ASME B30.4-2003
(Revision of ASME B30.4-1996)

PORTAL, TOWER, AND PEDESTAL CRANES

AN AMERICAN NATIONAL STANDARD



The American Society of Mechanical Engineers

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PORTAL, TOWER, AND PEDESTAL CRANES

ASME B30.4-2003

(Revision of ASME B30.4-1996)

SAFETY STANDARD FOR CABLEWAYS, CRANES, DERRICKS, HOISTS, HOOKS, JACKS, AND SLINGS

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The next edition of this Standard is scheduled for publication in 2008. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME Web site under the Committee Pages at http://www.asme.org/codes/ as they are issued, and will also be published within the next edition of the Standard.

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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 (formerly the United States of America Standards Institute). This Standard had its beginning in December 1916 when an eight-page Code of Safety Standards for Cranes, prepared by an ASME Committee on the Protection of Industrial Workers, was presented to 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 (later changed to American Standards Association and subsequently to the USA Standards Institute), 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 American Engineering Standards Committee 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 organized November 4, 1926, with 57 members representing 29 national organizations. The Safety Code for Cranes, Derricks, and Hoists, ASA B30.2-1943, was created from the eight-page document referred to in the first paragraph. This document was reaffirmed in 1952 and widely accepted as a safety standard.

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 Naval Facilities Engineering Command, U.S. Department of the Navy, was reorganized as an American National Standards Committee on January 31, 1962, with 39 members representing 27 national organizations.

The format of the previous code was changed so that separate standards (each complete as to construction and installation; inspection, testing, and maintenance; and operation) would cover the different types of equipment included in the scope of B30.

In 1982, the Committee was reorganized as an Accredited Organization Committee, operating under procedures developed by the ASME and accredited by the American National Standards Institute.

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 III, before rendering decisions on disputed points.

This volume of the Standard, which was approved by the B30 Standards Committee and by ASME, was approved by ANSI and designated as an American National Standard on February 19, 2003.

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.

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Safety Standards 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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SAFETY STANDARD FOR CABLEWAYS, CRANES, DERRICKS, HOISTS, HOOKS, JACKS, AND SLINGS

B30 SERIES INTRODUCTION

(03)

GENERAL

This Standard is one of a series of safety standards on various subjects that have been formulated under the general auspices of the American National Standards Institute. One purpose of the Standard is to serve as a guide to governmental authorities having jurisdiction over subjects within the scope of the Standard. It is expected, however, that the Standard will find a major application in industry, serving as a guide to manufacturers, purchasers, and users of the equipment.

For the convenience of the user, the Standard has been divided into separate volumes.

B30.1 Jacks
B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
B30.3 Construction Tower Cranes
B30.4 Portal, Tower, and Pedestal Cranes
B30.5 Mobile and Locomotive Cranes
B30.6 Derricks
B30.7 Base Mounted Drum Hoists
B30.8 Floating Cranes and Floating Derricks
B30.9 Slings
B30.10 Hooks
B30.11 Monorails and Underhung Cranes
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
Note: B30.15-1973 has been withdrawn. The revision of B30.15 is included in the latest edition of B30.5.
B30.16 Overhead Hoists (Underhung)
B30.17 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
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 Manually Lever Operated 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[1]
B30.27 Material Placement Systems[1]
B30.28 Balance-Lifting Units[1]

If these standards are 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.

The use of cableways, cranes, derricks, hoists, hooks, jacks, and slings is subject to certain hazards that cannot be met 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 safe operation of the equipment and the handling of the loads. Serious hazards are overloading, dropping or slipping of the load caused by improper hitching or slinging, obstructing the free passage of the load, and using equipment for a purpose for which it was not intended or designed.

The Standards Committee fully realizes the importance of proper design factors, minimum or maximum sizes, and other limiting dimensions 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 depend on many different factors, often varying with the installation and uses. These factors depend on the condition of the equipment or material; the loads; the acceleration or speed of the ropes, chains, sheaves, sprockets, or drums; the type of attachments; the number, size, and arrangement of sheaves or other parts; environmental conditions causing corrosion or wear; and many variables that must be considered in each individual case. The rules given in the Standard must be interpreted accordingly, and judgment must be used in determining their application.

The Standards Committee will be glad to receive criticisms of this Standard's requirements and suggestions

[1] B30.26, B30.27, and B30.28 are in the developmental stage.

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for its improvement, especially those based on actual experience in application of the rules.

Suggestions for changes to the Standard should be submitted to the Secretary of the B30 Committee, ASME, Three Park Avenue, New York, NY 10016-5990, and should be in accordance with the following format:

(a) Cite the specific paragraph designation of the pertinent volume.

(b) Indicate the suggested change (addition, deletion, revision, etc.).

(c) Briefly state the reason and/or evidence for the suggested change.

(d) Submit suggested changes to more than one paragraph in the order that the paragraphs appear in the volume.

The B30 Committee will consider each suggested change in a timely manner in accordance with its procedures.

(03) SECTION I: SCOPE

This Standard applies to the construction, installation, operation, inspection, maintenance, and safe use of lifting equipment used in construction and industrial settings. This includes, but is not limited to: articluating-boom, container, gantry, mobile, pedestal, portal, tower and stacker cranes; balance-lifting units; below-the-hook lifting devices; cableways; derricks; jacks; hoists; hooks; loads suspended from rotorcraft; material placement systems; monorails; rigging hardware; and scrap and material handlers.

This Standard does not apply to track and automotive jacks, railway or automobile wrecking cranes, shipboard cranes, shipboard cargo-handling equipment, well-drilling derricks, skip hoists, mine hoists, truck body hoists, car or barge pullers, conveyors, excavating equipment, or equipment falling within the scope of the following Committees: A10, A17, A90, A92, A120, B20, B56, and B77.

SECTION II: PURPOSE

This Standard is designed to

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

(b) provide direction to owners, employers, supervisors, 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 III: INTERPRETATIONS

Upon request, the B30 Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B30 Committee, ASME, Three Park Avenue, New York, NY 10016-5990.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his request utilizing the following format.

Subject: Cite the applicable paragraph number(s) and provide a concise description.

Edition: Cite the applicable edition of the pertinent volume for which the interpretation is being requested.

Question: Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain any proprietary names or information.

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which could change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

SECTION IV: NEW AND EXISTING INSTALLATIONS

(a) Effective Date. The effective date of this volume for the purpose of defining new and existing installations shall be 1 year after its date of issuance.

(b) New Installations. 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.

(c) Existing Installations. Inspection, testing, maintenance, and operation of equipment manufactured and facilities constructed prior to the effective date of this volume shall be done, as applicable, in accordance with the requirements of this volume.

It is not the intent of this volume to require retrofitting of existing equipment. However, when an item is being modified, its performance requirement shall be reviewed relative to the current volume. If the performance differs substantially, the need to meet the current requirement shall be evaluated by a qualified person selected by the

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owner (user). Recommended changes shall be made by the owner (user) within 1 year.

SECTION V: MANDATORY AND ADVISORY RULES

Mandatory rules of this volume are characterized by use of the word *shall.* If a provision is of an advisory nature, it is indicated by use of the word *should* and is a recommendation to be considered, the advisability of which depends on the facts in each situation.

SECTION VI: METRIC CONVERSIONS

The values stated in U.S. Customary units are to be regarded as the standard.

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ASME B30.4-2003
SUMMARY OF CHANGES

Following approval by the ASME B30 Committee and ASME, and after public review, ASME B30.4-2003 was approved by the American National Standards Institute on February 19, 2003.

ASME B30.4-2003 includes editorial changes, revisions, and corrections introduced in B30.4a-1998 and B30.4b-1999, as well as the following changes identified by **(03)**.

Page	*Location*	*Change*
viii	General	Updated
ix	Section 1	Revised
1	Section 4-0.1	Revised
5	Section 4-0.3	References updated
16	Subparagraph 4-2.1.3(e)	Revised
	Subparagraph 4-2.1.4(a)	Revised

Special Note:

The Interpretations to ASME B30.4 are included in this Edition as a separate section for the user's convenience. This section, however, is not part of the Edition itself.

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PORTAL, TOWER, AND PEDESTAL CRANES

Chapter 4-0
Scope, Definitions, and References

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

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

This volume applies only to portal, tower, and pedestal cranes utilizing a drum and wire rope for hoisting and which are used for hoisting work. The requirements for construction tower cranes (refer to ASME B30.3), telescopic boom cranes, twin boom container handling cranes, and knucklebroom cranes are not included in this volume.

SECTION 4-0.2: DEFINITIONS

4-0.2.1 Types of Cranes

construction tower crane: a tower crane that is regularly assembled and disassembled for use at various sites. It may include features for climbing or telescoping.

hammerhead crane: a crane with a horizontal boom and a load trolley that traverses the boom to change load radius, and that contains the sheaves and appurtenances that comprise the upper load block (see Fig. 3).

luffing crane: a crane with a boom pinned to the superstructure at its inner end and containing load hoisting tackle at its outer end, and with a hoist mechanism to raise or lower the boom in a vertical plane to change load radius (see Figs. 1, 2, and 4).

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

permanently mounted crane: a crane erected for long term use at one location, usually five years or more. The configuration of the crane usually remains unchanged during the entire installation period.

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 Fig. 2).

tower crane: similar to a portal crane, but with a tower intervening between the superstructure and the gantry or other base structure; ordinarily, no portal is provided for traffic to pass beneath the crane (see Figs. 3 and 4). To resist overturning moments, the assembly may be ballasted, fixed to a foundation, or a combination of both. The crane may be fixed or on a traveling base.

tower crane (construction): a class of tower crane built and intended for use at construction sites and for similar applications. They are characterized by provisions to facilitate frequent erection and dismantling. Additional mounting means may include arrangements that permit the crane to climb in the structure being built, or that permit increasing the tower height as the structure rises and utilizing braces attached to the host structure as needed. (Refer to ASME B30.3.)

4-0.2.2 General

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

administrative or regulatory authority: governmental agency, or the employer in the absence of governmental jurisdiction.

appointed: assigned specific responsibilities by the employer or the employer's representative.

authorized: approved by a duly constituted administrative or regulatory authority.

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

bogie: an assembly of two or more axles arranged to permit both vertical wheel displacement and an equalization of loading on the wheels.

boom: a member used for supporting the hoisting tackle, hinged to a fixed or rotating structure or to a mast,

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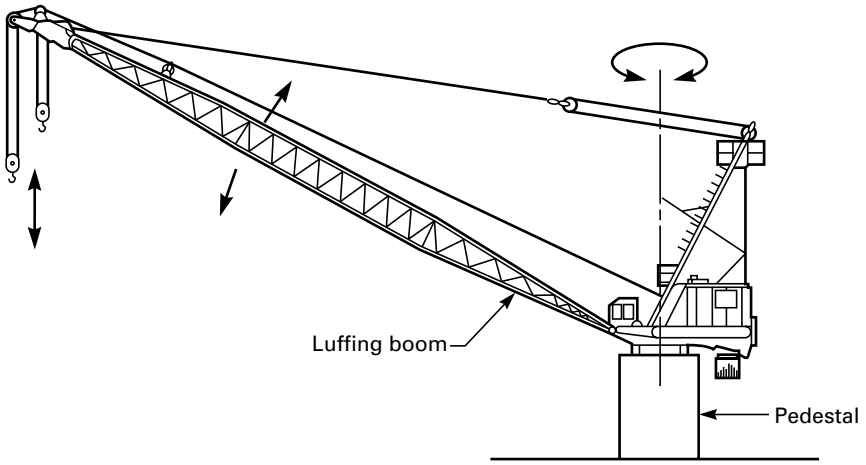


Fig. 1 Pedestal Crane With Luffing Boom

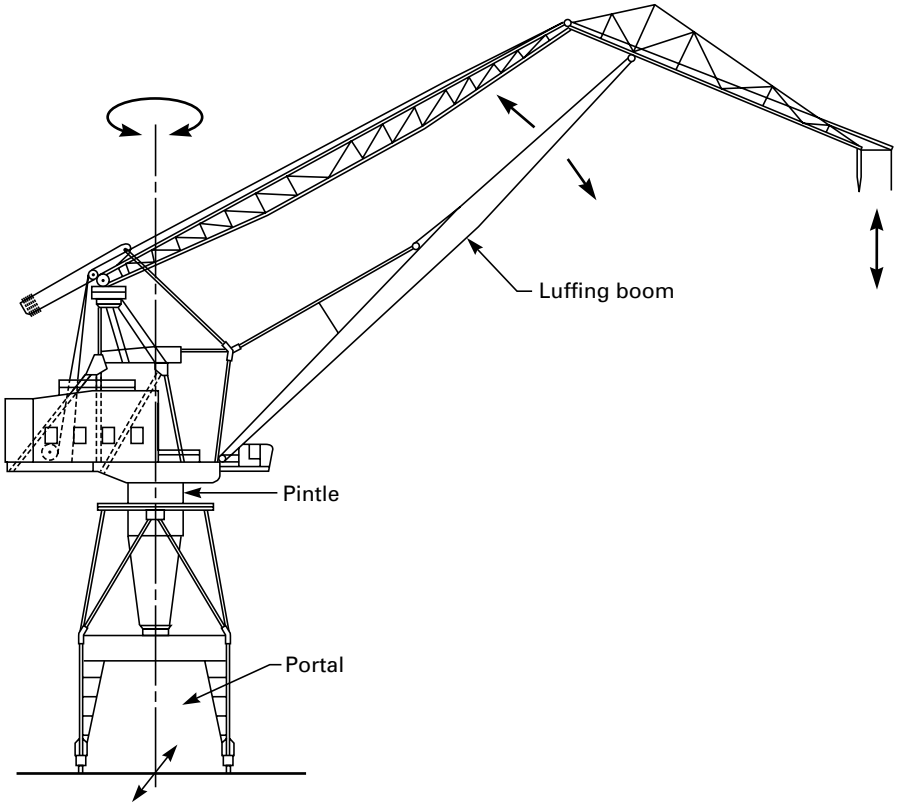


Fig. 2 Portal Crane With Level Luffing Boom

with its outer end supported by ropes, chains, rods, or hydraulic cylinder(s).

boom point: the outward end of the load-bearing boom.

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

braking means: a method or device for retarding or stopping motion.

buffer: an energy absorbing device for reducing impact when a moving crane reaches the end of its permitted travel.

cab: a housing provided for the operator and containing the crane controls.

clutch: a means for engagement or disengagement of power.

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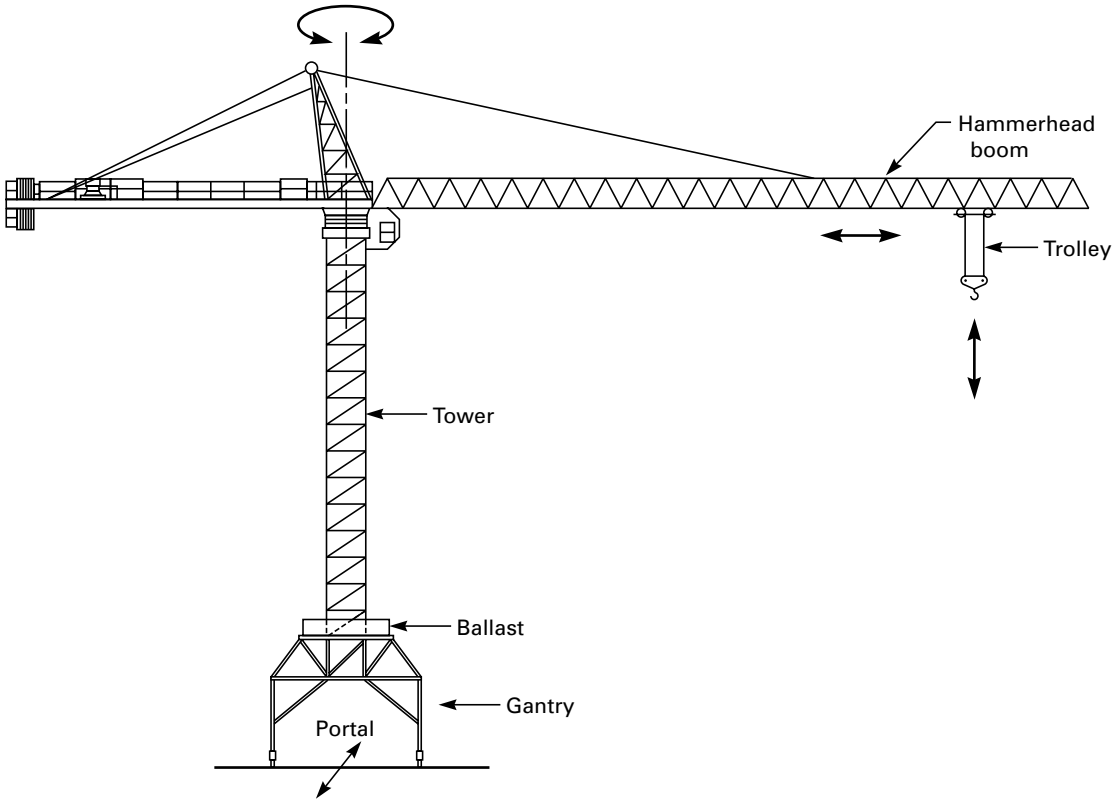


Fig. 3 Hammerhead Tower Crane on Traveling Base

counterweight: weight used to supplement the weight of the machine in providing stability for lifting working loads; it swings with the crane.

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

designated person: a person selected or assigned by the employer or the employer's representative as being competent to perform specific duties.

drum: the cylindrical member around which a rope is wound and through which power is transmitted to the ropes.

dynamic loading: loads introduced into the machine or its components by forces in motion.

flange point: the point of contact between the rope and drum flange where the rope changes layers on a rope drum.

gage, track: the horizontal distance between the center lines of the tow rails measured perpendicular to the direction of travel.

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

high strength (traction) bolts: high strength tensile bolts used in the assembly of crane components. The bolts are installed in tension, by torquing or other means, at a level greater than that produced by in- or out-of-service loads for the purpose of reducing the likelihood of bolt fatigue failure.

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.

load block, lower: the assembly of sheaves, pins, and frame suspended from the boom or mounted in the load trolley.

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

load, working: the external load applied to the crane including the weight of load attaching equipment such as load blocks, ropes, shackles, and slings.

out-of-service: the condition of a crane when unloaded, without power and with the controls unattended, and prepared to endure 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 induced bogie loads; it is provided with storm anchorages when required.

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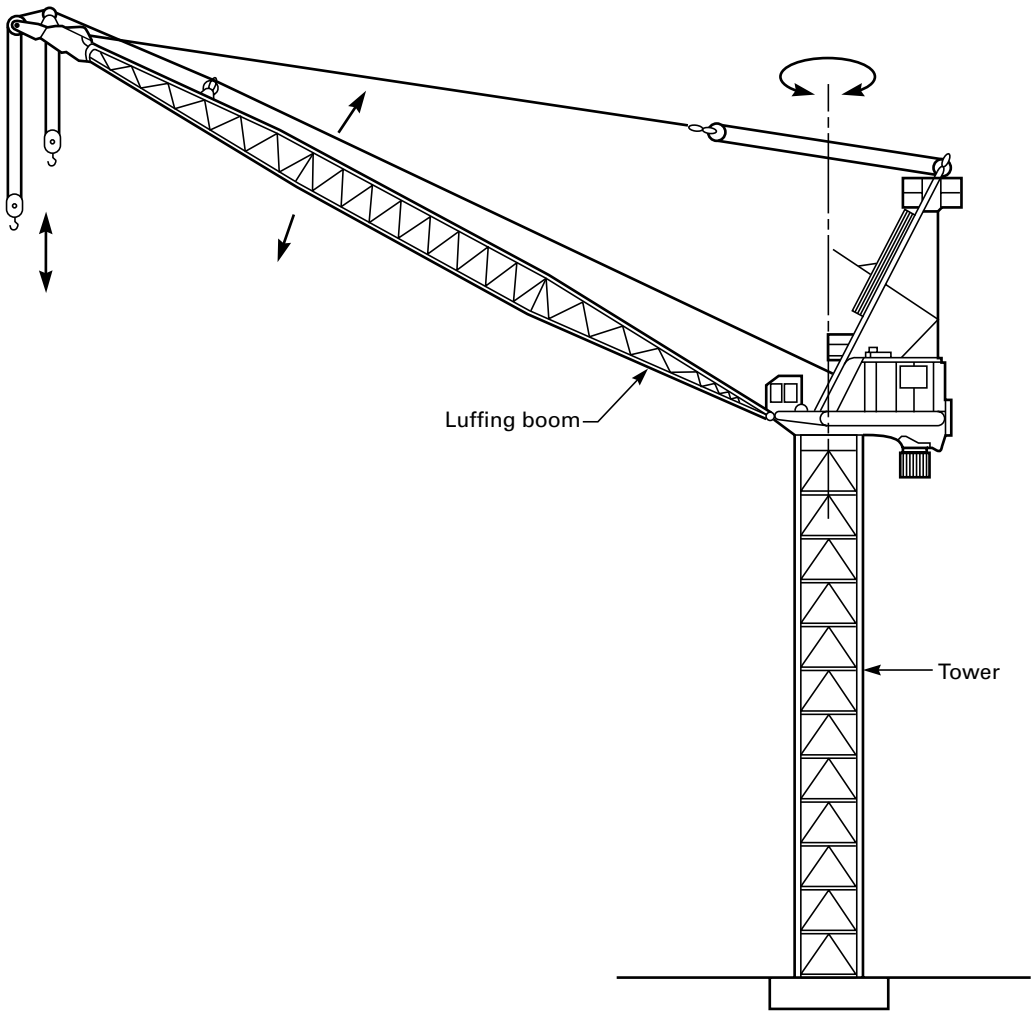


Fig. 4 Luffing Boom Tower Crane on a Fixed Base

pawl (dog): a device for positively holding a member against motion in one or more directions.

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

permanent installation: a crane installation intended to last the working life of the crane or for a period of five years or more before dismantling and reerection.

pitch diameter: the diameter of a sheave or rope drum measured at the centerline of the rope.

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 tower, gantry, 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 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 wire rope unless otherwise specified.

rotation-resistant rope: wire rope consisting of an inner layer of strand laid in one direction covered by a layer of strand laid in the opposite direction. This has the effect of counteracting torque by reducing the tendency of the finished rope to rotate.

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

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

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service, heavy: that 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.

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: indicates that the rule is mandatory and must be followed.

should: indicates that the rule is a recommendation, the advisability of which depends on facts in each situation.

standing rope (pendant): a supporting rope that maintains a constant distance between the points of attachment to the components connected by the rope.

structural competence: the ability of the machine and its components to withstand the stresses imposed by applied rated loads.

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

switch, limit: 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.

ton (short): 2000 pounds.

tower: a structural frame consisting of columns and bracing capable of supporting a superstructure with its working and dynamic loads.

traction (high strength) bolts: see *high strength bolts*.

trolley, load: the device that travels along the horizontal boom of a hammerhead crane and contains the upper load block.

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

two-blocking: the condition when the lower load block or hook assembly comes in contact with the upper load block.

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

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

wind velocity device: a device, such as an anemometer, that has a readout giving wind speeds.

SECTION 4-0.3: REFERENCES (03)

Within the text, reference is made to the following publications, copies of which may be obtained from the publishers as indicated.

ANSI A1264.1-1995, Safety Requirements for Workplace Floor and Wall Openings, Stairs, and Railing Systems

ANSI/ASCE 90 7-95, Minimum Design Loads for Buildings and Other Structures

Publisher: American Society of Civil Engineers (ASCE), 1801 Alexander Bell Drive, Reston, VA 20191-4400

ANSI Z26.1-1996, Safety Code for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicles Operating on Land Highways — Safety Standard

ANSI/SAE J185 — JUN 88 Access Systems for Off-Road Machines

Publisher: Society of Automotive Engineers (SAE), Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001

ANSI A14.3-1992, Safety Requirements for Ladders — Fixed[1]

Publisher: American Society of Safety Engineers (ASSE), 1800 East Oakton Street, Des Plaines, IL 60018-2187

ASME B30.3-1996, Construction Tower Cranes[1]

ASME B30.10-1999, Hooks[1]

Publisher: The American Society of Mechanical Engineers (ASME International), Three Park Avenue, New York, NY 10016-5900; ASME Order Department, 22 Law Drive, P.O. Box 2300, Fairfield, NJ 07007-2300

WRTB Wire Rope Users Manual, 3rd Edition

Publisher: Wire Rope Technical Board, P.O. Box 286, Woodstock, MD 21163-7030

ANSI/NEMA ICS3-1993, Part ICS 3-443, Industrial Systems[1]

Publisher: National Electrical Manufacturers Association (NEMA), 1300 North 17th Street, Rosslyn, VA 22209

ANSI/NFPA 70-1999, National Electrical Code[1]

Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101

ANSI/AWS D14.3-94, Specification for Welding Earth-Moving and Construction Equipment[1]

Publisher: American Welding Society (AWS), 550 NW, LeJeune Road, Miami, FL 33126

[1] May also be obtained from the American National Standards Institute, Inc., 25 West 43rd Street, New York, NY 10036.

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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 to 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 buffers adjusted for simultaneous contact with both sides of the travel base.

(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. 4-1.3.1).

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 to 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 towers 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.

4-1.1.3 Preoperation Procedures

(a) After erection, supports shall be tested, before placing the crane in service, using test loads that are 110% of rated load at the radius producing the greatest load moment. Stationary tower or pedestal cranes shall be tested with the load rotated slowly to those positions that cause maximum loading of each foundation and then held for at least 15 min at each critical position. Traveling cranes designed to travel with load shall be tested 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 not designed to travel with load, traveling cranes shall also be tested as for a stationary crane in each operating location.

(b) During overload tests, care is required to maintain accelerations and decelerations below ordinary operational levels.

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(c) Displacement of a support during testing is reason to refrain from placing the crane in operation until an evaluation is made by a qualified person.

(d) Before placing a crane in service, all functional motions, locking devices, and brakes shall be checked for operation. Limiting devices shall be checked for proper setting and operation.

(e) Functional motion tests shall be performed first without load and then at rated load, or where appropriate, with the overload test load boomed-in to rated radius. The tests shall include

(1) load hoisting and lowering

(2) boom hoisting and lowering, or traversing the trolley

(3) swing motion

(4) brakes and clutches

(5) limit, locking, and safety devices

(f) The trip setting of hoist limit devices should be determined by tests, with an empty hook 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 trip 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.

(g) The order in which tests of a newly erected crane are to be performed is as follows:

(1) functional motion test without load

(2) functional motion tests at rated load

(3) overload tests of supports

SECTION 4-1.2: LOAD RATINGS AND STABILITY

4-1.2.1 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 which 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 mounted; counterweight arrangement; and, when applicable, tower height; 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 should be determined using the maximum in-service wind velocity, as specified by the manufacturer, 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.

4-1.2.2 Load Ratings Where Structural Competence Governs 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 slewing 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 arrangement, tower height (when applicable), swing speed changes and other dynamic effects, hoist line reeving, and hoisting speed range. Therefore, the structural 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 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 competence.

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4-1.2.3 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) a full and complete range of manufacturer's approved crane load ratings for each permitted tower height (when applicable) and at all stated operating radii for each permitted boom length, jib length, and combination boom and jib (when applicable)

(b) the basis of ratings, as set forth in paras. 4-1.2.1 and 4-1.2.2, by identification of those ratings governed by strength limitations as opposed to stability

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

(d) 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

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

(f) whether hoist holding mechanism is automatically controlled, manually controlled, and if free fall is available

(g) 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

4-1.2.4 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 or load trolley 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

4-1.2.5 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 out-of-service wind forces appropriate to the installation site and in accordance with winds as given in ANSI A58.1; overturning moments shall not exceed 80% of the stabilizing moments, and overturning anchorage devices shall not be used. 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. Traveling cranes shall also possess a margin of resistance to storm wind induced sliding unless storm wind anchorages are provided. Rail clamps shall not be used to secure out-of-service stability. For fixed cranes, see para. 4-1.1.1(a).

4-1.2.6 Altered or Modified Cranes

Whenever cranes are altered or modified, 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 or modifications 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. For all altered or modified cranes, records of tests required under para. 4-2.2.1(a) shall be maintained and should include a description of the tests performed, the rationale for selecting those test conditions, the date and ambient conditions at the time of testing, and the signature of the qualified person who supervised the tests.

SECTION 4-1.3: DOCUMENTATION

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

4-1.3.1 Site Preparation and Crane Support Design Data

For use of the crane support designers, data such as 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 or bogie 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

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4-1.3.2 Erection Instructions

For the use of crane erection personnel, data such as 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

4-1.3.3 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.

4-1.3.4 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.

4-1.3.5 Repair Recommendations

In the event 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. 4-2.3.4).

4-1.3.6 Design Characteristics Affecting Safety

In addition to the information called for in para. 4-1.3.3, data such as 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. 4-1.16.8)

(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 4-1.4: HOISTING EQUIPMENT

4-1.4.1 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 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. Refer to ASME B30.10.

4-1.4.2 Hoist Drums

(a) No less than two full wraps of rope shall remain on the drum when the hook is in the extreme low position.

(b) The drum end of the rope shall be attached to the drum as recommended by the crane or rope manufacturer, or by a qualified person.

(c) The drum flanges shall extend one rope diameter but not less than $\frac{1}{2}$ in. (13 mm) over the top layer of the rope during operation.

(d) The diameter of the drum shall be sufficient to provide a first layer rope pitch diameter of not less than 18 times the nominal diameter of the rope used.

(e) Positive means, controllable from the operator's station, shall be provided to hold the drum from rotating in the lowering direction and be capable of holding the rated load indefinitely without further attention from the operator.

(f) Drum rotation indicators should be provided and located so as to afford sensing by the operator.

4-1.4.3 Hoist Brakes

(a) 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 shall be capable of maintaining controlled lowering speed of rated loads.

(b) The load hoist mechanism shall be equipped with at least one brake having holding capacity of not less than 125% of the full load hoisting torque at the point where the brake is applied.

(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.

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(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 of 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.

4-1.4.4 Hoist Sheaves

(a) Sheave grooves shall be free from surface defects that could cause rope damage. The cross-sectional radius at the bottom of the groove should be such as to form a close-fitting saddle for the size of rope used. The sides of the groove shall be tapered outwards to facilitate entrance of the rope into the groove. Flange rims shall run true about the axis of rotation.

(b) Sheaves carrying ropes that can become momentarily unloaded shall be provided with close fitting guards or other suitable devices to guide the rope back into the groove when a load is reapplied.

(c) All sheave bearings shall be provided with means for lubrication, except for those that are permanently lubricated.

(d) The pitch diameters of the upper and lower load block sheaves shall not be less than 18 and 16 times the nominal diameter of the rope used, respectively.

(e) 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.

4-1.4.5 Hoist Ropes

(a) The hoisting rope shall be of a construction recommended for that service by the rope or crane manufacturer or qualified person.

(b) The design factor of hoist ropes shall be not less than 3.5, but when rotation-resistant ropes are used, the design factor shall be 5 or greater. [The design factor of 5 or greater may be modified by the crane user by complying with the provisions of para. 4-3.2.1(a)(4).]

(c) The design factors in the preceding clause shall be the total nominal breaking strength of all hoist ropes supporting the load divided by the static load imposed on the hoist ropes.

(d) Rotation-resistant rope shall be given extra care during installation as it may be more easily damaged than other rope.

(e) If a load is supported by more than one part of rope, the tension in the parts shall be equalized.

(f) Socketing shall be done in the manner specified by the manufacturer of the rope or fitting.

(g) For ambient temperatures at the rope in excess of 1800°F (820°C), rope having an independent wire rope or wire strand core, or other temperature-damage-resistant core shall be used.

SECTION 4-1.5: LUFFING (BOOM HOIST) AND TROLLEY EQUIPMENT

4-1.5.1 General Requirements

(a) When using recommended reeving and with rated loads suspended, the boom hoist shall be capable of raising the boom, holding it stationary without attention from the operator, and lowering it only when coupled to its prime mover or suitable retarder.

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

(c) The boom hoist mechanism shall be equipped with at least one brake having holding capacity of not less than 125% of the full load hoisting torque at the point where the brake is applied.

4-1.5.2 Boom Hoist Drums

(a) The boom hoist drum(s) shall be provided with an auxiliary ratchet and pawl, or other positive locking device to hold the drum(s) from rotating in the lowering direction, hold the rated load indefinitely, and be controllable from the operator's station.

(b) The drum(s) shall have sufficient rope capacity to operate the boom at all positions from horizontal to the highest angle recommended when using the manufacturer's recommended reeving and rope size.

(1) No less than 2 full wraps of rope shall remain on the drum(s) with the boom point lowered to its lowest possible position.

(2) Each drum end of the rope shall be attached to the drum(s) as recommended by the rope or crane manufacturer, or by a qualified person.

(c) Drum diameter shall be sufficient to provide a first layer rope pitch diameter of not less than 15 times the nominal diameter of the rope used.

4-1.5.3 Boom Hoist Sheaves

(a) Boom hoist sheaves shall meet the requirements of 4-1.4.4(a), (b), and (c).

(b) Pitch diameters shall not be less than 15 times the nominal diameter of the rope used.

4-1.5.4 Load Trolley Systems

(a) Load trolleys shall be under control when traversing the boom during operations.

(b) The body or frame of the trolley shall be fitted with means to restrain the trolley from becoming

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detached from its guide rail(s) in the event of trolley wheel or axle breakage or side loading.

(c) The trolley shall be provided with an operating brake capable of stopping the trolley in either direction. The system shall include means for holding the trolley without further action on the part of the operator, and shall engage automatically if power or pressure to the brake is lost.

(d) In addition to the operating brake, the trolley shall be equipped with an automatic braking device capable of stopping the outward movement of the load trolley in the event of trolley drive rope breakage, if such ropes are used.

(e) The boom point sheave, if provided, shall have at least one broad stripe of bright, contrasting color on each side so that it can be determined whether or not the sheave is turning. Cheek plates shall be arranged so that the stripe will be visible as the sheave turns.

SECTION 4-1.6 SLEWING (SWING) MECHANISM

4-1.6.1 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.

4-1.6.2 Slewing 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 positively locking the rotating upper structure should be provided. When provided, it shall be arranged for avoidance of inadvertent engagement or disengagement. If a positive locking device is provided, a visual or audible indicator shall be furnished to warn the operator of device engagement.

SECTION 4-1.7 TRAVEL EQUIPMENT

4-1.7.1 General Requirements

(a) Means shall be provided to prevent cranes from running into the buffers or stops while under power.

(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, in the event a wind alarm sounds.

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

4-1.7.2 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.

4-1.7.3 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.

(c) When a crane is out of service, means shall be provided to lock the wheels against rotation to resist the effects of wind as stipulated by the manufacturer or by a qualified person. In the event that friction between locked wheels and rails is insufficient to restrain the crane from movement, other means shall be provided or recommended by the manufacturer or by a qualified person.

SECTION 4-1.8: BRAKES, GENERAL REQUIREMENTS

4-1.8.1

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

4-1.8.2

Braking means shall have heat dissipation capability consistent with service needs.

4-1.8.3

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

4-1.8.4

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

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SECTION 4-1.9: SWITCHES AND LIMITING DEVICES

4-1.9.1

The load hoist of all cranes shall be provided with an upper overtravel (two-blocking) limiting device or a two-block warning feature.

4-1.9.2

Lower overtravel-limiting devices should be provided for all load hoists where the hook enters areas not visible to the operator.

4-1.9.3 Lifting Magnets

(a) A crane for use with a lifting magnet shall have a separate magnet circuit switch of the enclosed type with provision for locking in the OPEN (OFF) position. The magnet disconnect switch shall be connected on the line side (power-supply side) of the crane disconnect switch.

(b) Means shall be provided for discharging the inductive load of a lifting magnet.

(c) Indication or signal lights should be provided to indicate that power to a lifting magnet is on or off. These lights, if used, shall be visible to the crane operator and to persons on the floor.

(d) For a remote-operated crane, the loss of the remote signal shall not result in demagnetizing the lifting magnet.

4-1.9.4

Load- and motion-limiting devices, and acceleration/deceleration limiters, when provided, shall be installed in enclosures that can be locked or sealed to inhibit tampering and unauthorized adjustment.

4-1.9.5

Motion-limiting devices may be provided with means to permit the operator to override them under controlled conditions.

SECTION 4-1.10: BOOM AND JIB SUPPORT ROPES

4-1.10.1

For standing ropes supporting booms or jibs, the minimum design factor shall be 3.0; for running ropes, the minimum design factor shall be 3.5. Rotation-resistant ropes and fiber core ropes shall not be used.

4-1.10.2

Standing ropes that are used as live ropes during erection, and boom hoist running ropes, shall have a minimum design factor of 3.0 for the loads occurring during erection, but shall comply with para. 4-1.10.1 for the erected condition.

4-1.10.3

The design factors in the preceding clauses shall be the total nominal breaking strengths of all the ropes supporting the boom or jib divided by the static load imposed on those ropes when supporting the weight of the boom or jib structure and rated loads.

4-1.10.4

Sheaves used during erection and dismantling that remain in the support system shall comply with para. 4-1.5.3.

4-1.10.5

Any new poured socket or swaged socket assembly used as a boom pendant shall be proof tested to the crane or fitting manufacturer's recommendation, but in no case greater than 50% of the component wire rope's or structural strand's nominal strength.

SECTION 4-1.11: REEVING ACCESSORIES

4-1.11.1

Eye splices shall be made in a manner recommended by the rope or crane manufacturer, or by a qualified person, and rope thimbles should be used in the eye.

4-1.11.2

Wire rope clips shall be drop-forged steel of the single-saddle (U-bolt) or double-saddle type clip. Malleable cast iron clips shall not be used. For spacing, number of clips, and torque values, refer to the clip manufacturer's recommendation. Wire rope clips attached with U-bolts shall have the U-bolt over the dead end of the rope and the live rope resting in the clip saddle. Clips shall be tightened evenly to the recommended torque. After the initial load is applied to the rope, the clip nuts shall be retightened to the recommended torque to compensate for any decrease in rope diameter caused by the load. Rope clip nuts should be retightened periodically to compensate for any further decrease in rope diameter during usage.

4-1.11.3

Swaged, compressed, or wedge socket fittings shall be applied as recommended by the rope, crane, or fitting manufacturer, or a qualified person.

4-1.11.4

Wire rope clips used in conjunction with wedge sockets shall be attached to the unloaded dead end of the rope only (see Fig. 5).

SECTION 4-1.12: COUNTERWEIGHTS

4-1.12.1

Crane superstructures shall be arranged to receive counterweights, made in accordance with the crane

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(a) Loop Back Method

(b) Extra Piece of Same Size Rope is Clipped to Main Rope

Fig. 5 Dead Ending Rope in a Socket

manufacturer's specifications, and to hold them in position with means provided to guard against shifting or dislodgement during crane operation.

4-1.12.2

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 4-1.13 CONTROLS

4-1.13.1 Crane Function Controls

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

(b) Controls for hoisting, luffing, trolleying, slewing, 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.

4-1.13.2 Power Plant Controls

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

(b) 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

4-1.13.3 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 4-1.14: ELECTRICAL EQUIPMENT

4-1.14.1 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 shall comply with the provisions of ANSI/NFPA 70 for temporary 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 ICS3, Part ICS 3-443.

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

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(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) Lightning protection shall be provided.

4-1.14.2 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 4-1.15 OPERATOR'S CABS

4-1.15.1 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) All cab glazing shall be safety glazing material as defined in ANSI 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.

4-1.15.2 Access

(a) Stairs or access ladders to the cab, machinery platforms, and tower shall be provided. Ladders shall conform to ANSI A14.3 or to ANSI/SAE J185, 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 A1264.1.

(c) When it is necessary to climb more than 120 ft (37 m) of vertical ladder in the crane tower 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.

4-1.15.3 Tool Box

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.

4-1.15.4 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.

4-1.15.5 Signal Device

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

SECTION 4-1.16: GENERAL REQUIREMENTS

4-1.16.1 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 top towers or 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.

4-1.16.2 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

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distortion unless the guard is located where it is not reasonable to expect a person to step during operation or maintenance.

4-1.16.3 Lubrication Points

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

4-1.16.4 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.

4-1.16.5 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.

4-1.16.6 Wind Velocity Device

A wind velocity indicating device should 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.

4-1.16.7 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.

4-1.16.8 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.

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Chapter 4-2
Inspection, Testing, and Maintenance

SECTION 4-2.1: INSPECTION

4-2.1.1 General

The manufacturer shall furnish operation and maintenance information (paras. 4-1.3.3 to 4-1.3.6).

4-2.1.2 Inspection Classification

(a) Initial Inspection. Prior to initial use, all new, reinstalled, altered, or extensively repaired cranes shall be inspected by a qualified person 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 by the operator or other designated person 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 by an appointed person at one to twelve month intervals or as appointed person at one to twelve month intervals or as specifically recommended by the manufacturer. Records shall be kept of apparent external conditions to provide a basis for continuing evaluation.

4-2.1.3 Frequent Inspection

Items such as the following shall be inspected at intervals defined in para. 4-2.1.2(b)(1) or as specifically indicated, including observation during operation for impairments that might appear between regular inspections. Such conditions shall be examined and determination made by a designated person as to whether they constitute a hazard.

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

(b) all control mechanisms for 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) indicators and load-limiting devices for proper operation and accuracy of setting (03)

(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) braces supporting crane masts (towers) and anchor bolt base connections for looseness or loss of preload

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

4-2.1.4 Periodic Inspection

(a) Complete inspections of the crane shall be performed at intervals, as generally defined in para. 4-2.1.2(b)(2) depending upon its activity, severity of service, and environment, or as specifically indicated below. (03)

Light service — annually

Normal service — semiannually to annually

Heavy service — quarterly

These inspections shall include the requirements of para. 4-2.1.3 and, in addition, items such as the following. Any deficiencies, such as listed below, shall be examined and determination made by a designated person as to whether they constitute a hazard and whether disassembly is required for additional inspection.

(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

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(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, and tubing for excessive wear or damage

(b) Visual inspection of members and their connections (see para. 4-1.3.4), shall be performed at intervals specified in (a) above. Observed signs of possible damage may indicate the need to remove paint or to use other than visual nondestructive examination techniques to permit determination as to whether a hazard exists. For cranes with 10 or more years of service other than light service, a visual inspection, in place of an inspection specified in (a) above, should be performed by a qualified person at annual intervals. The additional purpose of this inspection is to consider whether the observed condition of the crane calls for the use of more stringent examination techniques. The recommendations of the manufacturer in this regard shall be considered.

(c) High strength (traction) bolts used in connections and at the slewing bearing shall be checked for proper tension (torque) at intervals recommended by the manufacturer or as suggested in (a) above. 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.

(d) 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.

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 one month or more, but less than 12 months, shall be inspected in accordance with paras. 4-2.1.3 and 4-2.4.2(a) before being placed in service.

(b) A crane that has been idle for more than 12 months shall be inspected in accordance with paras. 4-2.1.4 and 4-2.4.2(b) before being placed in service.

(c) Standby cranes, before being used, shall be inspected in accordance with the requirements of para. 4-2.1.5(a) or (b), 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: TESTING

4-2.2.1 Operational Tests

(a) Prior to initial use, newly erected cranes shall be tested in accordance with para. 4-1.1.3. Altered or modified cranes shall be tested, under the direction of a qualified person, to verify compliance in accordance with para. 4-1.1.3(d), (e), and (f).

(b) Prior to initial use, repaired cranes shall be tested as determined by a qualified person. Testing may be limited to the function(s) affected by the repair. When a rated load test is required, it shall be in accordance with para. 4-2.2.2.

4-2.2.2 Rated Load Test

Prior to initial use, altered or modified cranes shall be load tested, under the direction of a qualified person, with 125% of rated load, unless the manufacturer recommends otherwise. Test radii and boom azimuths shall be chosen so as to place maximum loading on the relevant crane parts.

4-2.2.3 Test Records

Signed and dated test records should be made and kept available for all tests of repaired, altered, or modified cranes required under paras. 4-2.2.1 and 4-2.2.2. 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 4-2.3: MAINTENANCE

4-2.3.1 Preventive Maintenance

(a) A preventive maintenance program based on the crane manufacturer's recommendations would be established. Dated records should be kept available.

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

4-2.3.2 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.

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(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.

(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.

4-2.3.3 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 by a qualified person

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

4-2.3.4 Welded Construction

Welding procedures and welding operator qualifications for use in repair or alteration of load sustaining members shall be in accordance with ANSI/AWS D14.3 or ANSI/AWS D1.1. Where special steels or other materials are used, the manufacturer shall provide welding procedure instructions. The type of metal used for load sustaining members shall be identified by the manufacturer (see para. 4-1.3.5).

4-2.3.5 Lubrication

(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 shall be stationary while lubricants are being applied and protection provided as called for in paras. 4-2.3.2(a)(1) through (6), unless equipped for automatic lubrication.

SECTION 4-2.4: ROPE INSPECTION, REPLACEMENT, AND MAINTENANCE

4-2.4.1 General

Due to practical crane design configuration requirements, sheave diameters, drum diameters, and rope design factors are limited. Because of these limited design parameters, inspection in accordance with para. 4-2.4.2 to detect deterioration, and timely replacement in accordance with para. 4-2.4.3 are essential.

4-2.4.2 Inspection

(a) Frequent Inspection

(1) All running ropes should be visually inspected once each working day.

(2) Counterweight movement ropes, if provided, should be visually inspected at least once a month.

A visual inspection shall consist of observation of all rope that can reasonably be expected to be in use during the day's operations. These visual observations should be concerned with discovering gross damage, such as listed below, which may be an immediate hazard. When such damage is discovered, the rope shall either be removed from service or inspected as outlined in para. 4-2.4.2(b)

(a) distortion of the rope such as kinking, crushing, unstranding, birdcaging, main strand displacement, or core protrusion; loss of rope diameter in a short rope length or unevenness of outer strands provide evidence that rope replacement should be considered

(b) general corrosion
(c) broken or cut strands
(d) number, distribution, and type of visible broken wires [see paras. 4-2.4.3(b)(1), (2), and (7) for further guidance]
(e) core failure in rotation-resistant ropes (see Fig. 6)

(3) Particular care shall be taken when inspecting boom hoist ropes and sections of rope subject to rapid deterioration such as flange points, crossover points, and repetitive pickup points on drums.

(4) Particular care shall be taken when inspecting rotation-resistant ropes because of their susceptibility to damage from handling and misuse and potential for deterioration when used on equipment with limited design parameters.

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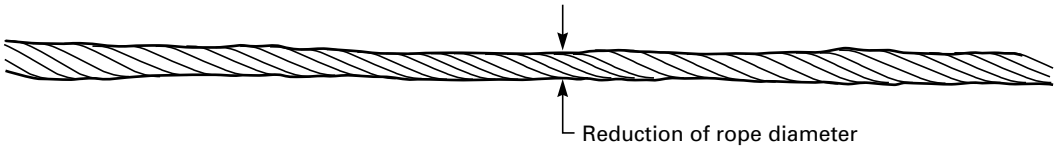


Fig. 6 Core Failure in 19 x 7 Rotation Resistant Rope (Note the Lengthening of Lay and Reduction of Diameter)

Internal deterioration of rotation-resistant ropes may not be readily observable.

(b) Periodic Inspection

(1) Inspection frequency shall be determined by a qualified person and shall be based on such factors as: expected rope life as determined by experience on the particular installation or similar installations, severity of environment, percentage of lifts at maximum rating, frequency rates of operation, and exposure to shock loads. Inspections need not be at equal calendar intervals and should be more frequent as the rope approaches the end of its useful life. However, this inspection shall be made at least annually.

(2) Periodic inspections shall be performed by an appointed or authorized person. These inspections shall cover the entire length of the rope. Any deterioration resulting in appreciable loss of original strength, such as described below, shall be noted and determination made as to whether further use of the rope would constitute a hazard.

(a) points listed in para. 4-2.4.2(a)

(b) reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wire

(c) severely corroded or broken wires at end connections

(d) severely corroded, cracked, bent, worn, or improperly applied end connections

(3) Care shall be taken when inspecting rope sections subject to rapid deterioration, such as the following:

(a) sections in contact with saddles, equalizer sheaves, or other sheaves where rope travel is limited

(b) sections of the rope at or near terminal ends where corroded or broken wires may protrude

(c) sections subject to reverse bends

(d) sections of rope that are normally hidden during routine visual inspection, such as parts passing over sheaves

4-2.4.3 Rope Replacement

(a) No precise rules can be given for determination of the exact time for rope replacement, since many variable factors are involved. Once rope reaches any one of the specified criteria, it may be allowed to operate to the end of the work shift, based on the judgment of a qualified person. The rope shall be replaced after that work shift, or at the latest time prior to the equipment being used by the next work shift.

(b) Removal criteria for rope replacement shall be as follows:

(1) in running ropes, six randomly distributed broken wires in one lay, or three broken wires in one strand in one lay

(2) in rotation-resistant ropes, four randomly distributed broken wires in one lay, or two broken wires in one strand in one lay

(3) one outer wire broken at the contact point with the core of the rope indicated by an externally protruding wire or loop of loose wire

(4) wear of one-third the original diameter of outside individual wires

(5) kinking, crushing, birdcaging, or any other damage resulting in distortion of the rope structure

(6) evidence of heat damage from any cause

(7) reductions from nominal rope diameter greater than those shown below

Nominal Rope Diameter	Maximum Allowable Reduction From Nominal Rope Diameter
Up to $\frac{5}{16}$ in. (8 mm)	$\frac{1}{64}$ in. (0.4 mm)
Over $\frac{5}{16}$ in. to $\frac{1}{2}$ in. (13 mm)	$\frac{1}{32}$ in. (0.8 mm)
Over $\frac{1}{2}$ in. to $\frac{3}{4}$ in. (19 mm)	$\frac{3}{64}$ in. (1.2 mm)
Over $\frac{3}{4}$ in. to $1\frac{1}{8}$ in. (29 mm)	$\frac{1}{16}$ in. (1.6 mm)
Over $1\frac{1}{8}$ in. to $1\frac{1}{2}$ in. (38 mm)	$\frac{3}{32}$ in. (2.4 mm)

(8) Attention shall be given to end connections. Upon development of more than two broken wires adjacent to a socketed end connection, the rope shall be resocketed or replaced. Resocketing shall not be attempted if the resulting rope length will be insufficient for proper operation.

(c) Broken wire removal criteria cited in this volume apply to wire rope operating on steel sheaves and drums. The user shall contact the sheave, drum, or crane manufacturer, or a qualified person for broken wire removal criteria for wire ropes operating on sheaves and drums made of material other than steel.

(d) Replacement rope and connections shall have a strength rating at least as great as the original rope and connections furnished by the manufacturer. Any deviation from the original size, grade, or construction shall be specified by a rope manufacturer, the hoist manufacturer, or a qualified person.

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(e) Ropes Not in Regular Use. All rope that has been idle for a period of 1 month or more due to shutdown or storage of the crane on which it is installed shall be inspected in accordance with para. 4-2.1.5 before it is placed in service. Inspections under para. 4-2.1.5(b) shall be for all types of deterioration and shall be performed by an appointed or authorized person.

(f) Inspection Records

(1) Frequent inspection — no records required.

(2) Periodic inspection — in order to establish data as a basis for judging the proper time for replacement, a dated report of rope condition shall be kept on file. This report shall cover points of deterioration listed in para. 4-2.4.2(b)(2). If the rope is replaced, only that fact need be recorded.

(g) A long range inspection program should be established to include records on examination of ropes removed from service to establish a relationship between visual observation and actual condition of the internal structure.

4-2.4.4 Rope Maintenance

(a) Rope should be stored in such a manner as to minimize damage or deterioration.

(b) Rope shall be unreeled or uncoiled in such a manner as to avoid kinking of or inducing a twist in the rope.

(c) Before cutting rope, seizings shall be placed on each side of the place where the rope is to be cut to prevent unlaying of the strands.

(d) During installation, care should be exercised to avoid dragging the rope in dirt or around objects that will scrape, nick, crush, or induce sharp bends in it.

(e) Rope should be maintained in a well-lubricated condition. Lubricant applied as part of a maintenance program shall be compatible with the original lubricant and to this end the rope manufacturer should be consulted; lubricant shall be of a type that does not hinder visual inspection. Those sections of rope that are located over sheaves or otherwise hidden during inspection and maintenance require special attention during lubrication. The object of rope lubrication is to reduce internal friction and to inhibit corrosion.

(f) When an operating rope shows greater wear at well-defined localized areas than on the remainder of the rope, rope life can be extended, in cases where a reduced rope length is adequate, by cutting off a section at the worn end and thus shifting the wear to different areas of the rope.

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Chapter 4-3
Operation

SECTION 4-3.1: QUALIFICATIONS FOR AND CONDUCT OF OPERATORS AND OPERATING PRACTICES

4-3.1.1 Operators

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

(1) designated persons

(2) trainees under the direct supervision of a designated 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 para. 4-3.1.1(a), 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 or other appointed person.

4-3.1.2 Qualification for Operators

(a) Operators shall be required by the employer to pass a practical operating examination. Examination shall be limited to the specific type of equipment that will be operated.

(b) Operators and operator trainees shall meet the following physical qualifications:

(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 for the specific operation

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

(c) 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, may be sufficient cause for disqualification. In such cases, specialized clinical or medical judgments and tests may be required.

(d) Evidence that an operator is subject to seizures or loss of physical control shall be sufficient reason for disqualification. Specialized medical tests may be required to determine these conditions.

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

4-3.1.3 Conduct of Operators

(a) The operator shall not engage in any practice that might divert attention while actually engaged in operating the crane.

(b) When physically or mentally unfit, an operator shall not engage in the operation of the equipment.

(c) The operator shall respond to signals from the person who is directing the lift, or an appointed signalperson. When a signalperson is not required as part of the crane operation, the operator is then responsible for the lifts. However, the operator shall obey a stop signal at all times, no matter who gives it.

(d) Each operator shall be responsible for those operations under the operator's direct control. Whenever there is any doubt as to safety, the operator shall consult with the supervisor before handling the loads.

(e) Before leaving the cane unattended, the operator shall

(1) land any load, lifting magnet, or other device.

(2) set trolley brakes and other locking devices and bring the hook to the highest position.

(3) disconnect power or disengage the master clutch, as applicable.

(4) place all controls in the OFF or NEUTRAL positions.

(5) secure the crane against inadvertent travel.

(6) stop the internal combustion engine, when provided.

(7) leave the upper structure free to weathervane unless provisions for nonweathervaning have been specified by the manufacturer or by a qualified person.

(8) restrain the crane from travel with rail clamps, or other means provided, when a wind alarm is given or on leaving the crane overnight. An exception to para. 4-3.1.3(e)(6) may exist when crane operation is frequently interrupted during a shift. Under these circumstances, the crane may remain running while the operator remains on the crane superstructure.

(f) If there is a warning sign on the power disconnecting means or starting controls, the operator shall not close the circuit or start the equipment until the warning sign has been removed by an appointed person.

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(g) Before closing the power disconnecting means or starting the equipment, the operator shall see that all controls are in the OFF or NEUTRAL position and that all personnel are in the clear.

(h) If power fails during operation, the operator shall

(1) set brakes and locking devices, as applicable

(2) move all clutch or other power controls to the OFF or NEUTRAL position

(3) if practical, the suspended load should be landed under brake control

(i) The operator shall be familiar with the equipment and its proper care. If adjustments or repairs are necessary, the operator shall report the condition promptly to the appointed person, and shall also notify the next operator.

(j) All controls shall be tested by the operator at the start of a new shift. If any controls do not operate properly, they shall be adjusted or repaired before operations are begun.

(k) Cranes shall not be operated when wind speeds exceed the maximum velocity recommended by the manufacturer.

(l) Operations undertaken during weather conditions that produce icing of the crane structure or reduced visibility should be performed at reduced function speeds and with signaling means appropriate to the situation.

(m) For night operations, lighting shall be adequate to illuminate the working areas while not interfering with the operator's vision.

SECTION 4-3.2: OPERATING PRACTICES

4-3.2.1 Handling the Load

(a) Size of Load

(1) No crane shall be loaded beyond the rated loads given in the rating chart except for test purposes as provided in paras. 4-1.1.3 and 4-2.2.2.

(2) The load to be lifted is to be within the rated load of the crane in its existing configuration.

(3) For lifts where the load weight is not accurately known, the person responsible for the lift shall ascertain that the weight of the load does not exceed the crane ratings at the radius at which the load is to be lifted.

(4) When rotation-resistant ropes are used with a design factor of less than 5 as permitted under para. 4-1.4.5(b), the special provisions that follow shall apply:

(a) For each such lifting assignment

(1) an appointed person shall direct each lift

(2) an appointed person shall ascertain that the rope is in satisfactory condition [paras. 4-2.4.2(a)(1)(a) through (e)] both before and after lifting, but more than one broken wire in any one lay shall be reason not to use the rope for such lifts

(3) operations shall be conducted in such manner and at such speeds as to minimize dynamic effects

(b) Each lift under these provisions shall be recorded in the crane inspection record, and such prior uses shall be considered before permitting another such lift.

(c) These provisions are not intended to permit duty cycle or repetitive lifts to be made under para 4-1.4.5(b) with design factors of less than 5.

(b) Attaching the Load

(1) The hoist rope shall not be wrapped around the load.

(2) The load shall be attached to the hook by means of slings or other devices of adequate capacity.

(c) Holding the Load

(1) The operator shall not leave the controls while the load is suspended.

(2) No person should be permitted to stand or pass under a suspended load.

(3) If the load must remain suspended for any considerable length of time, the operator shall keep the drum from rotating in the lowering direction by activating the drum holding device, if a separate nonautomatic device has been provided.

(4) As an exception to (c)(1) above, where a load is to be held suspended for a period of time exceeding normal lifting operations, the operator may leave the controls, provided that prior to that time, the appointed individual and operator shall establish the requirements for restraining the load, swing, and travel functions, and provide barricades, or whatever other precautions may be necessary.

(d) Moving the Load

(1) The person directing the lift shall see that

(a) proper slings or other lifting attachments are being used

(b) the load is well secured and balanced in the sling or lifting device before it is lifted more than a few inches

(c) the lift and swing path is clear of obstructions

(2) Before starting to lift, the following conditions should be noted

(a) hoist rope shall not be kinked

(b) multiple part lines shall not be twisted around each other

(c) the hook shall be brought over the load in such a manner as to minimize swinging

(d) if there is a slack rope condition, it shall be determined that the rope is seated on the drum and in the sheaves, as the slack is removed

(e) the effect of wind on the load and on the crane

(f) the load is free to be lifted; it is not caught on, nor attached to, other objects

(3) During lifting, care shall be taken that

(a) there is no sudden acceleration or deceleration of the moving load

(b) the load does not contact any obstructions

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(4) Side loading of booms shall be limited to freely suspended loads. Cranes should not be used for dragging loads.

(5) The operator should avoid carrying loads over people.

(6) The operator shall test the brakes each time a load approaching the rated load is handled by lifting it a few inches and applying the brakes.

(7) The load shall not be lowered below the point where less than two full wraps of rope remain on the drum.

(8) When swinging the boom, derricking load, or traveling the crane, sudden starts and stops shall be avoided. Swing and travel speeds shall be such that the load does not swing out beyond the radius at which it can be controlled. A tag or restraint line shall be used when swinging of the load is hazardous.

(9) Consideration should be given to the effects of wind on loads with large sail area.

4-3.2.2 Personnel Lifting

This volume recognizes that portal, tower, and pedestal cranes are designed and intended for handling materials. They do not meet personnel lifting or elevator requirements. Therefore, no crane function shall be performed while a person is on the hook, load, manlift platform, boom, or other personnel lifting device attached to the crane load or boom, unless each of the specific, special, following requirements are met.

(a) The following special procedures shall be followed when personnel are to be lifted.

(1) The person specifically responsible for the overall work function to be performed shall determine that there is no practical alternate way to perform the needed work or gain access to the area and he shall authorize its usage. The person responsible for the task shall issue a statement describing the operation and its time frame. The statement, after being approved by the authorizer, shall be retained.

(2) For each instance of personnel lifting, the person responsible for the task shall determine that each of the following requirements in paras. (3) through (20) below has been met.

(3) When used for lifting personnel, the crane shall be inspected daily in accordance with the requirements of paras. 4-2.1.3 and 4-2.4.2(a).

(4) The lifting and supporting shall be made under controlled conditions and under the direction of an appointed signalperson.

(5) A planning meeting attended by the crane operator, signalperson, person(s) to be lifted and supported, and the supervisor responsible for the task shall be held to review procedures to be followed, including procedures for entering and leaving the personnel platform or basket, and to identify the location(s) persons will enter and leave.

(6) The operator and signalperson shall conduct a test lift with the empty platform or basket.

(7) Communication between the crane operator, signalperson, and person(s) being lifted shall be maintained.

(8) When hook supported platforms are lifted, a two-block damage prevention feature shall be provided on telescopic boom cranes and a warning device shall be provided on lattice boom cranes.

(9) The crane shall be operated so that lowering motion will be power-controlled lowering (no free fall).

(10) When welding is done by personnel from the platform or basket, the electrode holders shall be protected from contact with metal components of the platform or basket.

(11) Personnel being lifted or supported shall wear safety belts with lanyards attached to designated anchor point(s).

(12) The operator shall remain at the controls when the platform is occupied.

(13) Movement of the work platform carrying personnel shall be done in a slow, controlled, cautious manner with no sudden movements of the crane or work platform. The lifting or lowering speed shall not exceed 100 ft/min (0.51 m/s).

(14) The personnel being lifted or positioned shall remain in continuous sight or in communication with the operator or signalperson.

(15) The total weight of the lifted load (including personnel) shall not exceed 50% of the crane rating under the planned conditions of use.

(16) Suspended personnel platforms shall be used only for personnel, their tools, and sufficient materials to do their work. They shall not be used for transporting bulk materials.

(17) Personnel shall keep all parts of the body inside the suspended platform during raising, lowering and positioning to avoid pinch points. Personnel shall not stand on or work from the top rail, midrail, or toeboard of the suspended platform.

(18) If the platform cannot be landed, it should be tied to the structure before personnel get off or on.

(19) Work platforms should not be used in winds in excess of 15 mph (25 km/h), electric storms, snow, ice, sleet, or other adverse weather conditions that could affect the safety of personnel.

(20) After positioning of the work platform, all brakes and locks on the lift crane shall be set before personnel perform any work.

(b) A platform that is designed and constructed in accordance with the following shall be used.

(1) The platform shall be designed by a qualified person.

(2) The platform shall be limited to a capacity of 6 persons.

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(3) The platform and attaching devices shall have a minimum design factor of 5.

(4) The platform shall have a plate specifying the weight of the empty platform and the maximum number of persons and weight for which the platform is rated.

(5) The platform shall have standard railing as defined in ANSI A1264.1.

(6) A grab rail shall be provided inside the suspended work platform to minimize hand exposure.

(7) The sides of the platform shall be enclosed from floor to midrail.

(8) If access doors are installed, they shall open only to the interior of the platform. Access doors shall be equipped with a device to restrain the door from inadvertent opening.

(9) The platform shall have overhead protection when there is an overhead hazard.

(10) The platform shall be easily identifiable by high visibility color or marking.

(11) The platform shall be attached by means such as, but not limited to, a shackle, hook (latched or moused), or wedge and socket attachment. A wedge and socket attachment shall have a clip on the free end of the load line (see Fig. 5).

(12) The suspension system shall minimize inclination of the platform due to the movement of personnel on the platform.

(13) All rough edges shall be ground smooth.

(14) All welds shall be inspected by a qualified person.

(15) All welding shall be performed by a certified welder.

SECTION 4-3.3: SIGNALS

4-3.3.1 Standard Signals

Standard signals to the operator shall be in accordance with the standards prescribed in para. 4.3.2, unless voice communication equipment (telephone, radio, or equivalent) is utilized. Signals shall be discernible or audible at all times. No crane motion shall be made unless signals are clearly understood.

4-3.3.2 Hand Signals

Hand signals shall be in accordance with Fig. 7 and shall be posted at the work site.

4-3.3.3 Special Signals

For operations not covered by para. 4-3.3.2, or for special conditions that occur from time to time, additions to or modifications of the standard signals may be required. In such cases, these special signals shall be agreed upon in advance by the operator and the signalperson and should not be in conflict with standard signals.

4-3.3.4 Instructions to the Operator

If it is desired to give instructions to the operator, other than those provided by the established signal system, crane motions shall be stopped.

SECTION 4-3.4: MISCELLANEOUS

4-3.4.1 Rail Clamps

Rail clamps, if used, should have slack between the point of attachment to the rail and the end fastened to the crane. Rail clamps shall not be used as a means of restraining tipping of a crane.

4-3.4.2 Operating Near Electric Power Lines

(a) Cranes shall be operated so that no part of the crane or load enters into the Danger Zone shown in Fig. 8.

(1) Exceptions

(a) The Danger Zone may be entered if the electrical distribution and transmission lines have been deenergized and visibly grounded at the point of work, or

(b) The Danger Zone may be entered if insulating barriers (not a part of nor attachment to the crane) have been erected to prevent physical contact with the lines.

(2) For lines rated 50 KV or below, minimum clearance between the lines and any part of the crane or load (including handling appendages) shall be 10 ft (3 m). For higher voltages, see Table 1.

(3) Caution shall be exercised when working near overhead lines, because they can move horizontally or vertically due to wind, moving the Danger Zone to new positions.

(4) A qualified signalperson shall be assigned to observe the clearance when the crane moves to within a boom's length of the Table 1 limits. The operator is not in the best position to judge distance between the power line and the crane or its protuberances.

(b) If cage-type boom guards, insulating links, or proximity warning devices are used on cranes, such devices shall not be a substitute for the requirements of para. 4-3.4.2(a), even if such devices are required by law or regulation. In view of the complex, invisible, and lethal nature of the electrical hazard involved, and to lessen the potential of false security, limitations of such devices, if used, shall be understood by operating personnel and tested in the manner and in intervals prescribed by the manufacturer of the device. Compliance with para. 4-3.4.2(a) is the recommended practice of this Standard in determining permissible proximity of the crane and its protuberances, including load and load lines to electrical power lines.

(c) Before the commencement of operations near electrical lines. The person responsible for the job shall notify the owners of the lines or their authorized representatives, providing them with all pertinent information and requesting their cooperation.

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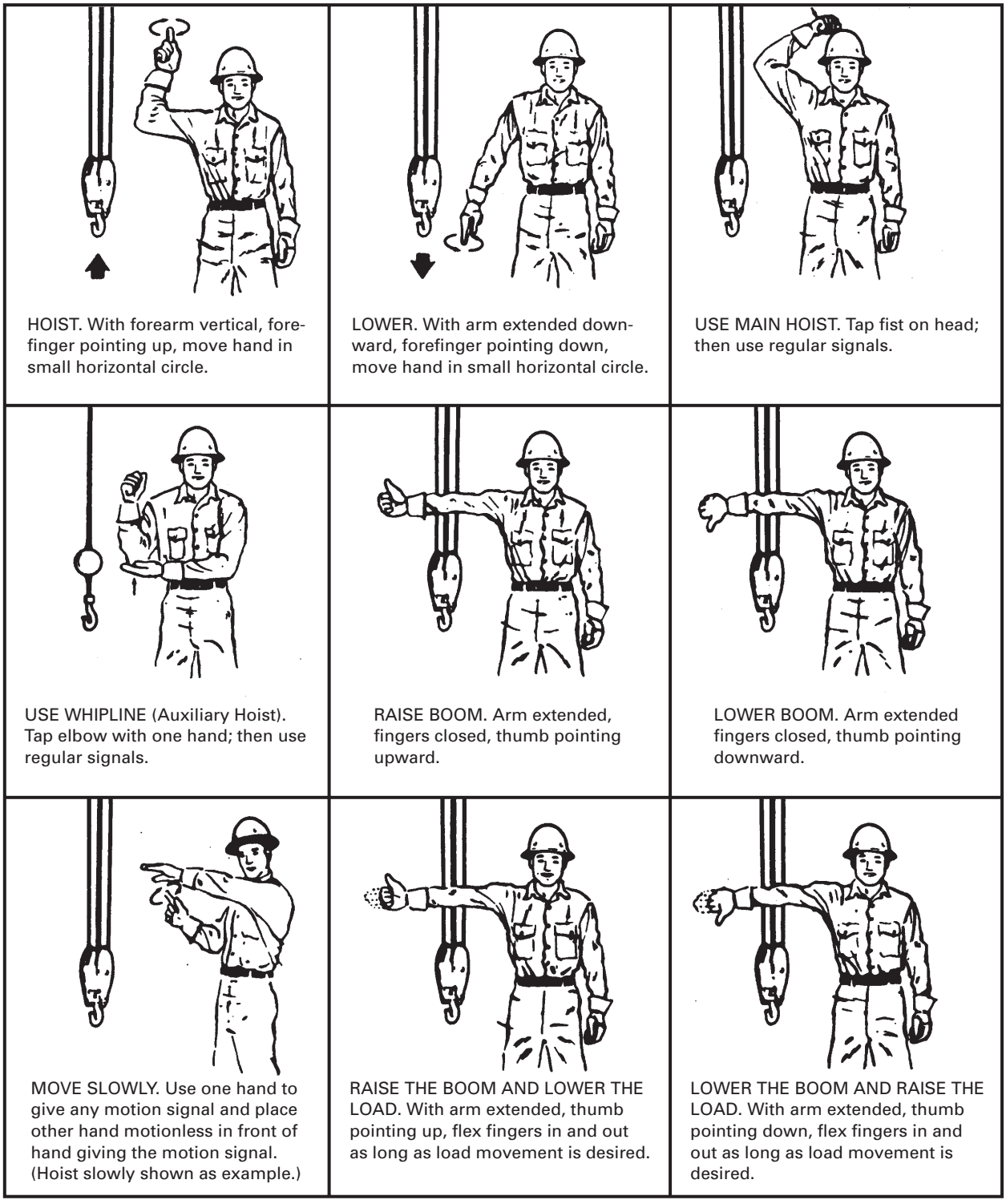


Fig. 7 Standard Hand Signals for Controlling Portal, Tower, and Pedestal Cranes

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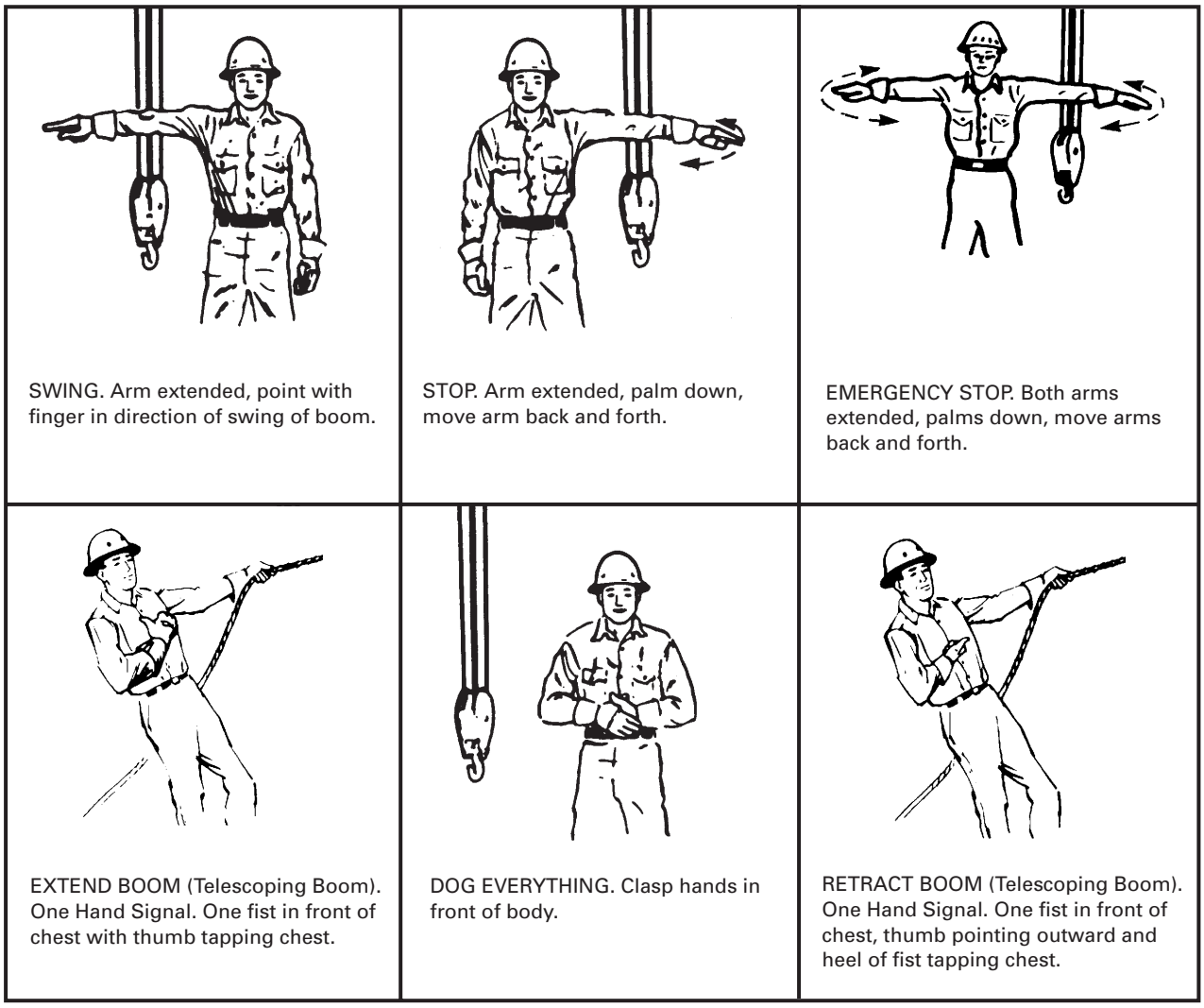


Fig. 7 Standard Hand Signals for Controlling Portal, Tower, and Pedestal Cranes (Cont'd)

(d) Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities verify that it is not an energized line.

(e) Exceptions to this procedure, if approved by the owner of the electrical lines, may be granted by the administrative or regulatory authority if the alternate procedure provides protection and is set forth in writing.

(f) When a crane is installed in proximity to power lines, durable signs shall be installed at the operator's station and on the base of the crane, warning that electrocution or serious bodily injury may occur unless a minimum clearance of 10 ft (3 m) is maintained between the crane or the load being handled, and energized power lines. Greater clearances are required because of higher voltage, as stated in para. 4-3.4.2(a)(1). These signs shall be revised when local jurisdiction requires greater clearances.

4-3.4.3 Cabs

(a) Necessary clothing and personal belongings shall be stored in such a manner as to not interfere with access or operation.

(b) Tools, oilcans, waste, and other necessary articles shall be stored in the toolbox, and shall not be permitted to lie loose in or about the cab.

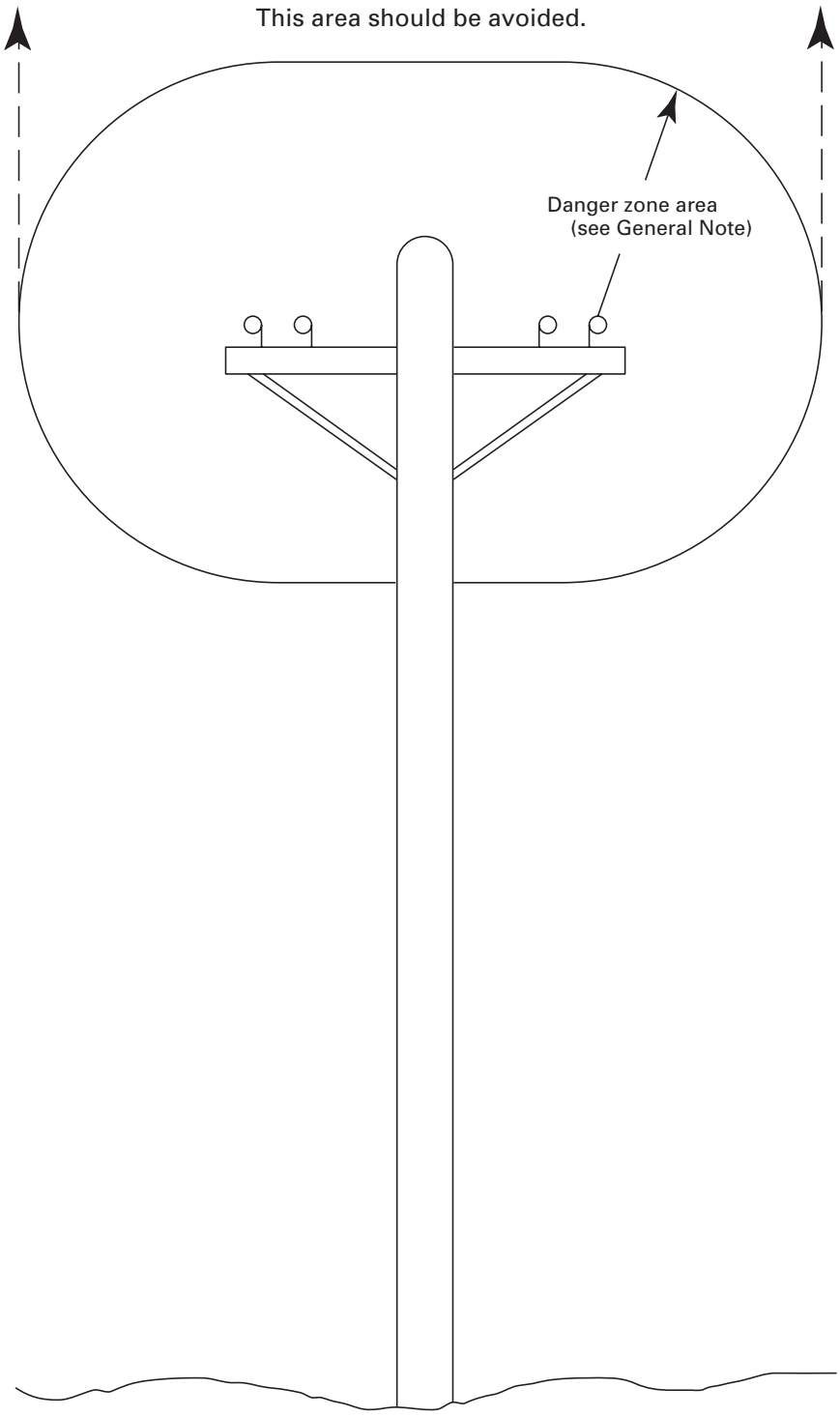
4-3.4.4 Refueling

(a) When refueling with gasoline using a portable container, it shall be a safety-type can equipped with automatic closing cap and flame arrester.

(b) Machines shall not be refueled with the engine running.

(c) Smoking or open flames shall be prohibited in the refueling area.

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GENERAL NOTE: For minimum radial distance of danger zone, see para. 4-3.4.2.

Fig. 8 Danger Zone for Cranes and Lifted Loads Operating Near Electrical Transmission Lines

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Table 1 Required Clearance for Normal Voltage in Operation Near High Voltage Power Lines

Normal Voltage, kV (Phase to Phase)	Minimum Required Clearance	
	ft	(m)
Operation Near High Voltage Power Lines		
To 50	10	(3.06)
Over 50 to 200	15	(4.6)
Over 200 to 350	20	(6.1)
Over 350 to 500	25	(7.62)
Over 500 to 750	35	(10.67)
Over 750 to 1000	45	(13.72)

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ASME B30.4 INTERPRETATIONS

Replies to Technical Inquiries
July 1995 through October 2002

FOREWORD

This publication includes all of the written replies issued between the indicated dates by the Secretary, speaking for the ASME B30 Committee, Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings, to inquiries concerning interpretations of technical aspects of ASME B30.4, Portal, Tower, and Pedestal Cranes.

These replies are taken verbatim from the original letters, except for a few typographical corrections and some minor editorial corrections made for the purpose of improved clarity. In some few instances, a review of the interpretations revealed a need for corrections of a technical nature: in these cases a corrected interpretation immediately follows the original reply.

These interpretations were prepared in accordance with accredited ASME procedures. ASME procedures provide for reconsideration of these interpretations when or if additional information is available which the inquirer believes might affect the interpretation. Further, persons aggrieved by this interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

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Interpretation: 4-3

Subject: ASME B30.4-1996, Portal, Tower, and Pedestal Cranes

Date Issued: May 23, 2000

Question: Can an "other positive locking device" consist of a "drum and/or disc-type braking system on the drum side of the hoist that is designed in a manner to activate during a power failure or at shutdown of the crane and is designed to be used in conjunction with additional braking methods that are directly linked to the shaft/motor side of the hoist?"

Reply: No.

Interpretation: 4-4

Subject: ASME B30.4-1996, Portal, Tower, and Pedestal Cranes

Date Issued: January 28, 2002

Question: Section 4-0.1 of B30.4 states that, "telescopic boom cranes and kunckle boom cranes are not within the scope of this volume". Is B30.4 applicable to pedestal cranes that have telescoping booms?

Reply: The Portal Tower, and Pedestal Cranes Volume is not applicable to your situation.

Although pedestal mounted, the type of crane you are using for handling large diameter hoses may be more similar to those addressed by the B30.5 Volume on Mobile and Locomotive Cranes with one exception: the Operating Practices of both B30.4 and B30.5 require that, "side loading of booms shall be limited to freely suspended loads. Cranes should not be used for dragging loads." If the hoses being handled are not freely suspended, the B30 Volumes would also not be applicable to your situation.

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