ASME B30.4-2020
(Revision of ASME B30.4-2015)

Portal and Pedestal Cranes

Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

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The next edition of this Standard is scheduled for publication in 2025. This Standard will become effective 1 year after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME website under the Committee Pages at http://cstools.asme.org/ as they are issued.

Errata to codes and standards may be posted on the ASME website under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

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The American Society of Mechanical Engineers
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FOREWORD

This American National Standard, Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings, has been developed under the procedures accredited by the American National Standards Institute (ANSI). This Standard had its beginning in December 1916, when an eight-page "Code of Safety Standards for Cranes," prepared by the American Society of Mechanical Engineers (ASME) Committee on the Protection of Industrial Workers, was presented at the annual meeting of the ASME.

Meetings and discussions regarding safety on cranes, derricks, and hoists were held from 1920 to 1925 involving the ASME Safety Code Correlating Committee, the Association of Iron and Steel Electrical Engineers, the American Museum of Safety, the American Engineering Standards Committee (AESC) [later changed to American Standards Association (ASA), then to the United States of America Standards Institute (USASI), and finally to ANSI], Department of Labor — State of New Jersey, Department of Labor and Industry — State of Pennsylvania, and the Locomotive Crane Manufacturers Association. On June 11, 1925, the AESC approved the ASME Safety Code Correlating Committee's recommendation and authorized the project with the U.S. Department of the Navy, Bureau of Yards and Docks, and ASME as sponsors.

In March 1926, invitations were issued to 50 organizations to appoint representatives to a Sectional Committee. The call for organization of this Sectional Committee was sent out October 2, 1926, and the Committee was organized on November 4, 1926, with 57 members representing 29 national organizations.

Commencing June 1, 1927, and using the eight-page Code published by ASME in 1916 as a basis, the Sectional Committee developed the "Safety Code for Cranes, Derricks, and Hoists." The early drafts of this safety code included requirements for jacks, but due to inputs and comments on those drafts, the Sectional Committee decided in 1938 to make the requirements for jacks a separate code. In January 1943, ASA B30.2-1943 was published, addressing a multitude of equipment types, and in August 1943, ASA B30.1-1943 was published, addressing only jacks. Both documents were reaffirmed in 1952 and widely accepted as safety standards.

Due to changes in design, advancement in techniques, and general interest of labor and industry in safety, the Sectional Committee, under the joint sponsorship of ASME and the Bureau of Yards and Docks (now the Naval Facilities Engineering Command), was reorganized on January 31, 1962, with 39 members representing 27 national organizations. The new Committee changed the format of ASA B30.2-1943 so that the multitude of equipment types it addressed could be published in separate volumes that could completely cover the construction, installation, inspection, testing, maintenance, and operation of each type of equipment that was included in the scope of ASA B30.2. This format change resulted in B30.3, B30.5, B30.6, B30.11, and B30.16 being initially published as "Revisions" of B30.2, with the remainder of the B30 volumes being published as totally new volumes. ASA changed its name to USASI in 1966 and to ANSI in 1969, which resulted in B30 volumes from 1943 to 1968 being designated as ASA B30, USAS B30, or ANSI B30, depending on their date of publication. In 1982, the Committee was reorganized as an Accredited Organization Committee operating under procedures developed by ASME and accredited by ANSI.

This Standard presents a coordinated set of rules that may serve as a guide to government and other regulatory bodies and municipal authorities responsible for the guarding and inspection of the equipment falling within its scope. The suggestions leading to accident prevention are given both as mandatory and advisory provisions; compliance with both types may be required by employers of their employees. In case of practical difficulties, new developments, or unnecessary hardship, the administrative or regulatory authority may grant variances from the literal requirements or permit the use of other devices or methods, but only when it is clearly evident that an equivalent degree of protection is thereby secured. To secure uniform application and interpretation of this Standard, administrative or regulatory authorities are urged to consult the B30 Committee, in accordance with the format described in Section IX of the B30 Standard Introduction, before rendering decisions on disputed points.

Safety codes and standards are intended to enhance public safety. Revisions result from committee consideration of factors such as technological advances, new data, and changing environmental and industry needs. Revisions do not imply that previous editions were inadequate.

B30.4 has been in existence since 1943. New editions were published in 1973 and 1981 under the title Portal, Tower, and Pillar Cranes. The 1990, 1996, and 2003 editions were published under the title Portal, Tower, and Pedestal Cranes. For the 2010 edition, B30.4 removed all references to tower cranes and revised the title to Portal and Pedestal Cranes. All requirements for tower cranes were incorporated into B30.3-2009. The 2015 edition contained technical and editorial

revisions, including the addition of responsibilities of personnel, personnel competence, and translations. In this 2020 edition, many changes were made throughout each chapter, including the scope and references to B30.30, Ropes.

This Volume of the Standard, which was approved by the B30 Committee and by ASME, was approved by ANSI and designated as an American National Standard on July 16, 2020.

ASME B30 COMMITTEE
Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

(The following is the roster of the Committee at the time of approval of this Standard.)

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B30 STANDARD INTRODUCTION

(20)

SECTION I: SCOPE

The ASME B30 Standard contains provisions that apply to the construction, installation, operation, inspection, testing, maintenance, and use of cranes and other lifting and material-movement-related equipment. For the convenience of the reader, the Standard has been divided into separate volumes. Each volume has been written under the direction of the ASME B30 Standards Committee and has successfully completed a consensus approval process under the general auspices of the American National Standards Institute (ANSI).

As of the date of issuance of this Volume, the B30 Standard comprises the following volumes:

B30.1 Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries

B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)

B30.3 Tower Cranes

B30.4 Portal and Pedestal Cranes

B30.5 Mobile and Locomotive Cranes

B30.6 Derricks

B30.7 Winches

B30.8 Floating Cranes and Floating Derricks

B30.9 Slings

B30.10 Hooks

B30.11 Monorails and Underhung Cranes (withdrawn 2018 — requirements found in latest revision of B30.17)

B30.12 Handling Loads Suspended From Rotorcraft

B30.13 Storage/Retrieval (S/R) Machines and Associated Equipment

B30.14 Side Boom Tractors

B30.15 Mobile Hydraulic Cranes (withdrawn 1982 — requirements found in latest revision of B30.5)

B30.16 Overhead Underhung and Stationary Hoists

B30.17 Cranes and Monorails (With Underhung Trolley or Bridge)

B30.18 Stacker Cranes (Top or Under Running Bridge, Multiple Girder With Top or Under Running Trolley Hoist)

B30.19 Cableways

B30.20 Below-the-Hook Lifting Devices

B30.21 Lever Hoists

B30.22 Articulating Boom Cranes

B30.23 Personnel Lifting Systems

B30.24 Container Cranes

B30.25 Scrap and Material Handlers

B30.26 Rigging Hardware

B30.27 Material Placement Systems

B30.28 Balance Lifting Units

B30.29 Self-Erecting Tower Cranes

B30.30 Ropes

B30.31 Self-Propelled, Towed, or Remote-Controlled Hydraulic Platform Transporters[1]

B30.32 Unmanned Aircraft Systems (UAS) Used in Inspection, Testing, Maintenance, and Lifting Operations[1]

SECTION II: SCOPE EXCLUSIONS

Any exclusion of, or limitations applicable to, the equipment, requirements, recommendations, or operations contained in this Standard are established in the affected volume's scope.

SECTION III: PURPOSE

The B30 Standard is intended to

(a) prevent or minimize injury to workers, and otherwise provide for the protection of life, limb, and property by prescribing safety requirements

(b) provide direction to manufacturers, owners, employers, users, and others concerned with, or responsible for, its application

(c) guide governments and other regulatory bodies in the development, promulgation, and enforcement of appropriate safety directives

SECTION IV: USE BY REGULATORY AGENCIES

These volumes may be adopted in whole or in part for governmental or regulatory use. If adopted for governmental use, the references to other national codes and standards in the specific volumes may be changed to refer to the corresponding regulations of the governmental authorities.

[1] This volume is currently in the development process.

SECTION V: EFFECTIVE DATE

(a) Effective Date. The effective date of this Volume of the B30 Standard shall be 1 yr after its date of issuance. Construction, installation, inspection, testing, maintenance, and operation of equipment manufactured and facilities constructed after the effective date of this Volume shall conform to the mandatory requirements of this Volume.

(b) Existing Installations. Equipment manufactured and facilities constructed prior to the effective date of this Volume of the B30 Standard shall be subject to the inspection, testing, maintenance, and operation requirements of this Standard after the effective date.

It is not the intent of this Volume of the B30 Standard to require retrofitting of existing equipment. However, when an item is being modified, its performance requirements shall be reviewed relative to the requirements within the current volume. The need to meet the current requirements shall be evaluated by a qualified person selected by the owner (user). Recommended changes shall be made by the owner (user) within 1 yr.

SECTION VI: REQUIREMENTS AND RECOMMENDATIONS

Requirements of this Standard are characterized by use of the word *shall*. Recommendations of this Standard are characterized by the word *should*.

SECTION VII: USE OF MEASUREMENT UNITS

This Standard contains SI (metric) units as well as U.S. Customary units. The values stated in U.S. Customary units are to be regarded as the standard. The SI units are a direct (soft) conversion from the U.S. Customary units.

SECTION VIII: REQUESTS FOR REVISION

The B30 Standards Committee will consider requests for revision of any of the volumes within the B30 Standard. Such requests should be directed to

Secretary, B30 Standards Committee
ASME Standards and Certification
Two Park Avenue
New York, NY 10016-5990

Requests should be in the following format:

Volume:	Cite the designation and title of the volume.
Edition:	Cite the applicable edition of the volume.
Subject:	Cite the applicable paragraph number(s) and the relevant heading(s).
Request:	Indicate the suggested revision.
Rationale:	State the rationale for the suggested revision.

Upon receipt by the Secretary, the request will be forwarded to the relevant B30 Subcommittee for consideration and action. Correspondence will be provided to the requester defining the actions undertaken by the B30 Standards Committee.

SECTION IX: REQUESTS FOR INTERPRETATION

The B30 Standards Committee will render an interpretation of the provisions of the B30 Standard. An Interpretation Submittal Form is available on ASME's website at http://cstools.asme.org/Interpretation/InterpretationForm.cfm.

Phrase the question as a request for an interpretation of a specific provision suitable for general understanding and use, not as a request for approval of a proprietary design or situation. Plans or drawings that explain the question may be submitted to clarify the question. However, they should not contain any proprietary names or information. Read carefully the note addressing the types of requests that the B30 Standards Committee can and cannot consider.

Upon submittal, the request will be forwarded to the relevant B30 Subcommittee for a draft response, which will then be subject to approval by the B30 Standards Committee prior to its formal issuance. The B30 Standards Committee may rewrite the question for the sake of clarity.

Interpretations to the B30 Standard will be available online at https://cstools.asme.org/Interpretation/SearchInterpretation.cfm.

SECTION X: ADDITIONAL GUIDANCE

The equipment covered by the B30 Standard is subject to hazards that cannot be abated by mechanical means, but only by the exercise of intelligence, care, and common sense. It is therefore essential to have personnel involved in the use and operation of equipment who are competent, careful, physically and mentally qualified, and trained in the proper operation of the equipment and the handling of loads. Serious hazards include, but are not limited to, improper or inadequate maintenance, overloading, dropping or slipping of the load, obstructing the free passage of the load, and using equipment for a purpose for which it was not intended or designed.

The B30 Standards Committee fully realizes the importance of proper design factors, minimum or maximum dimensions, and other limiting criteria of wire rope or chain and their fastenings, sheaves, sprockets, drums, and similar equipment covered by the Standard, all of which are closely connected with safety. Sizes, strengths, and similar criteria are dependent on many different factors, often varying with the installation and uses. These factors depend on

(a) the condition of the equipment or material
(b) the loads

(c) the acceleration or speed of the ropes, chains, sheaves, sprockets, or drums

(d) the type of attachments

(e) the number, size, and arrangement of sheaves or other parts

(f) environmental conditions causing corrosion or wear

(g) many variables that must be considered in each individual case

The requirements and recommendations provided in the volumes must be interpreted accordingly, and judgment used in determining their application.

ASME B30.4-2020
SUMMARY OF CHANGES

Following approval by the ASME B30 Committee and ASME, and after public review, ASME B30.4-2020 was approved by the American National Standards Institute on July 16, 2020.

ASME B30.4-2020 includes the following changes identified by a margin note, **(20)**.

Page	*Location*	*Change*
ix	B30 Standard Introduction	Updated
1	Chapter 4-0	Title revised
1	Section 4-0.1	Revised
1	4-0.2.1	Definition of *luffing crane* deleted
1	4-0.2.2	(1) Definitions of *accessory*; *axis of rotation*; *boom*; *boom point*; *brake*; *buffer/bumper*; *cab*; *counterweight*; *crane, standby*; *drum*; *jib*; *load block, lower*; *maximum operating wind speed*; *out-of-service*; *parking track*; *pedestal*; *radius*; *rail clamp*; *rope*; *service, heavy*; *service, light*; *service, normal*; *shall*; *should*; *switch, limit*; *truck, travel*; *two-blocking*; and *weathervaning* revised (2) Definitions of *level luffing boom*; *luffing boom*; *pintle/kingpost*; and *superstructure* added (3) Definitions of *administrative or regulatory authority*; *bogie*; *braking means*; *dynamic loading*; *flange point*; *gage, track*; *high strength (traction) bolts*; *load, working; minimum breaking force*; *pawl (dog)*; *permanent installation*; *pitch diameter*; *rotation resistant rope*; *standing rope (pendant)*; *structural competence*; *tower*; *traction*; and *trolley, load* deleted.
6	Chapter 4-1	(1) In Section 4-1.1, paras. 4-1.1.1.(g), 4-1.1.1.(j), and 4-1.1.2(g) revised, and para. 4-1.1.3 deleted (2) Section 4-1.2 added and subsequent Sections through former Section 4-1.14 redesignated (3) In Section 4-1.3 (formerly 4-1.2), paras. 4-1.3.1(c), 4-1.3.2(a), 4-1.3.2(b), 4-1.3.3(a), 4-1.3.3(e), 4-1.3.4(b)(2), and 4-1.3.6 revised (4) In Section 4-1.4 (formerly 4-1.3), paras. 4-1.4.1(a), 4-1.4.5, and 4-1.4.6 revised (5) In Section 4-1.5 (formerly 4-1.4), paras. 4-1.5.1(d), 4-1.5.2, 4-1.5.3(a) through 4-1.5.3(c), 4-1.5.4, and 4-1.5.5 revised (6) Section 4-1.6 (formerly 4-1.5) revised in its entirety (7) In Section 4-1.7 (formerly 4-1.6), subpara. 4-1.7.2(b) revised (8) In Section 4-1.8 (formerly 4-1.7), subpara. 4-1.8.1(a) revised (9) In Section 4-1.9 (formerly 4-1.8), subpara. (b) revised (10) Section 4-1.10 (formerly 4-1.9) revised in its entirety (11) In Section 4-1.11 (formerly 4-1.10), subparas. (a)(2), (b)(2), and (b)(4) revised; and subpara. (b)(5) deleted and subsequent subparagraphs redesignated (12) Section 4-1.12 (formerly 4-1.11) revised in its entirety

Page	Location	Change
		(13) Section 4-1.13 (formerly 4-1.12) revised in its entirety, and former Figure 4-1.12-1 deleted (14) In Section 4-1.15 (formerly 4-1.14), subparas. 4-1.15.1(a), 4-1.15.1(b), 4-1.15.2(a), and 4-1.15.2(b) revised; and subpara. 4-1.15.2(c) added (15) Former Section 4-1.15 deleted (16) In Section 4-1.16, subparas. (d) and (h) revised (17) In Section 4-1.17, subparas. 4-1.17.1(e), 4-1.17.2(a), and 4-1.17.2(c) revised (18) In Section 4-1.18, paras. 4-1.18.1(b) and 4-1.18.6 revised; and para. 4-1.18.9 added
14	4-2.1.1	Revised
14	4-2.1.2	Subparagraph (b)(2) revised
14	4-2.1.3	(1) Revised (2) Subparagraph (i) deleted: former subparas. (j) and (k) redesignated (3) Subparagraph (k) added
14	4-2.1.4	(1) Subparagraphs (a), (b), and (d) through (f) revised (2) Subparagraph (g) added
15	4-2.1.5	Subparagraphs (a) and (b) revised
15	4-2.3.1	Revised in its entirety
15	4-2.3.2	Revised
16	4-2.3.3	Added and subsequent paragraphs redesignated
16	4-2.3.4	Former para. 4-2.3.3, redesignated and revised
16	4-2.4.2	Subparagraph (a)(7) added
16	4-2.4.4	Revised
16	4-2.4.5	Revised in its entirety
18	4-3.1.2	Subparagraph (a) revised
19	4-3.1.3	Subparagraphs (f) and (g) added
19	4-3.1.3.1.2	Revised
20	4-3.1.3.2.2	Subparagraph (c)(1) revised
20	4-3.1.3.3.1	Subparagraph (o) deleted and remaining subparagraphs redesignated
21	4-3.1.3.4	Revised
21	4-3.1.3.5	Added
21	4-3.2.1	Revised
23	4-3.2.3	Added
23	Section 4-3.3	(1) Paragraph 4-3.3.3 revised and subpara. (d) added (2) Paragraph 4-3.3.5 revised (3) Paragraph 4-3.3.6 revised (4) Paragraph 4-3.3.7 deleted and subsequent paragraph redesignated
25	4-3.4.2	(1) Revised in its entirety (2) Figure 4-3.4.2.1 and Table 4-3.4.2-1 deleted

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Chapter 4-0
Scope, Definitions, Personnel Competence, Translations, and References (20)

(20) SECTION 4-0.1: SCOPE OF B30.4

Volume B30.4 includes provisions that apply to the construction, installation, operation, inspection, testing, and maintenance of electric motor or internal-combustion engine-powered portal and pedestal cranes that adjust operating radius by means of a boom luffing mechanism, that may be mounted on a fixed or traveling base, and to any variation thereof that retains the same fundamental characteristics.

This Volume applies only to portal and pedestal cranes having a luffing boom and utilizing a drum and rope for load hoisting. The requirements for tower cranes (refer to ASME B30.3), telescopic boom cranes, twin boom container handling cranes, and articulating boom cranes are not included in this Volume.

SECTION 4-0.2: DEFINITIONS

(20) 4-0.2.1 Types of Cranes

pedestal crane: a crane consisting of a rotating superstructure with operating machinery and boom, all of which is mounted on a pedestal (see Figure 4-0.2.1-1).

portal crane: a crane consisting of a rotating superstructure with operating machinery and boom, all of which is mounted on a gantry structure, usually with a portal opening between the gantry columns or legs for traffic to pass beneath the crane. The crane may be fixed or on a traveling base (see Figures 4-0.2.1-2 and 4-0.2.1-3).

(20) 4-0.2.2 General

accessory: a secondary part or assembly of parts that contributes to the overall function and usefulness of the crane.

alteration (modification): any change in the original equipment manufacturer's design configuration of the crane that pertains to load-supporting components, load-positioning components, and other components that affect the safe load-carrying capability of the crane (e.g., counterweights, holding valves), including operational aids, limit devices, and other safety equipment.

axis of rotation: the vertical axis around which the superstructure rotates.

boom: a member used for supporting the hoisting tackle, with its outer end supported by ropes, chains, rods, or hydraulic cylinder(s).

boom point: the outward end of the boom.

boom stop: a device or structure designed to limit boom travel to its highest allowable position.

brake: a device, other than a motor, used for retarding or stopping motion by means of friction or power.

bumper: an energy-absorbing device for reducing impact when a moving boom or crane reaches the end of its permitted travel. This is also known as a buffer.

cab: the operator's compartment on the crane.

clutch: a means for engagement or disengagement of power.

counterweight: weight used to supplement the weight of the crane in providing stability for lifting loads; it rotates with the superstructure.

drum: the cylindrical member around which the rope is wound for lifting or lowering the load or boom.

gantry: a movable structural frame consisting of columns and bracing capable of supporting a crane with its working and dynamic loads.

heavy service: service that involves operating at 85% to 100% of rated load or in excess of 10 lift cycles per hour as a regular specified procedure.

in-service: the condition of a crane ready for or engaged in work; an operator is at the controls.

jib: an extension attached to the boom point to provide added boom length for lifting specified loads. The jib may be in line with the boom or offset to various angles in the vertical plane of the boom.

level luffing boom: a type of luffing boom arrangement where the load stays at a constant elevation during luffing of the boom.

light service: service that involves irregular operation with loads generally about one-half or less of the rated load

limit switch: a device that is actuated by the motion of a part of a power-driven machine or equipment to alter or disconnect the electric, hydraulic, or pneumatic circuit associated with the machine or equipment.

load hoist: a hoist drum and rope reeving system used for hoisting and lowering loads.

lower load block: the assembly of hook, shackle, swivel, sheaves, pins, and frame suspended by the hoisting rope.

luffing boom: a member hinged to and part of the superstructure that raises and lowers to change load radius and is used for supporting the hoisting tackle (see Figures 4-0.2.1-1 through 4-0.2.1-3).

maximum operating wind speed: the maximum wind speed permitted by the crane manufacturer or a qualified person for the continued operation of the crane.

normal service: service that involves operating at less than 85% rated load and not more than 10 lift cycles per hour except for isolated instances.

operational aid: an accessory that provides information to facilitate operation of a crane or that takes control of particular functions without action of the operator when a limiting condition is sensed. Examples of such devices include, but are not limited to, the following: anti-two block device, rated capacity indicator, rated capacity (load) limiter, boom angle or radius indicator, drum rotation indicator, load indicator, and wind speed indicator.

out-of-service: the condition of a crane when unloaded, without power, with the controls unattended, and prepared to withstand winds above the in-service level.

parking track: for rail-mounted cranes, a section of track supported so that it is capable of sustaining storm or wind-induced wheel loads; it is provided with storm anchorages when required.

pedestal: a fixed raised crane base or foundation that may be solid or enclosed, but without a portal opening.

pintle/kingpost: fixed or rotating vertical structure (depending upon bearing arrangement) supporting the superstructure, which allows for rotation.

qualified person: a person who, by possession of a recognized degree in an applicable field or 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.

radius (load): the horizontal distance from a projection of the axis of rotation to the base of the crane portal or pedestal, before loading, to the center of vertical hoist line or tackle with load applied.

rail clamp: a device for fastening a traveling crane to its rails to limit storm or wind-induced travel.

remote-control station: a location, not on the crane, from which the operator can control all the crane movements.

rope: refers to rope covered by ASME B30.30.

service life: the time, expressed as the sum of the periods of operation, over which a stressed component can function without undue risk of failure when the crane is operated in accordance with the manufacturer's instructions under either light, normal, or heavy service.

shall: a word indicating a requirement.

should: a word indicating a recommendation.

standby crane: a crane not in regular service that is used occasionally or intermittently as required.

superstructure: the portion of the crane that rotates about the vertical axis (e.g., rotating frame, boom, A-frame, machinery house, hoisting machinery).

swing (slew): rotation of the superstructure for movement of loads in a horizontal direction about the axis of rotation.

travel truck: the assembly that includes a pivot, frame, axle(s), and wheel(s) on which a crane rides on rails.

two-blocking: the condition in which the lower load block or hook assembly comes in contact with the upper load block or boom point sheave assembly.

unattended: a condition in which the operator of a crane is not at the operating controls.

weathervaning: wind-induced swinging of a crane's superstructure, when out of service, so as to expose minimal surface area to the wind.

SECTION 4-0.3: PERSONNEL COMPETENCE

Persons performing the functions identified in this Volume shall meet the applicable qualifying criteria stated in this Volume and shall, through education, training, experience, skill, and physical ability, as necessary, be competent and capable to perform the functions as determined by the employer or employer's representative.

SECTION 4-0.4: TRANSLATIONS

(a) The documentation required by Section 4-1.4 shall be provided in a language specified by the purchaser at the time of the initial sale by the manufacturer.

(b) Pictograms used to identify controls shall be described in the instructions. The pictograms should comply with ISO 7000, ISO 7296, or other recognized source, if previously defined.

(c) Translations of the original language instructions (if the manufacturer no longer exists, translation of the instructions with the machine is acceptable) shall meet professional translation industry standards, which include, but are not limited to, the following:

(1) translating the complete paragraph message, instead of word by word

(2) ensuring grammatical accuracy

(3) preserving the source document content without omitting or expanding the text

Figure 4-0.2.1-1 Pedestal Crane With Luffing Boom

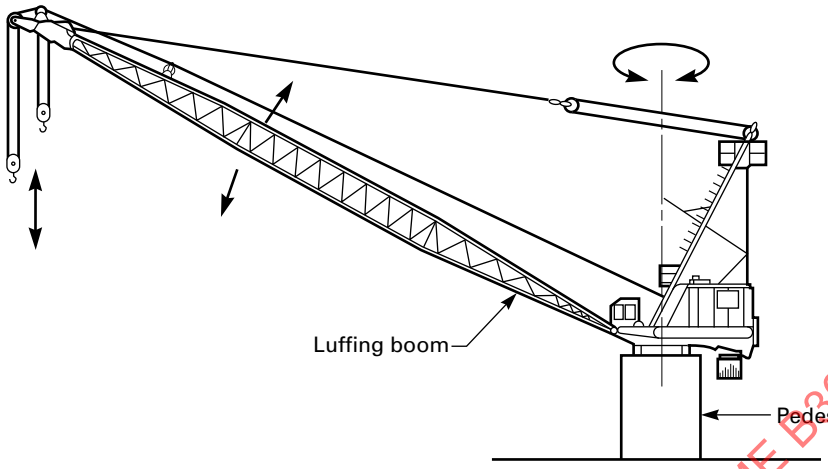


Figure 4-0.2.1-2 Portal Crane With Level Luffing Boom

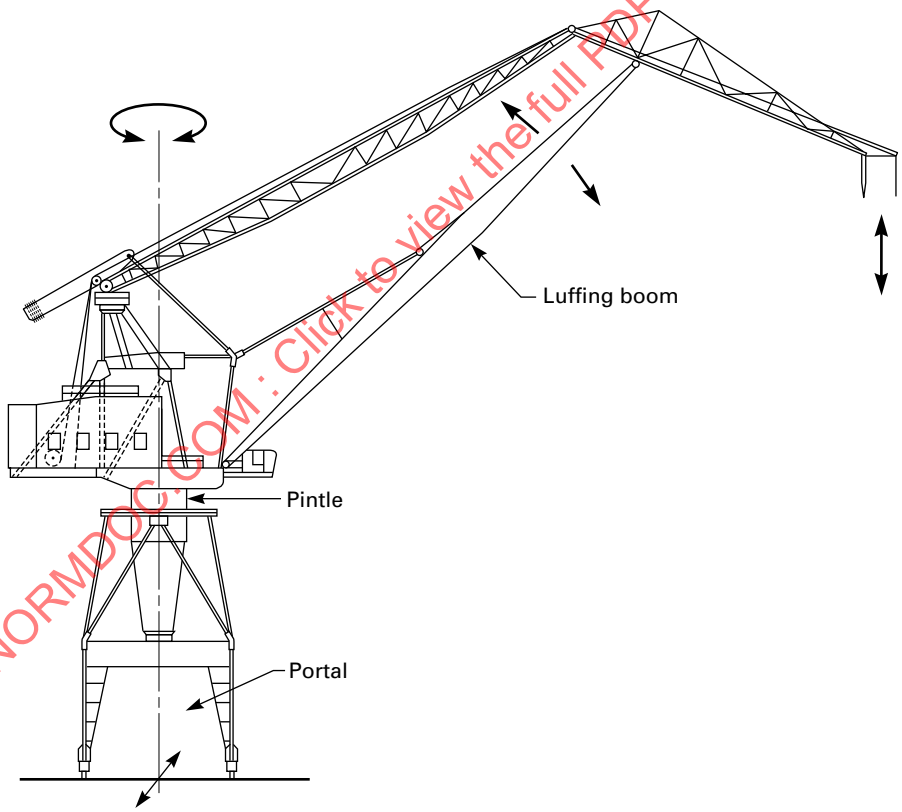
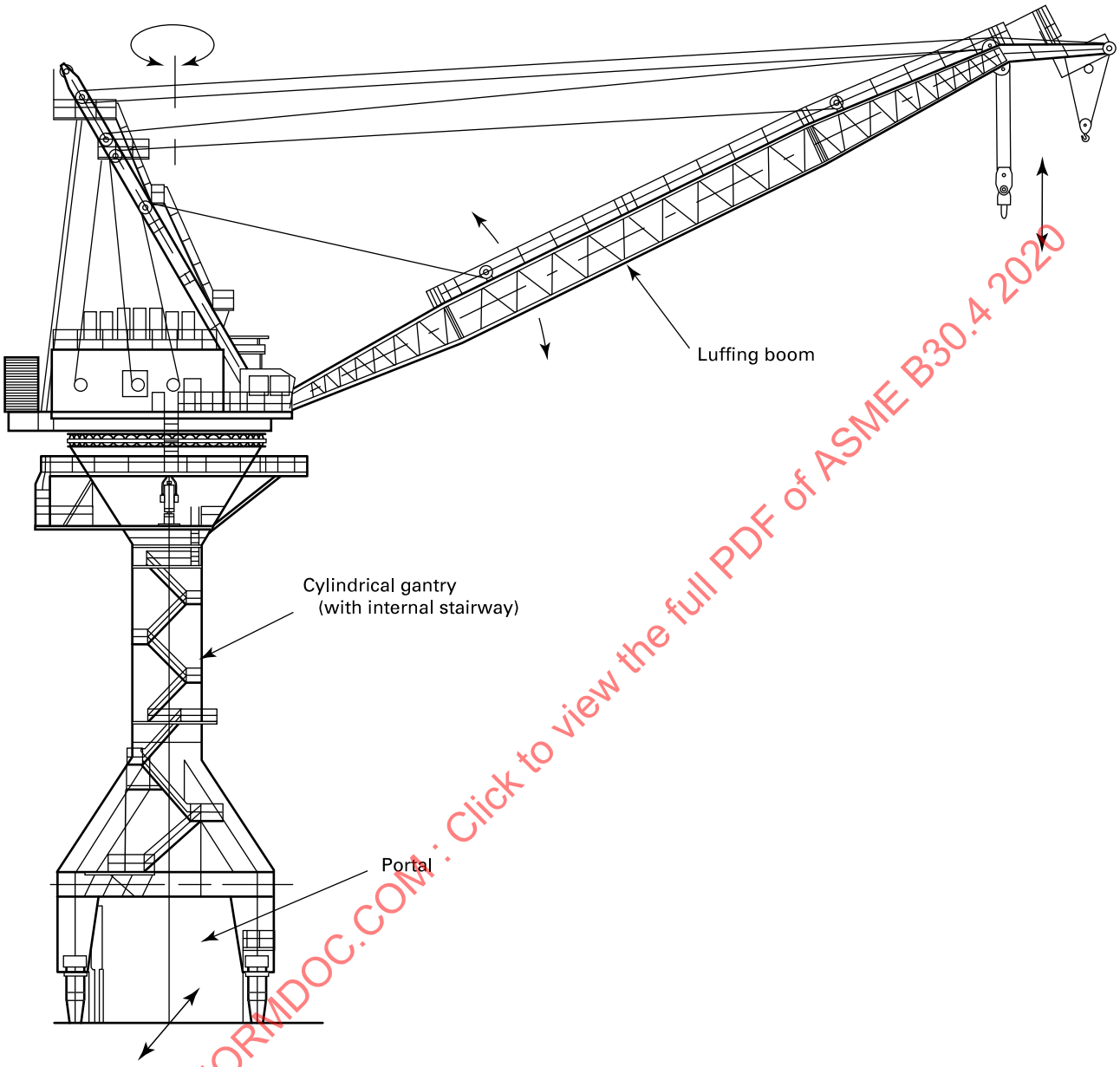


Figure 4-0.2.1-3 Portal Crane With Luffing Boom



(4) translating the terminology accurately

(5) reflecting the level of sophistication of the original document

(d) The finished translation shall be verified for compliance with (c)(1) through (c)(5) by a qualified person having an understanding of the technical content of the subject matter.

(e) The entities responsible for the operation, use, inspection, testing, maintenance, assembly, and disassembly of the covered equipment shall have the technical and safety-related information available in a language that their employees can read and understand. If the information is not available in a language understood by their employees, the entities shall obtain a translation of the original manufacturer's technical and safety related information from the manufacturer or from a translation service provider. The translation(s) shall meet the requirements of (c) and (d).

SECTION 4-0.5: REFERENCES

The following is a list of publications referenced in this Standard:

Aluminum Design Manual–2015
Publisher: The Aluminum Association, 1400 Crystal Drive, Suite 430, Arlington, VA 22202 (www.aluminum.org)

ANSI/AISC 360–16 Specification for Structural Steel Buildings
Publisher: American Institute of Steel Construction, 130 East Randolph, Suite 2000, Chicago, IL 60601 (www.aisc.org)

ANSI/ALI A14.3-2008 (R2018), Safety Requirements for Fixed Ladders
Publisher: American Ladder Institute (ALI), 330 North Wabash Avenue, Chicago, IL 60611 (www.americanladderinstitute.org)

ANSI/ASSE A1264.1-2007, Safety Requirements for Workplace Walking/Working Surfaces and Their Access; Workplace, Floor, Wall and Roof Openings; Stairs and Guardrail/Handrail Systems
Publisher: The American Society of Safety Engineers (ASSE), 520 N. Northwest Highway, Park Ridge, IL 60068 (www.asse.org)

ANSI/AWS D1.1-2015, Structural Welding Code–Steel
ANSI/AWS D14.3-2010, Specification for Welding Earth-Moving and Construction Equipment
Publisher: American Welding Society (AWS), 8669 NW 36 Street, No. 130, Miami, FL 33166 (www.aws.org)

ANSI/NEMA ICS8-2011, Industrial Control and Systems: Crane and Hoist Controllers
Publisher: National Electrical Manufacturers Association (NEMA), 1300 North 17th Street, Suite 900, Arlington, VA 22209 (www.nema.org)

ANSI/NFPA 70-2017, National Electrical Code
Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169 (www.nfpa.org)

ANSI/SAE J2703-2008, Cranes — Access and Egress
ANSI/SAE Z26.1-1996, Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways — Safety Standard
Publisher: SAE International, 400 Commonwealth Drive, Warrendale, PA 15096 (www.sae.org)

ASCE/SEI 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures
Publisher: American Society of Civil Engineers (ASCE), 1801 Alexander Bell Drive, Reston, VA 20191 (www.asce.org)

ASME B30.3-2016, Tower Cranes
ASME B30.10-2014, Hooks
ASME B30.23-2016, Personnel Lifting Systems
ASME B30.30-2019, Ropes
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

EN 13001-3-1-2013, Cranes – General Design – Limit States and Proof Competence of Steel Structure
Publisher: CEN, European Committee for Standardization, Avenue Marnix 17, B-1000, Brussels, Belgium (www.din.de)

FEM 1.001-1998, Rules for the Design of Hoisting Appliances
Publisher: European Materials Handling Federation, BluePoint Brussels, 80 Boulevard Auguste Reyers, B - 1030, Brussels, Belgium (www.fem-eur.com)

ISO 7000-2014, Graphical symbols for use on equipment — Registered symbols
ISO 7296-1991, Cranes — Graphical symbols — Parts 1 – 3
ISO 15614–1-2017, Specification and Qualification of Welding Procedures for Metallic Materials
Publisher: International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland (www.iso.org)

Specification for Structural Joints Using High-Strength Bolts–2014
Research Council on Structural Connections, One East Wacker Drive, Chicago IL 60601 (www.boltcouncil.org)

(20)

Chapter 4-1
Erection, Characteristics, and Construction

SECTION 4-1.1: SITE PREPARATION AND ERECTION

4-1.1.1 Crane Supports

(a) All load-bearing foundations, supports, and rail tracks shall be constructed or installed to support the crane loads and transmit them to the soil or other support medium. In addition to supporting vertical load, foundations and supports, rail supports excepted, should be designed to provide a moment resisting overturning equal to a minimum of 150% of the maximum crane overturning moment.

(b) Rails should be level and straight, unless specifically designed for curves or grades, and properly spaced for the crane trucks in accordance with the manufacturer's specifications. The track and support system should have sufficient rigidity to limit dynamic oscillations and deviations from plumb.

(c) Rails shall be securely attached to the supporting surface in a manner capable of resisting the horizontal and vertical loads specified by the manufacturer. When applicable, provision should be made for thermal expansion and contraction.

(d) Splices in rail tracks (bolted or welded) shall have smooth joints.

(e) When required, a designated portion of the track should be arranged and constructed as an out-of-service parking area complete with means needed for supporting the crane against storm wind effects and anchoring it against unwanted movement along the track; the parking track should be in place before erection commences.

(f) Rails shall be electrically grounded when they carry cranes electrically powered from an outside source.

(g) Both ends of all tracks shall be provided with stops or bumpers adjusted for simultaneous contact with both sides of the travel base unless engineered or administrative controls are utilized with dedicated track walkers/spotters while the crane is traveling.

(h) When more than one crane will be operating on a run of track, particular consideration should be given to the number and disposition of parking areas.

(i) The hazard of earthquake effects appropriate to the site or zone should be considered.

(j) The crane manufacturer or qualified person shall provide maximum resulting loads at the base of the crane, or wheel loads, for use in design of the supports (see para. 4-1.4.1).

4-1.1.2 General Erection Requirements

(a) When cranes are erected, the manufacturer's or a qualified person's written erection instructions and a list of the weights of each component to be erected shall be at the site.

(b) Cranes shall be erected in accordance with the crane manufacturer's or a qualified person's recommendations. Erection shall be performed under the supervision of a qualified person.

(c) Procedures shall be established before erection work commences to implement the erection instructions and adapt them to the particular needs of the site. The need for temporary guying and bracing during erection shall be established.

(d) Before crane components are erected, they shall be visually inspected for damage. Damaged members shall not be erected until repaired in accordance with the manufacturer's or qualified person's instructions or replaced.

(e) Slings and lifting accessories should be selected and arranged to avoid damaging or marring crane members during erection.

(f) Wind velocity at the site at the time of erection should be considered as a limiting factor that could require suspending the erection operation.

(g) Crane pedestals and gantries should be erected plumb to a tolerance that is specified by the manufacturer.

(h) Cranes required to weathervane when out of service shall be installed with clearance for the boom and superstructure to swing through a full 360-deg arc without striking any fixed object or other crane.

SECTION 4-1.2: STRUCTURAL DESIGN AND CONSTRUCTION

(a) Structural members shall be designed in accordance with the ANSI/AISC 360-16, or other appropriate design standards such as the Aluminum Design Manual or FEM 1.001.

(b) Welding shall conform to ANSI/AWS D1.1 or ANSI/AWS D14.3, or ISO 15614-1 when welding is to be performed on load-sustaining members. For materials

not covered by ANSI/AWS D1.1 or ISO 15614-1, the manufacturer or a qualified person shall provide welding procedures.

(c) Structural bolting shall be in accordance with the RCSC Specification for Structural Joints Using High Strength Bolts or EN 13001-3-1.

SECTION 4-1.3: LOAD RATINGS AND STABILITY

4-1.3.1 Load Ratings Where Stability Governs Lifting Performance

(a) For each stipulated operating radius, the load rating is established by taking a percentage of the load that by calculation produces a condition of incipient tipping when the boom is in the least stable direction. Under static conditions, the load ratings shall not exceed 67% of the calculated tipping loads. When wind is considered, if applicable, the combined effects of static and wind loads shall not exceed 77% of the calculated tipping load.

(b) A nonsymmetrical mounting may require a considerably higher loading to produce a tipping condition in a direction other than the least stable direction for which basic load ratings have been established. Therefore, if the crane specification includes ratings for other than the least stable direction, such ratings shall not exceed the applicable tipping percentages.

(c) For a load at any operating radius, stability is affected by the length of boom, jib, or combination of boom and jib and counterweight. The manufacturer shall take these conditions into account when establishing load ratings. Each load rating shall therefore be determined for the least stable permitted configuration governed by the rating.

(d) Wind forces shall be determined using the maximum operating wind speed applied in the direction least favorable to stability.

(e) For cranes designed to travel with load, inertia forces and forces induced by the maximum allowable track variation from level, as specified by the manufacturer, shall be considered in establishing load ratings.

(f) In addition to the above, the following stipulations shall apply to the establishment of load ratings:

(1) Incipient tipping exists when the algebraic sum of the overturning (tipping) moments equals the sum of the stabilizing moments.

(2) The crane is mounted level, except as in (e) above.

(3) Lifting attachments that are a permanent part of the crane in its working condition shall be considered part of the load for stability calculations whether or not such attachments are part of the published load ratings.

4-1.3.2 Load Ratings Where Factors Other Than Stability Govern Lifting Performance

(a) For each stipulated operating radius, the manufacturer shall ascertain that the crane is capable of supporting rated loads without stresses exceeding predetermined acceptable values. Dynamic effects associated with hoisting and swinging shall be considered, and wind, if applicable, shall be taken in the least favorable direction and at the maximum in-service velocity, as specified by the manufacturer.

(b) Under any condition of loading, stresses may be affected by boom or jib length, counterweight, swing speed changes and other dynamic effects, hoist line reeving, and hoisting speed range. Therefore, the structural, mechanical, hydraulic, electrical, or pneumatic competence shall be evaluated for the least favorable configuration and operating conditions covered by given load ratings.

(c) A nonsymmetrical mounting may require a considerably higher loading to produce a tipping condition in a direction other than the least stable direction for which basic load ratings have been established. Therefore, if the crane specification includes ratings for other than the least stable direction, such ratings may be governed by structural, mechanical, hydraulic, electrical, or pneumatic competence, in which case, they shall be verified.

(d) For cranes designed to travel with load, inertial forces, and forces induced by the maximum allowable track variation from level, as specified by the manufacturer, shall be considered in establishing structural, mechanical, hydraulic, electrical, or pneumatic competence.

4-1.3.3 Load Rating Chart

A durable rating chart with legible letters and figures shall be provided with each crane and attached in a location visible to the operator while seated at the controls and at remote-control stations. The content of these charts shall include, but not be limited to, the following:

(a) the crane manufacturer's name, model and serial number of the crane, and a full and complete range of manufacturer's approved crane load ratings at all stated operating radii for each permitted boom length, jib length, and combination boom and jib (when applicable).

(b) cautionary or warning notes relative to limitations on equipment and operation procedures.

(c) indication of the least stable direction and, in the case of nonsymmetrical mountings with ratings given for other than the least stable direction, the directional limitations applicable to each set of ratings.

(d) recommended parts of hoist reeving, size, and type of rope for various crane loads.

(e) whether the hoist-holding mechanism is automatically controlled, manually controlled, and if free fall is available.

(f) advice that slings and lifting attachments are part of the load. If the manufacturer elects to include the lower load block as part of the load, the rating chart shall so state.

4-1.3.4 Backward Stability

(a) The backward stability of a crane is its ability to resist overturning in the direction opposite the boom point while in the unloaded condition. The minimum acceptable backward stability condition, as determined by calculation, is such that the horizontal distance between the center of gravity of the crane and the axis of rotation shall not exceed 60% of the radial distance from the axis of rotation to the backward tipping fulcrum in the least stable direction.

(b) The general requirements applicable for determination of the backward stability condition are as follows:

(1) crane to be equipped for normal operation with shortest boom permitted (as applicable)

(2) boom to be positioned at minimum achievable radius

(3) crane to be unloaded (no hook, block, or attachment weight)

(4) crane standing on level track or foundation

(5) maximum operating wind speed acting in a direction to reduce stability

4-1.3.5 Out-of-Service Stability

The manufacturer shall ascertain by calculation that in each recommended configuration, traveling cranes shall have a margin of stability against incipient tipping when exposed to wind forces appropriate to the installation site as given in ASCE/SEI 7 when the crane is out of service. Overturning moments shall not exceed 80% of the stabilizing moments, without consideration of any anchorage devices or rail clamps. For weathervaning cranes, the boom shall be taken in the attitude dictated by its wind area balance; nonweathervaning cranes shall be taken in their least favorable attitude. For fixed cranes, see para. 4-1.1.1(a).

4-1.3.6 Altered (Modified) Cranes

Whenever cranes are altered, unless the work is done by the original manufacturer, the owner of the crane shall maintain records of the work performed. The records shall include calculations and drawings prepared and signed by a qualified person that delineate the alterations and that verify that the entire crane and/or the affected components satisfy the applicable portions of this Volume. The calculations shall include a recitation of the engineering criteria governing the design. After alterations, tests shall be performed in accordance with paras. 4-2.3.1 and 4-2.3.2.

SECTION 4-1.4: DOCUMENTATION

Each crane shall be provided with informational literature, including, but not limited to, the following.

4-1.4.1 Site Preparation and Crane Support Design Data

For use of the crane support designers, data such as what is listed below should be provided.

(a) vertical and horizontal forces and torsional and overturning moments applicable to the crane configuration and location of the particular installation; the data should indicate whether governing forces are due to in-service or out-of-service winds and the applicable wind velocities and direction(s); for traveling cranes, the data can be stated in terms of wheel loads

(b) maximum wind velocity for which traveling cranes possess adequate resistance to sliding, as determined by calculation, in the configuration for the particular installation and precautions that shall be taken to secure cranes at higher wind velocities

(c) rail track installation requirements and tolerances for traveling cranes

(d) anchorage arrangements for cranes to be installed on fixed bases

(e) crane dimensional data

4-1.4.2 Erection Instructions

For the use of crane erection personnel, data such as what is listed below should be provided.

(a) weight and dimensions for components and subassemblies

(b) recommended lifting attachment points, when applicable

(c) center of gravity location for nonuniform components and subassemblies

(d) the method and recommended sequence of assembly, when applicable; warnings should be given alerting erection personnel when member strength or stability requires particular methods or sequencing

(e) details, including diagrams where necessary, of critical component connections describing and identifying bolts, pins, and other parts needed, the method of assembling the joint, the torque or tension to be applied to prestressed bolts, the point in time in the erection process for applying torque or tension, and the means for retaining components such as pins

4-1.4.3 Operating Instructions, Limitations, and Precautions

Information, data, and recommended operating practices shall be provided by the crane manufacturer or a qualified person for use by the crane's operator and supervisory personnel.

4-1.4.4 Maintenance Requirements and Recommendations

This information should include identification of those members or locations it is advisable to periodically observe or test for the purpose of detecting the onset of metal fatigue, the loosening of prestressed bolts, or wear affecting the ability of the crane to support rated loads.

4-1.4.5 Repair Recommendations

If repairs are needed, advice on welding procedures should be provided, if applicable, and the type of metal used for load-sustaining members shall be identified [see para. 4-1.2(b)].

4-1.4.6 Design Characteristics Affecting Safety

In addition to the information called for in para. 4-1.4.3, data such as what is listed below should be provided.

(a) location, proper settings and adjustments, and functioning of limiting and indicating devices

(b) location and required settings of hydraulic or pneumatic pressure relief valves and locations of points where circuit pressure can be checked (see para. 4-1.18.8)

(c) limitations on service life of load-bearing members or mechanisms, if applicable, including manufacturer's recommendations for frequency of inspection as a function of severity of service

SECTION 4-1.5: HOISTING EQUIPMENT

4-1.5.1 General Requirements

(a) When using recommended reeving, the load hoist shall be capable of hoisting and lowering rated loads with operational characteristics required for crane service.

(b) Unless coupled directly, or through a hydrostatic drive, the load hoist mechanism shall be provided with a clutching or power-disengaging device.

(c) Electric-motor-operated cranes that are capable of overspeeding the power plant on overhauling loads shall be provided with overspeed protection.

(d) Hooks shall be in accordance with ASME B30.10. Hooks shall be provided with latches unless the application makes the use of the latch impractical. When provided, the latch shall bridge the throat of the hook for the purpose of retaining slings, chains, etc. under slack conditions.

4-1.5.2 Hoist Drums

Hoist drums shall be in accordance with ASME B30.30.

4-1.5.3 Hoist Brakes

(a) Positive means, such as an automatic spring applied brake, controllable from the operator's station, shall be provided to hold the drum from rotating in the lowering direction and be capable of holding not less than 125% of the full load hoisting torque indefinitely without further attention from the operator.

(b) A power control braking means, such as regenerative, dynamic counter torque, or eddy current braking or a mechanically, pneumatically, or hydraulically controlled braking means, shall be provided and capable of maintaining controlled lowering speed of rated loads.

(c) When power-operated brakes having no continuous mechanical linkage between the actuating and the braking means are used for controlling loads, an automatic means shall be provided to stop and hold the load in the event of loss of brake-actuating power.

(d) When directly coupled electric or hydraulic motor(s) are used for controlling loads, an automatic means shall be provided to stop and hold the load in the event of loss of power or pressure.

(e) When automatic braking means are provided, a means, such as a manual release, should be furnished to permit controlled lowering of the load in the event of loss of power or pressure.

(f) When provided, foot brake pedals shall be constructed so that the operator's feet will not readily slip off, and a means shall be provided for holding the brakes in the applied position without further attention by the operator.

4-1.5.4 Hoist Sheaves

Hoist sheaves shall be in accordance with ASME B30.30.

(a) Sheave bearings shall be provided with means for lubrication, except for those that are permanently lubricated.

(b) The sheaves in the lower load block shall be equipped with close-fitting guards that will guard against ropes becoming fouled in the sheaves when the block is lying on the ground with ropes loose.

4-1.5.5 Hoist Ropes

Hoist ropes shall be in accordance with ASME B30.30.

SECTION 4-1.6: LUFFING EQUIPMENT

4-1.6.1 General Requirements

Luffing of the boom may be by means of a rope drum or hydraulic cylinder(s).

(a) Luffing equipment that utilizes a rope drum shall meet all of the requirements of Section 4-1.5 in addition to the requirements outlined below.

(b) The drum(s) shall be provided with an auxiliary ratchet and pawl, or other positive locking device in addition to the brake required by para. 4-1.5.3(a) to hold the drum(s) indefinitely from rotating in the lowering direction.

(c) The drum(s) shall have sufficient rope capacity to operate the boom at all designed positions when using the manufacturer's recommended reeving and rope size.

(d) An integrally mounted holding device (such as a load hold check valve) shall be provided with boom support hydraulic cylinder(s) to prevent uncontrolled lowering of the boom in the event of a hydraulic system failure (e.g., supply hose rupture).

SECTION 4-1.7: SWING (SLEWING) MECHANISM

4-1.7.1 General Requirements

(a) The swing mechanism shall be capable of smooth starts and stops and of providing varying degrees of acceleration and deceleration.

(b) Cranes required to weathervane when out of service shall be equipped with means controllable from the operator's station that render the rotating upper structure free to rotate.

4-1.7.2 Swing Brakes and Locking Device

(a) A braking means with holding power in both directions shall be provided to prevent movement of the rotating upper structure during operation and shall be capable of being set in the holding position and remaining so without further action on the part of the operator.

(b) A device for locking the rotating upper structure should be provided. When provided, it shall be arranged for avoidance of inadvertent engagement or disengagement. If a locking device is provided, a visual or audible indicator shall be furnished to warn the operator of device engagement.

SECTION 4-1.8: TRAVEL EQUIPMENT

4-1.8.1 General Requirements

(a) Means shall be provided to prevent cranes from running into the bumpers or stops while under power. Means may include engineered or administrative controls [see para. 4-1.1.1(g)].

(b) Drives shall be capable of smooth starts and stops and of providing varying degrees of acceleration and deceleration. Provision should be made in the travel drive(s) to provide power characteristics that permit the crane to travel to a parking area, with or against the wind, if a wind alarm sounds.

(c) A warning signal shall automatically activate whenever the crane travels in order to warn persons in the vicinity.

(d) Means shall be provided to prevent crane travel from the effects of wind per ASCE SEI 7 when the crane is out of service.

4-1.8.2 Travel Trucks

(a) Crane trucks shall be fitted with sweeps extending to the top of the rail and placed in front of the leading wheels in either direction.

(b) Truck wheels shall be guarded.

(c) Means shall be provided to limit the drop of truck frames in case of wheel or axle breakage to a distance that will not cause the crane to overturn.

4-1.8.3 Travel Brakes

(a) Braking means shall be provided. A brake or other means shall be provided to hold the crane in position when not traveling and to lock the wheels against rotation to resist the effects of in-service wind and operational forces.

(b) Brakes shall automatically engage on loss of power or actuating pressure to the brake and when power is not applied to the travel drive.

SECTION 4-1.9: BRAKES, GENERAL REQUIREMENTS

(a) Brakes shall be arranged to permit adjustment where necessary to compensate for lining wear and maintain force in springs, where used.

(b) Brakes shall have heat dissipation capability consistent with service needs.

(c) Brakes shall be protected from the weather and from lubricants, hydraulic fluid, or other such liquids, and dirt.

(d) Where springs comprise part of the braking mechanism, they shall be subjected to compression only.

SECTION 4-1.10: LIFTING MAGNETS AND BELOW-THE-HOOK LIFTING DEVICES

Lifting magnets and other below-the-hook lifting devices shall comply with ASME B30.20.

SECTION 4-1.11: OPERATIONAL AIDS

(a) Indicating devices shall be provided to

(1) display the weight of the load on the hook

(2) display the luffing boom angle and/or operating radius

(3) indicate the rotation of boom and hoist drums

(b) Motion-limiting devices shall be provided to

(1) limit load hoist upward motion to prevent two-blocking

(2) limit load hoist downward motion to maintain the minimum rope on the drum per ASME B30.30

(3) limit boom hoist upward operation to prevent boom upper limit overtravel

(4) limit boom hoist downward motion to maintain the minimum rope on the drum per ASME B30.30

(5) limit the weight of the load lifted

(6) limit operating radius in accordance with crane's rated capacity, i.e., load moment

(7) limit pressures in hydraulic or pneumatic circuits (see para. 4-1.18.8)

(c) Motion-limiting devices such as in (b) above should be provided with means to permit the operator to override them under controlled conditions.

(d) Motion-limiting devices that do not provide means to permit the operator to override them under any condition

(1) Boom stops and bumpers shall be provided for cranes or boom elevation cylinders that limit the angle of the boom.

(2) Jibs shall be restrained from backward overturning.

SECTION 4-1.12: BOOM AND JIB SUPPORT ROPES

Standing ropes supporting booms or jibs shall be in accordance with ASME B30.30.

SECTION 4-1.13: REEVING ACCESSORIES

End terminations shall be in accordance with ASME B30.30.

SECTION 4-1.14: COUNTERWEIGHTS

(a) Crane superstructures shall be arranged to receive counterweights, made in accordance with the crane manufacturer's specifications, and to hold them in position with means provided to guard against shifting or dislodgement during crane operation.

(b) Movable counterweights, if provided, shall either move automatically or shall be equipped with a position indicator with readout at the operator's station(s). When counterweight position is controlled by ropes, means shall be provided to prevent uncontrolled movement in the event of rope breakage.

SECTION 4-1.15: CONTROLS

4-1.15.1 Crane Function Controls

(a) At the operator's station, controls used during the crane operating cycle shall be located within reach of the operator. Controls shall have legible markings or symbols to indicate their function and, where appropriate, the direction of the motion imparted.

(b) Controls for hoisting, luffing, swing, and travel shall cut off power to the motion drive when engagement pressure is released, unless intentionally restrained for functional purposes.

(c) Remote-operated cranes shall function so that if the control signal for any crane motion becomes ineffective, that crane motion shall stop.

(d) Electric-motor-operated cranes shall be provided with a device that will disconnect all motors from the line on failure of power and will not permit any motor to be restarted until the control is brought to the OFF position or a reset switch or button is operated.

(e) Electric-motor-operated cranes shall be provided with means for the operator to interrupt the main power circuit from the operating position.

(f) Remote-control stations shall include provisions for emergency stop in the event of a device malfunction.

(g) Provisions shall be made to prevent simultaneous activation of controls when more than one operator's station (remote control) is provided.

(h) Where cranes are powered by hydraulic motors, means shall be provided to automatically stop the power plant on loss of hydraulic pressure.

4-1.15.2 Power Plant Controls

(a) Cranes powered by internal combustion engines with a direct mechanical or hydrodynamic drive to any crane function (such as a torque converter or fluid coupling) shall be provided with a clutch or other means for disengaging power. The control shall be within reach from the operator's station.

(b) For cranes powered by internal combustion engines with a direct mechanical or hydrodynamic drive to any crane function, controls for operating the power plant shall be within reach of the operator and shall include, as applicable

(1) means to start and stop, with provisions to lock in the stop position

(2) means to control speed of internal combustion engines

(3) means to stop internal combustion engines under emergency conditions

(4) means for shifting selective transmissions

(c) For cranes powered by internal combustion engines that do not directly drive a crane function (e.g., the engine drives a generator or pump drive), a means shall be provided within reach of the operator to stop the engine. Other controls shall be provided at the engine itself or within reach of the operator.

4-1.15.3 Control Forces and Movements

(a) Forces to operate shall not be greater than 35 lb (156 N) on hand levers and not greater than 50 lb (225 N) nor less than 8 lb (35 N) on foot pedals.

(b) Travel distance on hand levers shall not be greater than 14 in. (360 mm) from the neutral position on two-way levers and shall not be greater than 24 in. (610 mm) on one-way levers. Travel distance on foot pedals shall not be greater than 10 in. (260 mm).

SECTION 4-1.16: ELECTRICAL EQUIPMENT

4-1.16.1 General Requirements

(a) Each electrically powered crane shall have a main disconnect switch mounted at or near the initial base of the crane. This switch shall have provisions for locking in the OFF position.

(b) Electrical equipment shall be so located or guarded that live parts are not exposed to inadvertent contact under normal operating conditions.

(c) Electrical equipment shall be protected from dirt, grease, oil, and moisture. Fixtures, wiring, and connections exposed to the weather shall be of weather-resistant type.

(d) Wiring, motors, controls, switches, and other electrical equipment shall meet the applicable requirements of ANSI/NFPA 70. Hoist, swing, trolley, and travel controllers shall conform to ANSI/NEMA ICS8.

(e) Provisions shall be made to guard against reversing of each motor due to reversed phase connections.

(f) Electrical circuits between the fixed and rotating portions of the crane shall pass through connections that permit continuous rotation in either direction unless other means are provided to prevent damage to the electrical conductors.

(g) Individual overload protection shall be provided for each motor.

(h) All parts of the crane shall be electrically grounded to protect against lightning strikes. Grounding includes providing bonding across hinges, bushings, slewing/rotate bearing, and pin locations.

4-1.16.2 Resistors

(a) Resistors shall be of corrosion-resistant material. If guarded or enclosed, provision shall be made for ventilation to forestall overheating. Resistors shall be installed with consideration for avoiding the accumulation of combustible matter.

(b) Resistor units shall be supported to minimize vibration.

SECTION 4-1.17: OPERATOR'S CAB

4-1.17.1 Construction

(a) An operator's cab shall be provided. It shall be constructed of materials that do not support combustion and shall have means for ventilation.

(b) An adjustable operator's seat with backrest shall be provided. The seat should be arranged and constructed to minimize operator fatigue.

(c) Where necessary, areas of the cab roof shall be capable of supporting, without permanent distortion, the weight of a 200-lb (90-kg) person.

(d) Cab doors, whether of the swinging or sliding type, shall be restrained from inadvertently opening or closing during travel or operation of the crane.

(e) Cab glazing shall be safety glazing material as defined in ANSI/SAE Z26.1. Windows shall be provided in the front and on both sides. Forward visibility should include a vertical range to cover the hook block and pickup points on the ground. Windows provided with openable portions shall be arranged to prevent inadvertent closure during operation. A windshield wiper should be provided on the front window.

(f) Means shall be provided for cleaning windows from inside the cab unless exterior platforms are provided.

(g) Cab lighting, either natural or artificial, shall provide a level of illumination that enables the operator to observe the operating controls.

4-1.17.2 Access

(a) Stairs or access ladders to the cab and machinery platforms shall be provided. Ladders shall conform to ANSI/ALI A14.3 or to ANSI/SAE J2703, as applicable.

(b) Outside platforms shall have walking surfaces of a skid-resistant type, shall be provided with standard handrails, and shall conform to ANSI/ASSE A1264.1.

(c) When it is necessary to climb more than 120 ft (37 m) of vertical ladder in the crane to reach the cab or machinery deck, consideration should be given to providing a powered means of access in addition to ladders.

(d) When access to the operator's cab requires a climb of 100 ft (30 m) or more, sanitary facilities should be provided.

4-1.17.3 Toolbox

A metal receptacle should be provided for the storage of small hand tools and lubricating equipment. It should be secured in the cab or on the machinery platform.

4-1.17.4 Fire Extinguisher

A portable fire extinguisher, with a basic minimum extinguisher rating of 10 BC, shall be installed in the cab or at the machinery housing.

4-1.17.5 Signal Device

An audible signal device should be provided with the control located within reach of the operator.

SECTION 4-1.18: GENERAL REQUIREMENTS

4-1.18.1 Footwalks and Ladders

(a) To provide access to the boom and its attachments such as connections, limiting devices, sheaves, rope, and fittings, a footwalk with skid-resistant surface and with handrails or holding lines should be provided. Other means for access should be provided on booms too small for footwalks. Footwalks, when provided, should be 18 in. (450 mm) or more in width.

(b) When A-frame gantries include items requiring inspection or routine maintenance, ladders, handgrips, and, if necessary, platforms with skid-resistant surfaces and with railings shall be provided.

(c) When it is necessary to periodically check or adjust the tension of slewing ring-bearing attachment bolts, access shall be provided, including work platforms with railings, where needed.

(d) Footwalks, platforms, ladders, and railings shall be capable of supporting the weight of a 200-lb (90-kg) person without permanent distortion. Holding lines should be installed so as not to deflect laterally more than 6 in. (150 mm) when a 200-lb (900-N) lateral force is applied.

4-1.18.2 Guards for Moving Parts

(a) Exposed moving parts, such as gears, projecting set screws and keys, drive chains and sprockets, and reciprocating or rotating parts, which might constitute a hazard under normal operating conditions, shall be guarded.

(b) Each guard shall be capable of supporting the weight of a 200-lb (90-kg) person without permanent distortion, unless the guard is located where it is not reasonable to expect a person to step during operation or maintenance.

4-1.18.3 Lubrication Points

Lubrication points should be accessible without the necessity of removing guards or other parts with tools unless equipped for centralized lubrication.

4-1.18.4 Exhaust Gases

Engine exhaust gases shall be piped and discharged away from the operator. Exhaust pipes shall be guarded or insulated to prevent contact by personnel when performing normal duties.

4-1.18.5 Clutch Protection and Adjustment

(a) Dry friction clutches shall be protected against rain and other liquids, such as oil and lubricants.

(b) Clutches shall be arranged to permit adjustments where necessary to compensate for wear.

4-1.18.6 Wind Velocity Device

A wind velocity-indicating device shall be provided and mounted at or near the top of the crane. The velocity readout should be at the operator's station in the cab, and a visible or audible alarm should be triggered in the cab and at remote-control stations when a preset wind velocity has been exceeded.

4-1.18.7 Fuel Filler Pipes

Fuel tank filler pipes shall be located or protected so as not to allow spillage or overflow to run onto the engine, exhaust, or electrical equipment of the machine being fueled.

4-1.18.8 Hydraulic and Pneumatic Pressures

(a) Relief valves shall be provided in hydraulic and pneumatic circuits carrying fluid pressurized by a power driven pump in order to limit the maximum pressure in the circuit. The magnitude of the relief settings shall permit operation under rated load conditions, and means shall be provided to prevent unauthorized adjustment or tampering.

(b) Means shall be provided for checking manufacturer's specified pressure settings in each circuit.

4-1.18.9 Hydraulic and Pneumatic Line Protection

Exposed lines subject to damage shall be protected insofar as it is practical.

Chapter 4-2
Inspection, Testing, and Maintenance

SECTION 4-2.1: INSPECTION

(20) 4-2.1.1 General

All inspections shall be performed by designated persons. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard and, if so, what additional steps need to be taken to address the hazard. For rope inspection, see Section 4-2.5.

(20) 4-2.1.2 Inspection Classification

(a) Initial Inspection. Prior to initial use, all new, reinstalled, altered, or extensively repaired cranes shall be inspected to verify compliance with the applicable provisions of this Volume.

(b) Regular Inspection. Inspection procedures for cranes in regular service are divided into two general classifications based on the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the crane and the degree of the exposure to wear, deterioration, or malfunction. The two general classifications are designated as frequent and periodic with respective intervals between inspection as defined below.

(1) Frequent Inspection. Visual examination with records not required.

(-a) light service — monthly
(-b) normal service — weekly to monthly
(-c) heavy service — daily to weekly

(2) Periodic Inspection. Visual inspection at intervals listed below or as specifically recommended by the manufacturer. Records shall be kept of apparent external conditions to provide a basis for continuing evaluation.

(-a) light service — annually
(-b) normal service — semiannually to annually
(-c) heavy service — quarterly

(20) 4-2.1.3 Frequent Inspection

Items such as the following shall be inspected, including observation during operation for deficiencies that might appear between regular inspections:

(a) all control mechanisms for maladjustment interfering with proper operation — daily, when in use

(b) all control mechanisms for legible markings, excessive wear of components, and contamination by lubricants or other foreign matter

(c) all crane function-operating mechanisms for maladjustment interfering with proper operation and excessive wear of components

(d) motion-limiting devices for proper operation with the crane unloaded; each motion should be inched into its limiting device or run in at slow speed with care exercised

(e) operational aids for malfunction or inaccuracies — daily, when in use

(f) all hydraulic and pneumatic hoses, particularly those that flex in normal operation

(g) electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation

(h) hooks and latches for deformation, chemical damage, cracks, and wear (refer to ASME B30.10)

(i) hydraulic system for proper fluid level — daily when in use

(j) structural members for damage or deformation

(k) any additional inspections specified by the manufacturer or a qualified person

4-2.1.4 Periodic Inspection (20)

(a) Complete inspections of the crane shall be performed.

(b) These inspections shall include the requirements of para. 4-2.1.3 and items such as the following:

(1) deformed, cracked, or corroded members and welds in the crane structure and boom

(2) loose bolts or rivets

(3) cracked or worn sheaves and drums

(4) worn, cracked, or distorted parts, such as pins, bearing, shafts, gears, rollers, locking and clamping devices, sprockets, and drive chains or belts

(5) excessive wear on brake and clutch system parts, linings, pawls, and ratchets

(6) load, wind, and other indicators for inaccuracies outside the tolerances recommended by the manufacturer

(7) power plants for performance and compliance with safety requirements

(8) electrical apparatus for signs of deterioration in controllers, master switches, contacts, limiting devices, and controls

(9) crane hooks inspected per ASME B30.10

(10) load blocks for cracks, deformation, and excessive wear

(11) travel mechanisms for malfunction, excessive wear, or damage

(12) hydraulic and pneumatic pumps, motors, valves, hoses, fittings, cylinders, and tubing for excessive wear, damage, or degradation

(c) Any deficiencies, such as those listed above, shall be examined and a determination made as to whether disassembly is required for additional inspection.

(d) Signs of possible damage may indicate the need to remove paint or use other than visual nondestructive examination techniques to permit determination as to whether a hazard exists.

(e) High-strength bolts used in connections and at the slewing ring bearing shall be checked for proper tension (torque) at intervals recommended by the crane or bearing manufacturer or at intervals noted in para. 4-2.1.2(b)(2). Bolts that loosen should be checked for permanent deformation or other damage. Visible cracks, difficulty in threading or unthreading a nut by hand, or observable necking are reason for replacement.

(f) Sheaves used in the hoisting system shall be checked for cracks in the flanges and spokes. When external evidence of defects exists, it may be necessary to remove the sheave from its mounting for this purpose.

(g) Any additional inspections specified by the manufacturer or a qualified person.

(20) 4-2.1.5 Cranes Not in Regular Use

(a) A crane, other than a standby crane, that has been idle for a period of 1 month or more, but less than 12 months, shall be inspected in accordance with para. 4-2.1.3 before being placed in service.

(b) A crane that has been idle for more than 12 months shall be inspected in accordance with para. 4-2.1.4 before being placed in service.

(c) Standby cranes, before being used, shall be inspected in accordance with the requirements of (a) or (b) above, depending on the interval since they were last used. When such cranes are exposed to adverse environments, they should be inspected more frequently.

SECTION 4-2.2: OPERATIONAL AIDS

(a) Prior to daily operation, operational aids shall be checked in accordance with the device/crane manufacturer's recommended procedures to determine if they are functioning properly.

(b) Operational aids shall be inspected and tested in accordance with the device/crane manufacturer's recommended procedures as part of the periodic inspection of para. 4-2.1.4.

(c) When operational aids are inoperative or malfunctioning, the crane and/or device manufacturer's recommendations for continued operation or shutdown of the crane shall be followed until the aids are restored to proper operation. Without such recommendations and any prohibitions for the manufacturer against further operation, the requirements of para. 4-3.2.1(b) shall apply.

SECTION 4-2.3: TESTING

4-2.3.1 Operational Tests (20)

(a) Before placing a new or altered crane in service, all functional motions, locking devices, and brakes shall be tested for operation without load under the direction of a qualified person. Testing of repaired cranes may be limited to the function(s) affected by the repair.

(b) Functional motion tests shall include

(1) load hoisting and lowering

(2) boom hoisting and lowering

(3) rotate motion

(4) brakes and clutches

(5) limit, locking and safety devices

(c) The activation setting of hoist limit devices should be determined by tests comprising a series of runs each at increasing hook speed up to the maximum speed. The actuating mechanism of the limit device shall be located so that it will activate the device, under all conditions, in sufficient time to prevent contact of the lower load block with the upper load block or boom point sheaves.

4-2.3.2 Rated Load Test (20)

Prior to initial use, or after being altered, cranes shall be load tested under the direction of a qualified person. Repaired cranes shall be tested as determined by a qualified person. Testing may be limited to the function(s) affected by the repair. Test loads shall not be less than 100% or more than 110% of rated load, unless otherwise recommended by the manufacturer or a qualified person. Test radii and boom azimuths shall be chosen so as to place maximum loading on the relevant crane parts. If the complete crane rail system was previously tested, the loaded crane shall be traveled 100 ft or 50% of the crane rail length, whichever is less, in both directions with the boom at rated radius perpendicular to the rails while traveling in one direction and then rotated 180 deg to be perpendicular to the rails on the opposite side when traveling in the other direction. Pedestal cranes shall be tested with the superstructure rotated slowly to those positions that cause maximum loading of the pedestal and then held for at least 10 min.

(20) **4-2.3.3 Crane Rail Test**

New crane rail systems shall be tested under the direction of a qualified person by slowly traveling the loaded crane the length of the runway with the crane oriented so as to cause maximum wheel loadings on one rail, then returning with the crane oriented to similarly load the other rail, if possible. If not designed to travel with a load, the crane shall be tested as a pedestal crane (para. 4-2.3.2) in each operating location. Accelerations and decelerations shall be maintained below ordinary operational levels.

(20) **4-2.3.4 Test Records**

Signed and dated test records shall be made and kept available for all tests of new, repaired, or altered cranes required under paras. 4-2.3.1, 4-2.3.2, and 4-2.3.3. At a minimum, the records should describe the test(s) performed, the loads, radii, and azimuths of the tests as applicable, the rationale for testing conditions and procedures adopted, and the name(s) of the qualified person(s) making the determinations and directing the tests.

SECTION 4-2.4: MAINTENANCE

4-2.4.1 Preventive Maintenance

(a) The manufacturer shall furnish operation and maintenance information (paras. 4-1.4.3 through 4-1.4.6). A preventive maintenance program shall be established and should be based on the recommendations of the crane manufacturer or a qualified person. Dated records should be kept available.

(b) Replacement parts shall be at least equal to the original manufacturer's specifications.

(20) **4-2.4.2 Maintenance Procedure**

(a) Before major adjustments or repairs are started, the following precautions shall be taken:

(1) A traveling-type crane to be repaired should be moved to a location where it will cause the least interference with other cranes and operations in the area.

(2) All controllers shall be at the OFF position.

(3) The main or emergency switch shall be open and locked in the OPEN position, except for test purposes.

(4) Warning or OUT OF ORDER signs shall be placed by appointed personnel.

(5) Where other cranes are in operation on the same runway, rail stops or other suitable means shall be provided to prevent interference with the idle crane.

(6) Where temporary protective rail stops are not available, or practical, a signalperson shall be placed at a visual vantage point for observing the approach of an active crane and warning its operator.

(7) Relieve hydraulic oil pressure from all hydraulic circuits before loosening or removing hydraulic components.

(b) After adjustments or repairs have been made, the crane shall not be returned to service until all guards have been reinstalled, limiting and protective devices reactivated, trapped air removed from hydraulic systems, and maintenance equipment removed. Warning or OUT OF ORDER signs shall be removed by appointed personnel only.

4-2.4.3 Adjustments and Repairs

(a) Any hazardous condition disclosed by the inspection requirements of Section 4-2.1 shall be corrected before operation of the crane is resumed. Adjustments and repairs shall be performed only by designated personnel.

(b) Adjustments shall be maintained to ensure correct functioning of components. The following are examples:

(1) functional operating mechanisms
(2) limiting devices
(3) control systems
(4) braking systems
(5) power plants

(c) Repairs or replacements shall be provided as needed for operation. The following are examples:

(1) crane hooks showing defects described in para. 4-2.1.3(h) shall be taken out of service; repairs by welding or reshaping are not recommended.

(2) critical parts that are cracked, broken, bent, or excessively worn or corroded.

(3) pitted or burned electrical contacts should be corrected only by replacement and in sets. Controller parts should be lubricated as recommended by the manufacturer or a qualified person.

(d) Remote-control stations shall be kept clean with function identification labels legible.

4-2.4.4 Welded Construction (20)

Welding procedures and welding operator qualifications for use in repair or alteration of load-sustaining members shall be in accordance with para. 4-1.2(b).

4-2.4.5 Lubrication (20)

(a) All moving parts of the crane, for which lubrication is specified, should be regularly lubricated. Lubricating systems should be checked for delivery of lubricant. Care should be taken to follow manufacturer's recommendations as to points of lubrication, maintenance of lubricant levels, and types of lubricant to be used.

(b) Machinery should be stationary while lubricants are being applied and protection provided as called for in paras. 4-2.4.2(a)(1) through 4-2.4.2(a)(6), unless equipped for automatic lubrication.

SECTION 4-2.5: ROPE INSPECTION, REPLACEMENT, AND MAINTENANCE

4-2.5.1 General

Rope inspection, replacement, and maintenance shall be in accordance with ASME B30.30.

Chapter 4-3
Operation

SECTION 4-3.1: QUALIFICATIONS AND RESPONSIBILITIES

4-3.1.1 Operators

(a) Cranes shall be operated only by the following qualified personnel:

(1) designated persons.

(2) trainees under the supervision of a designated person. The number of trainees permitted to be supervised by a single designated person, the physical location of the designated person while supervising, and the type of communication required between the designated person and trainee shall be determined by a qualified person.

(3) maintenance and test personnel, when it is necessary in the performance of their duties.

(4) inspectors (crane).

(b) No one, other than personnel specified in (a) above, shall enter a crane cab with the exception of persons such as oilers, supervisors, and those specific persons authorized by supervisors whose duties require them to do so and then only in the performance of their duties and with the knowledge of the operator.

(20) ### 4-3.1.2 Qualifications for Operators

(a) Operators shall pass a practical operating examination. Examination may be limited to the specific type of crane (portal, pedestal) that will be operated.

(b) Operators and operator trainees shall meet the following physical qualifications unless it can be shown that failure to meet the qualifications will not affect the operation of the crane. In such cases, specialized clinical and/or medical judgments and tests may be required.

(1) Have vision of at least 20/30 Snellen in one eye and 20/50 in the other, with or without corrective lenses.

(2) Be able to distinguish colors, regardless of position, if color differentiation is required for operation.

(3) Hearing, with or without hearing aid, shall be adequate to meet operational demands.

(4) Have sufficient strength, endurance, agility, coordination, and speed of reaction to meet the demands of equipment operation.

(5) No evidence of physical defects, or emotional instability that could pose a hazard to the operator or others, or, which in the opinion of the examiner could interfere with the operator's performance. Such evidence may be sufficient reason for disqualification. In such cases, specialized clinical or medical judgments and tests may be required.

(6) No evidence of being subject to seizures or loss of physical control. Such evidence shall be sufficient reason for disqualification. Specialized medical tests may be required to determine these conditions.

(7) Operators and operator trainees should have normal depth perception, field of vision, reaction time, manual dexterity, coordination, and no tendencies to dizziness or similar undesirable characteristics.

(8) A negative result on a substance abuse test. The level of testing will be determined by the current standard practice for the industry where the crane is employed, and the test results shall be confirmed by a recognized laboratory service.

(c) Operator requirements shall include, but not be limited to, the following:

(1) evidence of successfully passing a physical examination as defined in (b) above

(2) satisfactory completion of a written examination covering operational characteristics, controls, and emergency control skills, such as response to fire or control malfunction, as well as characteristic and performance questions appropriate to the crane type for which qualification is being sought

(3) demonstrated ability to read, write, comprehend, and use arithmetic and a load/capacity chart in the English language

(4) satisfactory completion of a combination written and verbal test on load/capacity chart usage that covers a selection of the configurations the crane may be equipped to handle, for the crane type for which qualification is being sought

(5) satisfactory completion of testing by appropriate written, oral, or practical methods demonstrating proficiency in operating the specific crane type, including prestart and poststart inspections, shutdown, and securing procedures

(6) demonstrated understanding of the applicable sections of the B30 Standard and federal, state, and local requirements

(d) Operators who have successfully qualified to operate a specific crane type shall be required to be requalified if supervision deems it necessary. Requalification