CRANES, HOISTS, WINCHES, AND RIGGING

NIST S 7101.69
Approval Date: 04/02/2024
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1. PURPOSE

The purpose of this program is to define requirements and associated roles and responsibilities for protecting employees and covered associates (hereafter referred to as "staff") from the hazards presented by operating various types of cranes (*e.g.*, overhead, jib, gantry), hoists, and winches (hereafter referred to collectively as "cranes") and the associated rigging equipment.

2. BACKGROUND

NA

3. APPLICABILITY

a. The provisions of this suborder apply to all NIST staff whose work activities involve operating cranes and using rigging equipment at any NIST owned and operated site.

b. The provisions of this suborder do not apply to the use of powered industrial truck attachments (*e.g.*, boom attachments) which may be used for lifting payloads. Please refer to NIST S 7101.74 for requirements associated with those attachments.

c. NIST staff who work with overhead cranes and use rigging equipment at non-NIST sites must follow requirements of the host organization's program which must meet or exceed all applicable OSHA requirements. Contact OSHE as needed for assistance in evaluating crane programs from other organizations.

4. REFERENCES

a. 29 CFR 1910.179, *Overhead and Gantry Cranes*

b. 29 CFR 1910.184, *Slings*

[1] For revision history, see Appendix A.

c. 29 CFR 1926 Subpart CC, *Cranes and Derricks in Construction*

d. 29 CFR 1926.251: *Rigging Equipment for Material Handling*

e. 29 CFR 1926.753: *Hoisting and Rigging*

f. ANSI B30.2, *Overhead and Gantry Cranes* (current version)

g. ANSI/ASME B30, *Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings*

h. ASME B30.7, *Winches*

5. APPLICABLE NIST DIRECTIVES

The NIST OSH Suborders listed below are incorporated by reference as standard operating procedures for this suborder.

a. NIST O 7101.00: *Occupational Safety and Health Management System*

b. NIST S 7101.20: *Work and Worker Authorization Based on Hazard Reviews*

c. NIST S 7101.23: *Safety Education and Training*

d. NIST S 7101.31: *Construction, Renovation, and Demolition Safety* (under development)

e. NIST S 7101.73: *Out of Service*

f. NIST S 7101.74: *Powered Industrial Trucks*

g. NIST S 7401.03: *Impairment of Fire Protection and Life Safety Systems*

6. REQUIREMENTS

a. Crane and Rigging used in Construction, Renovation, and Demolition Activities

(1) Requirements for cranes used in construction, renovation, and demolition activities are covered in NIST S 7101.31 and meet the regulations specified in 29 CFR 1926 Subpart CC.

(a) When permanently installed overhead and gantry cranes are used in construction, renovation, or demolition activities, the requirements of this suborder apply (per 29 CFR 1926.1438).

(2) Requirements for rigging used in construction, renovation, and demolition activities are covered in NIST S 7101.31 and meet the regulations specified in:

(a) 29 CFR 1926.251; and

(b) 29 CFR 1926.753.

b. Crane Installation and Subsequent Modification

(1) Installation/set-up must meet:

(a) Manufacturer recommendations;

(b) OSHA 29 CFR 1910.179 requirements; and

(c) Current version of ANSI/ASME B30.

(2) The rated load of a crane must be plainly marked on each side of the crane.

(a) If the crane has more than one hoisting unit:

i. Each hoist shall have its rated load marked on it with the marking clearly legible from the ground or floor; or

ii. Each load block shall have its rated load marked on it with the marking clearly legible from the ground or floor.

(3) Except for floor operated cranes, a gong or other effective warning signal must be provided for each crane equipped with a power traveling mechanism.

(4) Cranes may be modified and rerated provided such modifications and the supporting structure are checked thoroughly for the new rated load by a qualified engineer or the equipment manufacturer.

(a) Modified cranes shall be taken out of service, in accordance with the requirements of NIST S 7101.73, until tested and the new rated load is determined and displayed.

(b) The modified crane shall be tested and the new rated load shall be displayed in accordance with this suborder.

c. Crane Inspections

(1) Crane inspections shall be performed as prescribed below in accordance with use.

(a) Initial Inspection – Prior to initial use, all new and altered cranes shall be inspected to ensure compliance with 29 CFR 1910.179, ANSI B30.2, and ANSI/ASME B30 by a qualified person.

(b) Functional Inspection – A functional test inspection is a visual and audible operational examination of the crane performed on the day it will be used. It shall be conducted by a designated person at the beginning of each workday or beginning of each shift if multiple shifts are used each day. In special applications, where the suspended load is transferred from operator to operator at shift change, the functional test inspection shall be performed when that lift is completed. It will consist of testing operational controls, upper limit devices, and rope condition in accordance with ANSI/ASME B30.

(c) Frequent Inspection – A frequent inspection is a visual and audible examination of the crane performed monthly under normal service, weekly to monthly under heavy service and daily to weekly under severe service. Frequent inspections shall be conducted in accordance with 29 CFR 1910.179(j)(2) and (m) by a designated person.

(d) Periodic Inspection – A periodic inspection is a visual and audible examination of the crane conducted yearly under normal and heavy service; and quarterly under severe service. Periodic inspections shall be conducted in accordance with 29 CFR 1910.179(j)(3) by a qualified person.

(2) A crane which has been idle for a period of 1 month or more, but less than 6 months, shall be given an inspection conforming with the above Frequent inspection requirements before placing in service.

(3) A crane which has been idle for a period of over 6 months shall be given a complete inspection conforming with the above Frequent and Periodic inspection requirements before placing in service.

(4) Standby cranes shall be inspected at least every six months in accordance with the above Frequent inspection requirements.

(5) Should a crane experience an unexpected shock loading event, an "Out of Service" tag, warning sign, or lock shall be placed on the crane's controls and/or power source until after a Periodic Inspection has been performed.

(6) If an inspection finds that the crane or lifting device is not safe for use, an "Out of Service" tag, warning sign, or lock shall be placed on the crane's controls and/or power source by the individual who identified the deficiency in accordance with the requirements of NIST S 7101.73. A qualified person shall be contacted to assess the deficiency and effectuate the necessary repair actions before the crane can be placed back into service.

d. Rigging Equipment and Inspections

(1) General Requirements for Rigging Equipment

(a) Rigging equipment shall have permanently affixed and legible identification markings as prescribed by the manufacturer that indicate the recommended safe working load.

i. Rigging equipment without affixed, legible identification markings shall be taken out of service in accordance with NIST S 7101.73 and:

(i) Disposed of; or

(ii) Not used until it is tested and labeled by a qualified service provider.

(b) Rigging equipment shall not be loaded in excess of its recommended safe working load as prescribed on the identification markings by the manufacturer.

i. Rigging equipment loaded in excess of its recommended safe working load shall be removed from service and disposed of.

(c) Rigging equipment experiencing a shock loading event shall be removed from service and disposed of.

(d) Rigging equipment, when not in use, shall be removed from the immediate work area so as not to present a hazard to staff.

(e) Rigging equipment shall be inspected by a designated person to ensure it is safe to use:

i. Prior to use on each shift; and

ii. As necessary during its use (this type of inspection is performance-based and shall be clearly documented in the risk assessment documentation for individual tasks using rigging equipment).

NOTE: Inspection of alloy steel chain slings has a recordkeeping requirement, please see Section 6.e(3)(a).

(f) Defective rigging equipment shall be immediately removed from service and disposed of.

(2) Requirements for Specific Rigging Equipment

(a) In addition to the requirements of Section 6.c(1), specific types of rigging equipment shall be used in accordance with the requirements listed below:

i. Alloy Steel Chain Slings –29 CFR 1910.184(e);

ii. Metal Mesh Slings – 29 CFR 1910.184(g);

iii. Natural Rope and Synthetic Fiber Slings – 29 CFR 1910.184(h);

iv. Synthetic Webbing Slings – 29 CFR 1910.184(i);

v. Wire Rope Slings –29 CFR 1910.184(f); and

vi. Shackles and Hooks – 29 CFR 1926.251(f).

(b) Special custom design grabs, hooks, clamps, or other lifting accessories shall be marked to indicate the safe working loads and shall be proof-tested prior to use to 125 percent of their rated load.

e. Hazard Review

(1) OUs shall perform a hazard review in accordance with NIST S 7101.20 for all their crane activities.

(a) At a minimum, the hazard review shall address the following:

i. Safety evaluation of the load, *e.g.*:

(i) Load weight;

(ii) Load configuration;

(iii) Load stability (*e.g.*, center of gravity); and

(iv) Load reliability (*e.g.*, structural steel member versus non-homogeneous concrete slab);

ii. Proper selection of rigging equipment (*e.g.*, type of sling/wire, use of shackles/rigging hooks, use of spreader bar; appropriate working load limit);

iii. Proper selection of rigging pick points;

iv. Crane capacity (please see definition for "critical" lift);

v. Number of cranes required to make a lift (please see definition for "critical" lift);

vi. Specific safe operating practices for a lift to be performed (*e.g.*, pre-lift safety briefing, ensuring the appropriate number of spotters, barricading the lift area, verifying travel path is clear, verify landing area is properly set up); and

vii. Required training.

Where applicable, determination of an appropriate safety factor for a given lift shall be documented as part of the hazard review (*e.g.*, possible load or rigging connection failure during transport).

(b) A hazard review shall be performed for each specific lift.

i. OUs may create a generic hazard review to address general crane-related hazards, but the generic hazard review shall not be used by itself for a specific lift. The hazard review for the specific lift may incorporate the generic crane-related hazard review.

(2) Safe Operating Practices for Cranes

(a) OUs shall develop and maintain safe operating procedures in accordance with 29 CFR 1910.179 as part of the hazard review for each crane under their control. The procedures must consider the design and controls of the crane, the items being lifted, and the conditions, configuration and construction of the area. At a minimum, these safe operating procedures shall address the following:

i. Operation of the equipment by an authorized crane operator or trainee who is under the direct supervision of an authorized crane operator;

ii. Ensuring an impairment permit is obtained, in accordance with the requirements of NIST S 7401.03, if operation of a crane will trigger a fire alarm (*e.g.*, beam detector);

iii. Maintaining full attention on the task being performed (*e.g.*, no use of headsets, music);

iv. Training on and use of hand signals during the task being performed;

v. Restrictions on using cranes placed "out of service", in accordance with the requirements of NIST S 7101.73, until the appropriate inspection is completed to render it back in service;

vi. Restrictions for operators and nearby workers from standing on or riding on a suspended load;

vii. Restrictions for operators and workers from passing under a suspended load;

viii. Restrictions for operators to refrain from passing a suspended load over workers;

ix. Installation of proper guards for exposed gears, belts, electrical equipment, couplings and fans of the crane;

x. Procedures for keeping suspended loads as low to the work surface as possible and kept clear of obstructions and personnel unless obstructions are unavoidable;

xi. Procedures for ensuring suspended loads are not left unattended unless provisions have been made to provide auxiliary support under the suspended load. Where possible, suspended loads should be either lowered or supported in the event of a building evacuation;

xii. Procedures for stabilizing the load, *e.g.*, all loads shall be:

(i) Securely rigged and properly balanced before they are set in motion;

(ii) Kept under control at all times, *e.g.*, taglines shall be used to prevent uncontrolled motion; and

(iii) Safely landed and properly blocked before being unhooked and unslung.

xiii. Positioning of hands and/or fingers when the sling is being tightened around the load;

xiv. Prohibition of shock loading;

xv. If applicable, a critical lift plan shall be developed by a qualified person and meet the minimum requirements found in Appendix B.

(3) Safe Operating Practices for Rigging Equipment

(a) OUs shall develop and maintain safe operating procedures in accordance with 29 CFR 1910.184 as part of the hazard review for the use of rigging equipment. The procedures must consider the design and construction of the rigging equipment, the items being lifted, and the conditions, configuration, and construction of the area.

(b) All staff who handle wire slings and cables shall wear leather (or equivalent) gloves to prevent hand injury.

f. Training

(1) Training shall be provided, documented, and recorded in accordance with the requirements of NIST S 7101.23.

(2) Staff to whom this suborder applies shall receive the following information and training prior to their initial assignment to be considered an authorized crane operator:

(a) Training provided by OSHE on crane safety; and

(b) Activity-specific crane operator training provided by their OUs in accordance with NIST S 7101.20.

i. This training should consist of crane and lift type(s), communication strategies used during lifts, lifting requirements and personnel needed, basic rigging gear inspection and use, determining load weights, calculating capacities, physical characteristics of the workplace, performance characteristics and complexity of the crane, and crane accident identification and response.

ii. Written, including electronic versions, and practical examinations shall be conducted that verify that the person has acquired the knowledge and skill to operate the particular crane(s) that will be operated by the person. The examinations shall be defined by the owner/user and in accordance with the type of crane used.

iii. A certificate or formal record for each crane that verifies that the person has been trained and has passed the examinations required or confirm that the person has a valid certificate or formal record that satisfies the requirements ANSI B30.2-1967 shall be issued. The Safety Education and Training System (SETS) can be used to meet this requirement.

(3) NIST staff to whom this suborder applies shall receive the following information and training prior to their initial assignment to perform a rigging operation:

(a) Training provided by OSHE on rigging and rigging equipment; and

(b) Activity-specific rigging training provided by their OUs in accordance with NIST S 7101.20.

i. This training should consist of basic rigging gear inspection and use in the location.

(4) Refresher training in relevant topics shall be provided to the crane operator when:

(a) The operator has been observed to operate the crane in an unsafe manner; or

(b) The operator has been involved in an accident or near-miss incident with the crane they are operating.

(5) Refresher training in relevant topics shall be provided to the rigger when:

(a) The rigger has been observed not following requirements for rigging; or

(b) The rigger has been involved in an accident or near-miss incident with a load they have rigged.

g. Records Required by this Suborder.

(1) Crane Inspections

(a) OUs shall maintain a written record of the following inspections for a minimum of one year:

i. Frequent crane inspections and

ii. Periodic crane inspections.

iii.

(b) A written record shall be available for inspection which includes:

i. An identifier for the equipment which was inspected;

ii. The signature of the person who performed the inspection; and

iii. The date of inspection.

(2) Crane Maintenance and/or Modifications

(a) OUs shall maintain a written record of crane maintenance and/or modification for the life of the crane.

(b) A written record shall be available for inspection which includes:

i. An identifier for the equipment which was maintained and/or modified;

ii. The service provided or modification made;

iii. The signature of the person who performed the maintenance and/or modification; and

iv. The date of the service or modification was completed.

(3) Rigging Inspections

(a) OUs shall maintain a written record of the most recent month in which each alloy steel chain sling was inspected.

i. A written record shall be available for inspection which includes:

(i) An identifier for the equipment which was inspected;

(ii) The signature of the person who performed the inspection; and

(iii) The date of inspection.

(b) OUs may maintain a written record of inspections for other rigging equipment.

7. DEFINITIONS

Definitions common to all NIST OSH suborders can be found in Section 6 of NIST O 7101.00. The definitions specific to this suborder are as follows:

a. Abnormal Operating Conditions – Environmental conditions that are unfavorable, harmful, or detrimental to or for crane operations (*e.g.*, excessively high or low ambient temperatures, corrosive fumes, moisture-laden atmospheres).

b. Crane – A "crane" is defined by OSHA 29 CFR 1910.179 as a machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism an integral part of the machine. Cranes whether fixed or mobile are driven manually or by power, *e.g.*, overhead gantry crane.

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

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

e. Crane Service, Severe – Service that involves normal or heavy service with abnormal operating conditions.

f. Critical lift – A lift that exceeds 75 percent of the rated capacity of the crane or requires the use of more than one crane.

g. Designated Person – A person selected or assigned by the employer or the employer's representative as being competent to perform specific duties.

h. Hoist – A machinery unit that is used for lifting or lowering a freely suspended (unguided) load.

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

j. Safety Factor – The ratio between the strength of a structure or material, *i.e.*, ability of a structure or material to carry a load, and the load imposed on that structure or material. A value above unity indicates the structure or material is not overloaded and will not fail, but a value of unity or lower indicates the structure or material is loaded at or above its capacity and will fail.

k. Shock Loading – Occurs when a load is quickly jerked in any direction or if it is allowed to free-fall before the rigging catches it. Rapid acceleration increases the force put on the rigging system, and if the acceleration is too severe, it can overload the capacity of the system.

l. Sling – An assembly which connects the load to the material handling equipment.

m. Standby Crane – A crane not in regular service that is used intermittently as required.

n. Winch – A hauling or lifting device consisting of a rope, cable, or chain winding around a horizontal rotating drum, turned by a crank or by motor or other power source. Winches are designed to pull loads horizontally across a relatively level surface.

8. ACRONYMS

Acronyms common to all NIST OSH suborders can be found in Section 7 of NIST O 7101.00. The acronyms specific to this suborder are as follows:

a. ANSI – American National Standards Institute

b. CFR – Code of Federal Regulations

c. NIST – National Institute of Standards and Technology

d. OSHE – Office of Safety, Health, and Environment

e. OU – Organizational Unit

9. RESPONSIBILITIES

Roles and responsibilities common to all NIST OSH suborders can be found in Section 8 of NIST O 7101.00. The roles and responsibilities specific to this suborder are as follows:

a. OU Directors are responsible for:

(1) Establishing policies and procedures, as needed, for the requirements of this program to be met as it applies to their staff and to cranes operated during their OU operations and ensuring that those policies and procedures are implemented; and

(2) Ensuring subordinate managers have the authority, resources, and training needed to implement OU-established policies and procedures.

b. Division Chiefs (or Equivalents)[2] are responsible for:

(1) Implementing this program as it applies to activities involving their personnel in accordance with any applicable OU-established policies and procedures;
(2) Allocating budgetary and other resources capable of ensuring the health and safety of NIST staff and visitors in divisional work areas;

(3) Providing support to divisional group leaders, safety personnel, and staff in carrying out their responsibilities with respect to implementing the requirements of this suborder and managing cranes within the division; and

[2] Some NIST OUs do not have Division Chiefs; these OUs shall designate other individuals to carry out these responsibilities.

(4) Acting on all incidents involving cranes and related safety concerns reported by personnel quickly and completely to protect staff from the health and physical hazards presented by cranes in divisional work areas.

c. Line Management is responsible for:

(1) Reviewing crane procurement requests to ensure hazards have been identified and evaluated prior to procurement;

(2) Reviewing crane procurement requests to ensure equipment will be procured only when their design and construction meets 29 CFR 1910.179;

(3) Ensuring required training has been completed by affected staff;

(4) Ensuring inspections are conducted at the proper frequency by the appropriate personnel; and

(5) Providing oversight as necessary aimed at ensuring that staff who operate cranes do so in accordance with this suborder.

d. NIST Staff are responsible for:

(1) Completing the training required by this program and their OUs/divisions;

(2) Requesting additional training as needed or as conditions change; and

(3) Operating cranes in accordance with their training and the requirements of this suborder.

10. AUTHORITIES

There are no authorities specific to this suborder alone. For authorities applicable to all NIST OSH suborders, see section 9 of NIST O 7101.00.

11. DIRECTIVE OWNER

Chief Safety Officer

12. APPENDICES

A. Revision History

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Version No.	Approval Date	Effective Date	Brief Description of Change; Rationale
1	10/05/20	06/30/23	• None – Initial document • NOTE: Effective date was originally TBD due to the COVID-19 pandemic. It was updated on 4/17/23.
2	04/02/2024	04/01/25	• Title of program was modified from Overhead Cranes and Hoists • Background section deleted • Applicability section modified to indicate use of powered industrial trucks with attachments are not covered by the requirements of this suborder • References added (29 CFR 1926.753 and ASME B30.7) • Applicable NIST Directives added (NIST S 7101.31 and S 7101.74) • New Section 6.a added to address construction, renovation, and demo crane and rigging activities • Section 6.b(1)(b): Functional inspection modified to indicate they are conducted at the beginning of each workday or shift • Section 6.c(1)(a)i: Added requirements for what to do with poorly or unmarked rigging • Section 6.c(1)(e): Added requirement related to inspection of rigging equipment • Section 6.d(1)(a)vii: An "appropriate" safety factor is required • Section 6.d(2)(a)xv: Added requirement for who shall develop a critical lift plan • Appendix B added. • Editorial modifications
Admin. Revision	9/12/24	04/01/25	• Fixed formatting for Section 6 subsections from 6 a-b-b-c-d-d-e to 6 a-b-c-d-e-f-g.

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Appendix B: Minimum Requirements of a Critical Lift Plan

A qualified person shall ensure that a step-by-step procedure is prepared for critical lifts.

Although individual procedures are prepared for one-time critical lifts, general procedures may be employed to accomplish routine recurrent critical lifts. For example, a general procedure may be used to lift an item or series of similar items that are frequently lifted or repeatedly handled in the same manner. A critical lift procedure should contain the following, as applicable:

- Identify the items to be moved.
- Special precautions, if any.
- Weight of the item and total weight of the load.
- Center of gravity location.
- A list of each 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 and rated capacity).
- Designated checkpoints and holdpoints and estimated instrument readings, as relevant, so that job progress can be checked against the plan.

  NOTE: Sign-offs in the procedure are generally appropriate. For example, initial and time/date the procedure as key steps are completed. Hold points or sign-off points should be provided for personnel assigned to witness the work.

- Rigging sketch(s), which include the following:
  - Lift point identification.
  - Method(s) of attachment.
  - Load vectors.
  - Sling angles.
  - Accessories used.
- Other factors affecting the equipment capacity.
- Rated capacity of equipment in the configuration(s) in which it will be used.
- A load-path sketch that shows the load path and height at key points in the job.
- A sketch indicating lifting and travel speed limitations. (This may be noted on the load path sketch or on a separate sketch).
- A sign-off sheet to verify that equipment and tackle inspections or tests are current.

NOTE: Practice lifts are recommended. If used, requirements for the practice lift should be documented in the procedure.