractors** - Only designated personnel shall be permitted to operate a crane or Lifting Device(s) at GRC. The designated person shall provide proof of classroom training for the lifting device(s) to be used and receive hands-on training for the device(s) to be used. The designated person shall comply with Section 20.7.5 Operations, and with all safe operating procedures, including a practical test on the crane(s) that will be operated. This practical test shall be administered by a licensed lifting device operator for that specific lifting device. It is the responsibility of the competent person to assure compliance with this section.

20.5.2 Levels of Training

Two levels of operator training and proficiency - Operations where critical lifts are involved require operators to be educated in the specific hazards and special procedures associated with the critical lift.

20.5.3 Non-Critical Lifts

The certification program for non-critical lift operators shall include the following:

a. Training
   - Classroom training in safety and emergency procedures, general performance standards, requirements, pre-operational checks, and methods for detecting safety related defects and symptoms (for initial certification as needed) every four (4) years. Such training is provided from the NASA Safety Training Center (NSTC) 16 hour Overhead

Crane and Materials Handling course or an equivalent course approved by the NASA Glenn Lifting Device Equipment Manager (LDEM).

- Hands-on training (for initial certification and as needed to accommodate change).
- An annual review of the items in subparagraph (a) above utilizing NASA Glenn Research Center Learning Center video library, a formal review session, or a classroom course through NASA Safety Training Center or a course of equal or greater value applicable to lifting device operators.

b. Examination

- Physical examination requirements for Support Service Contractors use Medical Criteria and Medical Clearance Forms NASA C-142, for NASA Civil Servants use Medical Criteria and Medical Clearance Forms NASA C-143. (http://ltid.grc.nasa.gov/Eforms/InformedWebPages/home.htm)
- Written examination covering classroom curriculum.
- Operational demonstration (for initial certification only).

c. Licensing/Operator Certification

- Upon completion of the training specified in 20.5.2 and 20.5.3 (a) and (b), the Glenn Safety office will issue a license to the operator.
- Licenses shall be revoked for negligence, violations of safety requirements, or failure to meet medical standards. Supervisors shall make periodic checks of operators to verify they have licenses in their possession.
- Renewal of all licenses shall require demonstration of proficiency to their supervisor. Licenses or certifications will expire at least every 4 years. Renewal procedures will include items in Training (1) (a) and (b).

20.5.4 Critical Lifts

Besides the training, examination, licensing, and renewal requirements for non-critical lifts, operators that are being certified to perform critical lifts must be knowledgeable of the specific hazards and special procedures associated with the lift. Operators also must demonstrate proficiency and operating finesse with the crane to be used for the particular critical lift and alternately be directly supervised by a certified operator during the demonstration of proficiency. The licenses will indicate specific cranes for which the operator is certified.

20.6 CRITICAL LIFT REQUIREMENTS

Refer to section 20.4.1 of the Glenn Safety Manual for definitions of Critical and Non-Critical Lifts. Or, contact the Glenn Safety Office.

20.6.1 Critical Lift Procedures

Once a lift has been determined to be critical, a written procedure, specific to the lift being conducted, shall be prepared and submitted to the GRC Safety and Assurance Technologies Directorate (SATD) 8300, Quality Management Office (QMO) 8200 within 2 working days of the lift. Prime Contractors using GRC facilities will prepare and approve their own critical lift procedures before submitting them to the identified GRC Manager for necessary reviews by the Program manager. QMO and the Safety Office are only responsible for Critical lifting operations that are performed at GRC facilities or involved Government Furnished Equipment. Off site lifting operations performed by a contractor are the responsibility of the contractor to follow OSHA and NASA lifting requirements as required.

20.6.2 Pre-Lift Meeting

Upon review of the Critical Lifting Procedure by the Safety Office and approval of the written procedure by the QMO, a pre-lift meeting shall be held. At this meeting the crane operator, rigger, designated signal person, critical lift monitor, QMO/Safety representative, and all personnel involved with the critical lift, shall review the written operating procedures including crane operations, emergency steps, communication requirements, and special requirements including checklists and inspection requirements. A review shall be done of assigned responsibilities, including crane operator, signal person, rigger, critical lift monitor, and any personnel directly involved with the critical lift.

20.6.3 Critical Lift Monitors

A Critical Lift Monitor shall be designated for all critical lift operations. This monitor will have no other responsibilities other than to monitor the operation, for compliance with the written procedure developed.

20.6.4 Critical Lift Load Testing

Cranes used frequently for critical lifts shall be load tested annually. Cranes used infrequently for critical lifts shall be load tested before the critical lift is scheduled if more than a year has elapsed since the last load test.

Lifting equipment shall be load tested per NASA Standard for Lifting Devices and Equipment 8719.9 and a visual inspection of all lifting equipment shall be performed for cracks, deformations, gouges, galling, kinks, crushed areas, corrosion, and for proper configuration prior to every lift.

20.6.5 Safety Analysis

A hazard analysis shall be performed by the requesting organization on all cranes used for critical lifts. The analysis shall, as a minimum, determine potential sources of danger,

identify most probable failure modes, and recommend resolutions for those conditions found in the hardware-facility-environment-human relationship that could cause loss of life, personal injury, or loss of crane, facility, or load.

20.6.6 Operations

A Pre-ops check to demonstrate operational readiness shall be performed and a safety zone established before initiating operations.

Before each lift or series of lifts, the operator shall test the functional operation of the upper limit switches with no load on hook.

20.7 OVERHEAD CRANE AND HOIST SYSTEMS

20.7.1 Testing

Three types of tests are required for all overhead crane and hoist systems: proof load tests, periodic rated load tests, and operational tests. The proof load and operational tests shall be performed prior to first use of new, reinstalled, or existing cranes that have had repairs, alterations, or modifications to components involved in the lifting or holding capability of that crane. The rated load and operational tests shall be performed every 4 years for standard lift cranes and annually for cranes used for frequent critical lift operations. Cranes used infrequently for critical lift operations must have a rated load test conducted prior to a critical lift unless the last rated load test conducted within 1 year prior. All load tests shall be witnessed by a designated representative of the NASA Glenn Research Center at Lewis Field, Facilities and Test Engineering Division or the Plum Brook Management Office, as appropriate.

In the proof load test, the test load for overhead cranes and hoists shall not be more than 125 percent of the rated load unless otherwise recommended by the manufacturer or specified in NASA Standard for Lifting Devices and Equipment 8719.9. Test loads for mobile cranes shall not exceed 110 percent of the rated load at any selected working radius as per NASA Standard for Lifting Devices and Equipment 8719.9 5.3.1 Proof Load Test.

20.7.2 Tagging

Following the load test, all cranes and hoists shall be given a permanently affixed tag with an identity number, the date of the last load test, and the date of the next scheduled rated load test.

20.7.3 Emergency Cutoff Switch

All overhead cranes must be equipped with an emergency cutoff switch or disconnect located in the immediate vicinity of the operating crane. The cutoff switch or disconnect

shall be plainly identified, and personnel operating the crane shall know the exact location of the switch or disconnect.

20.7.4 Markings

The rated capacity of the crane or hoist shall be plainly marked on each side of the crane or hoist. The markings are to be clearly visible from the floor level.

20.7.5 Operations

Safe operation of an overhead crane or hoist requires the following:

a. Training - Only personnel having the required training and the authorization of the supervisor shall be permitted to operate the lifting equipment. Training requirements are outlined in Sections 20.5.2 and 20.5.3 of this chapter.
b. Inspection - Prior to the operator's first use each day or shift, the operator of the crane or hoist shall visually inspect it for mechanical soundness and shall perform a functional integrity test (i.e., ascertain that all equipment performs as intended). If anything questionable is found, the unit shall be removed from service.
c. Proper load - The operator shall never pick up a load in excess of the rated capacity marked on the unit.
d. Correct load movement - The load should never be picked up with a side pull; it should be kept as near to the ground as practical. No one should ever be allowed to ride the hook or load, and a suspended load should never be left unattended.
e. When operating a crane or hoist with a wire rope, the operator should never lay the hook on the floor, thereby creating a slack condition. Furthermore, when picking up or lowering the load, the operator should maintain at least two full wraps of rope on the hoist drum at all times.
f. No person is permitted to be located under a suspended load. This includes occupied buildings, offices, shops etc.
g. All loads hoisted above shoulder level must have a tag line attached.

20.8 LIFTING DEVICES

20.8.1 Description

This section applies to slings, linkage mechanisms, and structural members (e.g., spreader beams) that extend between a lifting hook on a crane or hoist and the object being lifted.

20.8.2 Purchase of lifting devices

All purchase requests for lifting devices shall be routed for approval through the Facilities and Test Engineering Division at Lewis Field or the Plum Brook Management

Office at Plum Brook. Identification and specification requirements will be assigned. Upon receipt, the lifting device(s) will be inspected for conformance to those requirements.

20.8.3 Testing - Two tests are required for lifting devices:

a. Proof load test - Prior to first use, all new, extensively modified, repaired, or altered lifting devices shall undergo a proof load test. Proof load tests performed by the manufacturer are acceptable if the necessary test certification papers or tags are provided.
b. Periodic rated load test - All lifting devices shall undergo a periodic load test once every 4 years for standard lifting devices, and annually for lifting devices used for critical lifts.

20.8.4 Tagging

Following the load test, all lifting devices shall be given a permanently affixed tag with an identity number, the rated capacity (in pounds), the date and proof load applied (in tons), the date of the last periodic load test (when applicable), and the date of the next scheduled load test.

20.8.5 Operations - Safe operation of slings and other lifting devices requires:

a. Inspection - Prior to use, the operator shall check slings or other lifting devices for defects such as cracks, deformations, gouges, galling, kinks, crushes, corrosion, and excessive wear. Slings that appear to be damaged shall be removed from service. The user shall verify that the weight of the load is within the rated capacity of the sling and that the tag indicates a rated load test within the last 4 years (or 1 year for critical lifts).
b. Safe practices - Kinks, loops, or twists in the legs of slings should be avoided. The sling must be lifted slowly to avoid shock-loading it, and any sharp corners in contact with the sling shall be padded to minimize damage to it. A sling must never be pulled from under the load when the load is resting on it.

20.9 PERSONNEL-LIFTING DEVICES

20.9.1 Description

This section applies to crane or hoist-supported devices that are intended to raise or lower personnel; it does not apply to elevators or ground-supported personnel lifts such as personnel-lifts, aerial devices, scissor lifts, and so on. The lifting of personnel for all activities including construction, maintenance, and any such action shall be accomplished in accordance with CFR Part 1926.550 (g).

20.9.2 Design hazard analysis

All personnel-lifting devices shall be subjected to a design hazard analysis and a failure mode and effects analysis to determine potential sources of danger and to develop resolutions for those conditions that could cause injury, loss of life, damage to property, or impact to the operations that this equipment supports.

20.9.3 Testing - Three types of tests are required for personnel-lifting devices:

a. Proof load test - Before first use, all new, extensively repaired, extensively modified, or altered personnel-lifting devices shall undergo a proof load test at 1.5 times the rated capacity.
b. Rated load test - Each personnel-lifting device shall be tested at least once every year with a load equal to the rated capacity.
c. Operational test - When a proof or rated load test is performed, an operational test with rated load shall be performed.

20.9.4 Tagging

Following the proof load test, crane- or hoist-supported personnel lifts shall be given a permanently affixed tag with an identity number, the rated capacity (in pounds), the date and proof load applied (in tons), the date of the last rated load test, and the date of the next scheduled rated load test.

20.9.5 Operations - Safe operation of a personnel-lifting device requires:

a. Training - Only personnel having the required training and the authorization of the supervisor shall be permitted to operate a crane- or hoist-supported personnel-lifting device.
b. Inspection - Prior to use, the operator shall visually inspect the device for mechanical soundness and perform a functional integrity test.
c. Detailed operating procedures - Detailed technical operating procedures describing personnel-lifting device operation, emergency steps, communication requirements, and special requirements shall be prepared.
d. Safe egress - A method for safe egress of personnel or emergency lowering to the ground level or other safe location shall be provided.
e. Fall prevention - Those personnel using personnel-lifting devices are required, where possible, to tie off to approved attachment points that are not on the work cage. Handrails shall not be used as an attachment point.

20.10 BIBLIOGRAPHY

- Title 29, Code of Federal Regulation, Pt. 1910, Subpart. N. Occupational Safety and Health Standards. Materials Handling and Storage.

- ANSI/ASME B30.2, 1990.
- NASA-STD-8719.9 (http://www.hq.nasa.gov/office/codeq/doctree/87199.pdf
- Title 29, Code of Federal Regulations. Part 1926.550

NASA Responsible Official: Manuel Dominguez
Web Curator: Deborah Ripley