

ASME B30.29-2012

# Self-Erecting Tower Cranes

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

AN AMERICAN NATIONAL STANDARD



The American Society of  
Mechanical Engineers

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**The American Society of  
Mechanical Engineers**

Three Park Avenue • New York, NY • 10016 USA

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The next edition of this Standard is scheduled for publication in 2018. This Standard will become effective 1 year after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME Web site under the Committee Pages at <http://cstools.asme.org/> as they are issued. Interpretations will also be included with each edition.

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## FOREWORD

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

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

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

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

Due to changes in design, advancement in techniques, and general interest of labor and industry in safety, the Sectional Committee, under the joint sponsorship of ASME and the Bureau of Yards and Docks (now the Naval Facilities Engineering Command), U.S. Department of the Navy, was reorganized on January 31, 1962, with 39 members representing 27 national organizations.

The new Committee changed the format of ASA B30.2-1943 so that the multitude of equipment types it addressed could be published in separate volumes that could completely cover the construction, installation, inspection, testing, maintenance, and operation of each type of equipment included in the scope of ASA B30.2. This format change resulted in the initial publication of B30.3, B30.5, B30.6, B30.11, and B30.16 being designated as revisions of B30.2, with the remainder of the B30 volumes being published as new volumes. The USASI changed its name to the American National Standards Institute in 1969, which resulted in B30 volumes from 1943 to 1968 being designated as either ASA B30, USAS B30, or ANSI B30, depending on their date of publication.

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

This Standard presents a coordinated set of rules that may serve as a guide to government and other regulatory bodies and municipal authorities responsible for the guarding and inspection of the equipment falling within its scope. The suggestions leading to accident prevention are given both as mandatory and advisory provisions; compliance with both types may be required by employers of their employees.

In case of practical difficulties, new developments, or unnecessary hardship, the administrative or regulatory authority may grant variances from the literal requirements or permit the use of other devices or methods, but only when it is clearly evident that an equivalent degree of protection is thereby secured. To secure uniform application and interpretation of this Standard, administrative or regulatory authorities are urged to consult the B30 Committee, in accordance

with the format described in Section IX of the B30 Standard Introduction, before rendering decisions on disputed points.

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

The ASME B30 Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings has not included cranes referred to as self-erect tower cranes in the past. Self-erect tower cranes have distinct operating, erecting, and transporting characteristics that do not allow them to be included in ASME B30.3 or ASME B30.5. The use of these machines has increased rapidly in the United States of America in recent years. In 2007, the ASME B30 committee voted to form a subcommittee to write a volume for the B30 Safety Standard covering self-erecting tower cranes.

This first edition of the B30.29 Volume was approved by the B30 Standards Committee and by ASME. It was approved by ANSI and designated as an American National Standard on November 27, 2012.



# ASME B30 COMMITTEE

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

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

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

## B30 STANDARD INTRODUCTION

### SECTION I: SCOPE

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

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

- B30.1 Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries
- B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
- B30.3 Tower Cranes
- B30.4 Portal and Pedestal Cranes
- B30.5 Mobile and Locomotive Cranes
- B30.6 Derricks
- B30.7 Winches
- B30.8 Floating Cranes and Floating Derricks
- B30.9 Slings
- B30.10 Hooks
- B30.11 Monorails and Underhung Cranes
- B30.12 Handling Loads Suspended From Rotorcraft
- B30.13 Storage/Retrieval (S/R) Machines and Associated Equipment
- B30.14 Side Boom Tractors
- B30.15 Mobile Hydraulic Cranes  
(withdrawn 1982 — requirements found in latest revision of B30.5)
- B30.16 Overhead 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
- B30.27 Material Placement Systems
- B30.28 Balance Lifting Units
- B30.29 Self-Erecting Tower Cranes
- B30.30 Ropes<sup>1</sup>

### SECTION II: SCOPE EXCLUSIONS

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

### SECTION III: PURPOSE

The B30 Standard is intended to

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

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

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

### SECTION IV: USE BY REGULATORY AGENCIES

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

### SECTION V: EFFECTIVE DATE

(a) *Effective Date.* The effective date of this Volume of the B30 Standard shall be 1 yr after its date of issuance.

<sup>1</sup> This volume is currently in the development process.

Construction, installation, inspection, testing, maintenance, and operation of equipment manufactured and facilities constructed after the effective date of this Volume shall conform to the mandatory requirements of this Volume.

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

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

## **SECTION VI: REQUIREMENTS AND RECOMMENDATIONS**

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

## **SECTION VII: USE OF MEASUREMENT UNITS**

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

## **SECTION VIII: REQUESTS FOR REVISION**

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

Secretary, B30 Standard Committee  
ASME Codes and Standards  
Three Park Avenue  
New York, NY 10016-5990

Requests should be in the following format:

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

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

## **SECTION IX: REQUESTS FOR INTERPRETATION**

The B30 Standard Committee will render an interpretation of the provisions of the B30 Standard. Such requests should be directed to

Secretary, B30 Standard Committee  
ASME Codes and Standards  
Three Park Avenue  
New York, NY 10016-5990

Requests should be in the following format:

Volume: Cite the designation and title of the volume.  
Edition: Cite the applicable edition of the volume.  
Subject: Cite the applicable paragraph number(s) and the relevant heading(s).  
Question: Phrase the question as a request for an interpretation of a specific provision suitable for general understanding and use, not as a request for approval of a proprietary design or situation. Plans or drawings that explain the question may be submitted to clarify the question. However, they should not contain any proprietary names or information.

Upon receipt by the Secretary, the request will be forwarded to the relevant B30 Subcommittee for a draft response, which will then be subject to approval by the B30 Standard Committee prior to its formal issuance.

Interpretations to the B30 Standard will be published in the subsequent edition of the respective volume, and will be available online at <http://cstools.asme.org>.

## **SECTION X: ADDITIONAL GUIDANCE**

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

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

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

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

(d) the type of attachments

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

(f) environmental conditions causing corrosion or wear

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

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

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# SELF-ERECTING TOWER CRANES

## Chapter 29-0 Scope, Definitions, and References

### SECTION 29-0.1: SCOPE OF B30.29

Volume B30.29 includes provisions that apply to the construction, operation, inspection, testing, and maintenance of powered self-erect tower cranes that adjust operating radius by means of a trolley traversing a jib. These may be horizontal, elevated, articulating, or telescoping, and used for vertical lifting and lowering of freely suspended, unguided loads that consist of equipment and materials.

Self-erect tower cranes have vertical or nearly vertical masts that are bottom slewing and mounted on fixed, traveling, or mobile bases. The cranes are capable of moving or being moved from jobsite to jobsite fully assembled or nearly fully assembled.

This Volume does not apply to cranes used for nonvertical lifting service or lifting a guided load, or to truck-mounted material delivery cranes with a tubular boom and trolley traversing the boom. Tower cranes (refer to ASME B30.3) and mobile crane tower attachments (refer to ASME B30.5) are not within the scope of this Volume.

### SECTION 29-0.2: DEFINITIONS

#### 29-0.2.1 Types of Self-Erect Tower Cranes

See Figs. 29-0.2.1-1 and 29-0.2.1-2.

#### 29-0.2.2 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 as satisfactory by a duly constituted administrative or regulatory authority.

*axis of rotation*: the vertical line about which a crane swings.

*axle*: the shaft or spindle with which or about which a wheel rotates. On wheel-mounted cranes, it refers to

a type of axle assembly including housings, gearing, differential, bearings, and mounting appurtenances.

*balanced*: the condition of the superstructure of a self-erect crane necessary for telescoping the mast; the load is positioned at that radius that causes the vertical moment of the superstructure about the balance point to go to zero.

*ballast*: weights added to the fixed frame to create additional stability or to counter the effects of the lifted load.

*bogie*: the assembly that includes a pivot, frame, axle(s), and wheel(s) on which a crane rides on rails, and includes an assembly of two or more axles arranged to permit both vertical wheel displacement and an equalization of loading on the wheels.

*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 or trolley reaches the end of its permitted travel.

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

*control station*: the location of the crane function controls, either cab-mounted or by remote control.

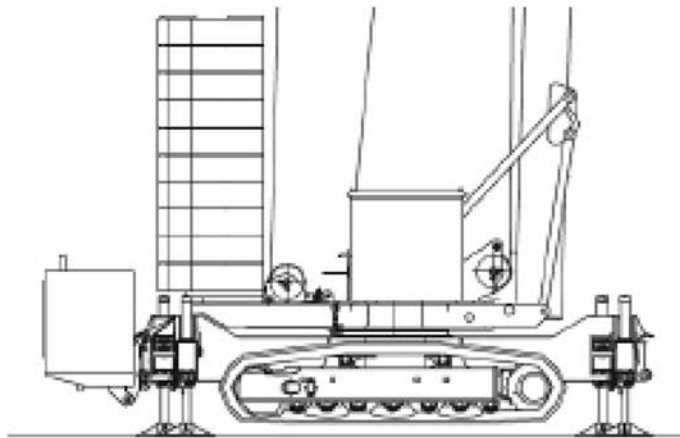
*counterweight*: weights added to the rotating frame to create additional stability or to counter the effects of the lifted load.

*crane*: in this Volume, the use of the word "crane" refers to self-erect cranes, which are lifting machines, mounted on a base, with a superstructure consisting of a mast, rotating frame, and a jib.

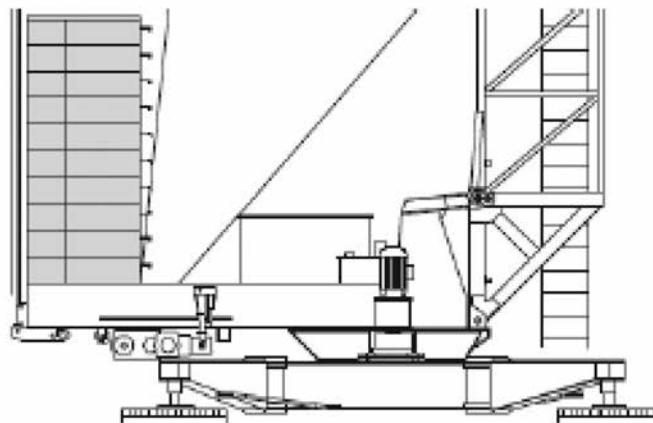
*crossover points*: points of rope contact where one layer of rope on a rope drum crosses over the previous layer.

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

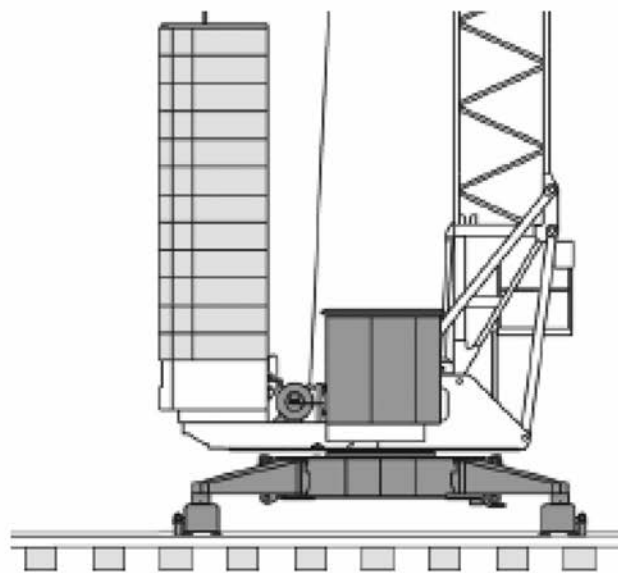
Fig. 29-0.2.1-1 Types of Self-Erect Tower Cranes by Base Type



(a) Crawler



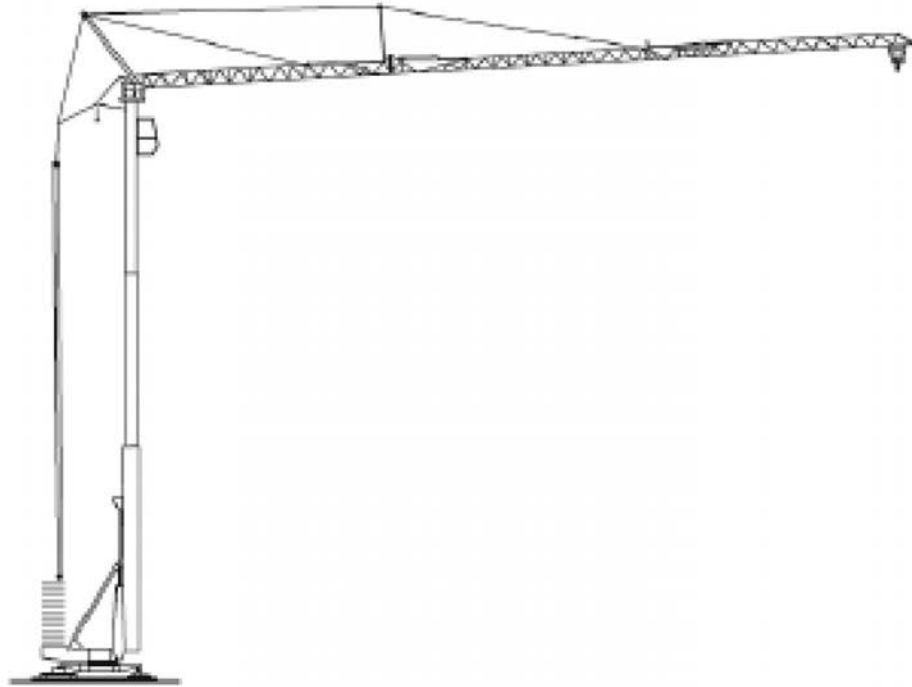
(b) Outrigger



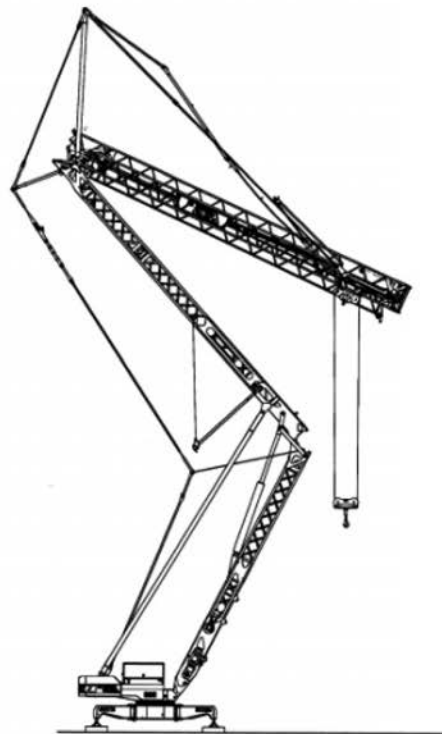
(c) Rail Traveling



**Fig. 29-0.2.1-2 Types of Self-Erect Tower Cranes by Mast Type**



**(a) Telescoping**



**(b) Folding**

*direct supervision:* a designated operator in the immediate area of the trainee, within visual sighting distance, and able to effectively communicate with the trainee. The designated operator shall have no duties other than observing the operation of the crane by the trainee.

*dismantle:* to fold/retract and disassemble crane for removal or relocation.

*dog everything:* apply or engage all brakes, locks, and pawls.

*drum:* the cylindrical member around which rope is wound; used for multiple functions on the crane.

*dynamic loading:* loads introduced into the machine or its components due to accelerating or decelerating forces.

*ensure:* the term used when the meaning "take steps to see that" or "make sure" is intended.

*equalizer:* a device that compensates for unequal length of two or more supporting components.

*erection:* assembly, setup, and initial configuration of the crane.

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

*folding jib:* a multiple-section jib that folds or unfolds into the erected, reconfigured, or dismantled position.

*folding mast:* a multiple-section mast that folds or unfolds into the erected or dismantled position.

*gage, track:* the horizontal distance between two rails measured perpendicular to the rails.

*hoist mechanism:* a hoist drum and rope reeving system; used for one or more functions on the crane.

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

*jib:* the structural member attached to the mast of a crane on which the trolley travels when changing load radius.

*jobsite:* area within the boundaries of the project where the crane is to be operated.

*limiting device:* a mechanical or electrical device that interacts with some part of a power-driven machine or equipment to control loads or motions of the machine or equipment.

*load:* the total weight applied to the load block or hook.

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

*load block, upper:* the assembly of sheaves and pins mounted in the trolley.

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

*load indicator:* a device that measures the weight of the load.

*mast:* vertical or near vertical structure that allows for the support of the jib and the load.

*minimum breaking force:* the minimum load at which a new and unused wire rope will break when loaded to destruction in direct tension.

*operational aid:* an accessory that provides information to facilitate operation of a crane or that takes control of particular functions without action of the operator when a limiting condition is sensed.

*out-of-operation:* the condition of a crane during erection, dismantling, reconfiguration, or adjustment/repairs when not in lifting service.

*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.

*outriggers:* extendable or fixed members attached to the mounting base that rest on supports at the outer ends used to support the crane.

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

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

*pendant:* a rope or bar of specified length with fixed end connections.

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

*qualified operator:* an operator who has met the requirements of paras. 29-3.1.2(a) through (c).

*qualified person:* a person who, by possession of a recognized degree in an applicable field or a certificate of professional standing, or 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 the crane's axis of rotation to the center of the 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.

*rated capacity indicator:* a device that automatically monitors radius, load weight, and load rating, and warns the crane operator of an overload condition.

*rated capacity (load) limiter:* a device that automatically monitors radius, load weight, and load rating, and prevents movements of the crane that would result in an overload condition.

*rated load (load rating):* the maximum allowable load at each lifting radius, designated by the manufacturer; rated loads are expressed in pounds, kilograms, short tons, or metric tons.

*reconfigure*: to change the mast height, jib length, or jib angle.

*remote control*: a radio or cable control device used to activate the crane control functions.

*rope*: refers to wire rope unless otherwise specified.

*rotating frame*: a horizontal member of a crane on which the mast, counterweights, and usually the hoisting machinery are mounted.

*rotation-resistant rope*: wire rope consisting of an inner layer of strands laid in one direction covered by a layer of strands laid in the opposite direction.

*running rope*: a rope that travels around sheaves or drums.

*shall*: indicates that a rule is mandatory and must be followed.

*sheave*: a grooved wheel or pulley used with a rope to change the direction and point of application of a pulling force.

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

*side loading*: a load applied at an angle to the vertical plane of the jib.

*standing rope*: a fixed-length supporting rope intended to maintain a nominally fixed distance between the two points of attachment; may also be called a stay rope, guy rope, or pendant.

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

*superstructure*: the portion of the crane above the slewing bearing.

*swing mechanism*: the machinery involved in providing rotation of the superstructure.

*telescoping jib*: a base jib from which one or more jib sections are telescoped for additional length.

*telescoping mast*: a base mast from which one or more mast sections are added or telescoped for additional height.

*travel truck*: the enclosure that houses the bogie.

*trolley*: the component of the crane that travels along the jib of a self-erect crane and contains the upper load block.

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

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

*weathervaning*: releasing of the swing brakes to allow wind-induced free rotation of a crane superstructure

when out of service to expose minimal surface area to the wind.

*wind area balance*: the projected surface area that a jib presents to the wind when it is free to rotate in the wind and achieves directional equilibrium, i.e., aligns itself with the wind direction.

*working rope*: portion of running rope that is spooled off the drum during operation.

### SECTION 29-0.3: REFERENCES

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

- ANSI A14.3-2008, Safety Requirements for Ladders — Fixed
- ANSI/ASSE A1264.1-2007, Safety Requirements for Workplace Walking/Working Surfaces and Their Access; Workplace Floor, Wall, and Roof Openings; Stairs and Guardrails Systems
- ANSI/SAE Z26.1-1996, American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways — Safety Code
- Publisher: American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036 ([www.ansi.org](http://www.ansi.org))
- ANSI/AWS D1.1-08, Structural Welding Code — Steel
- ANSI/AWS D14.3-05, Specification for Welding Earth-Moving and Construction Equipment
- Publisher: American Welding Society (AWS), 8669 Doral Boulevard, Doral, FL 33166 ([www.aws.org](http://www.aws.org))
- ANSI/NEMA ICS 2-2000, Industrial Systems
- ANSI/NEMA ICS 18-2001, Motor Control Centers
- Publisher: National Electrical Manufacturers Association (NEMA), 1300 North 17th Street, Rosslyn, VA 22209 ([www.nema.org](http://www.nema.org))
- ANSI/NFPA 70-2008, National Electrical Code
- Publisher: National Fire Protection Association (NFPA), One Batterymarch Park, Quincy, MA 02269-9101 ([www.nfpa.org](http://www.nfpa.org))
- ASME B30.9-2010, Slings
- ASME B30.10-2009, Hooks
- ASME B30.20-2010, Below-the-Hook Lifting Devices
- ASME B30.23-2005, Personnel Handling Systems
- ASME B30.26-2010, Rigging Hardware
- Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900 ([www.asme.org](http://www.asme.org))
- EN 14439:2010, Crane-Safety — Tower Cranes
- Publisher: DIN Deutsches Institut für Normung e. V., Am DIN-Platz, Burggrafenstraße 6, 10787 Berlin, Germany ([www.din.de](http://www.din.de))

ISO 7000, Graphical symbols for use on equipment<sup>1</sup>

ISO 7296-1, Cranes — Graphical symbols — Part 1:  
General<sup>1</sup>

ISO 7296-2, Cranes — Graphical symbols — Part 2:  
Mobile cranes<sup>1</sup>

ISO 7296-3, Cranes — Graphical symbols — Part 3:  
Tower cranes<sup>1</sup>

Publisher: International Organization for  
Standardization (ISO) Central Secretariat, 1, ch. de la  
Voie-Creuse, Case postale 56, CH-1211, Genève 20,  
Switzerland/Suisse ([www.iso.org](http://www.iso.org))

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<sup>1</sup> May also be obtained from the American National Standards  
Institute (ANSI), 25 West 43rd Street, New York, NY 10036.

## Chapter 29-1

# General Construction and Installation

### SECTION 29-1.1: SITE PREPARATION AND ERECTION

#### 29-1.1.1 Crane Supports

(a) Crane supports for individual outrigger pads shall be level in accordance with the manufacturer's specifications or those of a qualified person. Supports may be individual timbers, mats, or engineered structural supports to distribute the load so as not to exceed the allowable bearing capacity of the underlying material as determined by a qualified person.

(b) Consideration should be given to the length of time that the crane will be erected in one position and the likely deterioration of the ground or supports over time (e.g., timber deterioration, undermining by water or frost, drying out, adjacent excavations and trenches).

(c) All load-bearing structural supports and rail supports shall be designed and installed to support the crane loads.

(d) All excavations in the proximity of foundations, supports, and rail supports shall be evaluated and approved by a qualified person.

(e) Rails shall be attached to their supports in a manner capable of resisting the applicable horizontal loads determined by the manufacturer or by a qualified person.

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

(g) When required, a designated portion of track or a designated portion of the working track shall 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.

(h) The crane manufacturer or a qualified person shall provide maximum resulting loads at the base of the crane, or wheel loads, for use in design of the supports [see (a) above].

#### 29-1.1.2 Erection, Reconfiguring, and Dismantling

(a) The area in which a self-erect tower crane is to be installed shall be assessed to ensure that it is suitable before the crane is delivered and put into service. The area chosen shall be of a sufficient size to enable the self-erect tower crane to be maneuvered into position, set up, operated, and dismantled with sufficient clearances between the crane and surrounding structures.

(b) When cranes are erected, reconfigured, or dismantled, written instructions by the manufacturer shall be followed. If circumstances do not permit the manufacturer's written instructions to be followed, alternative written instructions from the manufacturer or qualified person shall be followed.

(c) When cranes are erected, reconfigured, or dismantled, the written instructions and a list of the weights of each subassembly shall be at the site.

(d) Procedures shall be established before erection, reconfiguration, or dismantling work commences to implement the written instructions and to adapt them to the particular needs of the site.

(e) Erection, reconfiguration, and dismantling shall be performed under the supervision of a designated person.

(f) Identify related hazards on the site prior to erection, reconfiguration, or dismantling. A qualified person shall be consulted if hazards are identified.

(g) A designated person should prepare a site plan of the project. The plan, if prepared, shall include, but not be limited to, the following information:

- (1) name and address of project
- (2) name and contact information of person preparing site plan
- (3) plan and elevation drawings
- (4) outline of the building and property under construction
- (5) location of the crane with positioning dimensions
- (6) erection and dismantling clearances
- (7) make, model, and configuration of crane selected
- (8) maximum hook reach
- (9) height under hook
- (10) rated load at maximum radius
- (11) identified hazards

(h) If a site plan exists, the crane shall be erected in the position shown on the plan. Any changes in crane location shall be approved and documented by a qualified person.

(i) Since crane masts or other components may use connections with special devices or high-strength bolts, a designated person shall instruct the erection personnel in identifying and installing these special devices or high-strength bolts.

(j) When assembling mast sections connected by high-strength bolts, the bolts shall be tensioned in accordance with the requirements of the manufacturer or, if the manufacturer no longer exists, a qualified person.

(k) Bolts, pins, or other connection components that will be reused shall be inspected for defects prior to installation. Reasons for rejection include, but are not limited to

- (1) visible cracks
- (2) difficulty in threading a nut by hand
- (3) visible elongation
- (4) pitting or gouging

(l) Before crane components are erected, they shall be visually inspected for damage from shipping and handling. Damaged structural members shall not be erected until replaced or repaired in accordance with the requirements of the manufacturer or a qualified person [see para. 29-3.1.3.1.1(c)].

(m) Ballast and its lifting points shall be inspected for damage before lifting the ballast into place.

(n) Slings and lifting accessories shall be selected and arranged so as to avoid damaging crane members during erection, reconfiguration, and dismantling.

(o) Erection, reconfiguration, and dismantling should be suspended when adverse conditions exist. These conditions include, but are not limited to

- (1) deteriorating support
- (2) wind velocity or gusting winds
- (3) heavy rain
- (4) lightning
- (5) fog
- (6) extreme cold or heat
- (7) ice or snow
- (8) inadequate lighting

(p) When a crane is required to weathervane when out of service, it shall be installed with clearance for the jib and superstructure to swing through an unobstructed 360-deg arc and without encroaching upon any power line danger zone.

(q) Advertising signs or similar panels shall not be installed on the crane unless in accordance with the manufacturer's or a qualified person's instructions [see para. 29-3.1.3.1.1(c)].

(r) Artificial lighting shall not be installed on the crane unless in accordance with the manufacturer's or a qualified person's instructions [see para. 29-3.1.3.1.1(c)].

(s) Crane bases shall be ballasted in accordance with the requirements of the manufacturer or a qualified person.

(t) Rails shall be level and straight unless specifically designed for curves or grades. They shall be properly spaced for the travel trucks in accordance with the manufacturer's or a qualified person's specifications. The track and support system shall have sufficient rigidity to limit dynamic oscillations and deviations from plumb.

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

(v) Both ends of all tracks shall be equipped with stops or buffers adjusted for simultaneous contact with both sides of the travel trucks. Stops attached to rails shall be mounted in accordance with the requirements of the manufacturer or a qualified person.

(w) Provisions shall be made to prevent traveling bases from rolling on the track in the event of high winds.

### 29-1.1.3 Operational Tests

Operational tests are intended to verify that the crane can satisfactorily perform its intended functions and is in compliance with the manufacturer's specifications. If indications of unsatisfactory performance of any function are observed, further testing shall be discontinued until a qualified person has verified that the crane performance and condition are satisfactory.

(a) When cranes are erected and after each reconfiguration, before placing the crane in service, all functional motions, motion-limiting devices, brakes, and indicating devices shall be tested for proper operation.

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

(1) *Functional Motion Tests Without Load*. Each test shall include

- (a) hoisting and lowering
- (b) traversing the trolley
- (c) swing motion
- (d) brakes and clutches
- (e) operational aids and motion-limiting devices

(2) *Functional Load Tests at Rated Load*. Each test shall include

- (a) load hoisting and lowering
- (b) traversing the trolley
- (c) swing motion
- (d) brakes and clutches
- (e) operational aids and load-limiting devices

During testing, the crane supports shall be checked. Any observed displacement is reason to suspend testing until an evaluation is made by a qualified person.

(3) For cranes mounted on engineered structural supports, the test shall be conducted as follows:

(a) A test shall be conducted with the maximum moment load placed at maximum radius permitted by site limitations. The superstructure shall be rotated through 360 deg or maximum degrees of rotation permitted by site limitations, with 5-min stops at each outrigger position or as close to each outrigger position as site limitations permit. If any part of the support structure becomes displaced or distressed, all crane operations shall stop until an evaluation is made by a qualified person.

(b) For rail-mounted cranes, a load test shall be conducted with the jib in the position causing maximum

loading on one wheel or bogie. The test shall comprise traveling the entire length of the runway, then returning with the same load on the other rail. If a sleeper or support becomes displaced or damaged, crane operations shall stop until an evaluation is made by a qualified person. Where traveling with a load is not permitted by the manufacturer, the load test shall be conducted with the superstructure positioned to create maximum loading on one wheel or bogie.

## **SECTION 29-1.2: RATED LOADS**

### **29-1.2.1 Rated Loads Where Stability Governs Lifting Performance**

(a) For each stipulated operating radius, the rated load shall be in accordance with EN 14439, section 5-2.

(b) Wind force effect on stability shall be determined using the maximum in-service wind velocity, as specified by the manufacturer, applied in the direction least favorable to stability.

(c) 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 rated loads.

(d) The following stipulations shall apply to the establishment of rated loads:

(1) The crane shall be mounted level as specified by the manufacturer, but for those cranes that exhibit significant elastic deformation due to dead, live, wind, or dynamic loads, the effect of such deformations on stability shall be taken into account.

(2) Lifting attachments that are a permanent part of the crane shall be considered part of the dead load for stability calculations.

(3) The manufacturer shall specify if outriggers and/or counterweight/ballast are required to achieve stability.

(4) For rail-mounted cranes, the track shall be level as specified by the manufacturer. Where the manufacturer information does not exist, the rail shall be level in accordance with EN 14439. See paras. 29-1.1.1(c) through (h).

(e) The effectiveness of these preceding stability factors will be influenced by such additional factors as freely suspended loads; track, wind, or ground conditions; jib lengths; proper operating speeds for existing conditions; and, in general, careful and competent operation.

### **29-1.2.2 Rated Loads Where Structural Competence Governs Lifting Performance**

(a) For each stipulated operating radius, the rated load shall be in accordance with EN 14439, section 5-2. Dynamic effects associated with hoisting and slewing shall be considered.

(b) Wind shall be determined in the least favorable direction and at the maximum in-service velocity, as specified by the manufacturer.

(c) 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.

(d) The following stipulations shall apply to the establishment of rated loads:

(1) The crane shall be mounted level, except as in para. 29-1.2.1(c), but for those cranes that exhibit significant elastic deformation due to dead, live, wind, or dynamic loads, the effects of such deformations shall be taken into account.

(2) Lifting attachments that are a permanent part of the crane in its working condition shall be considered part of the dead load for rating calculation purposes whether or not such attachments are part of published rated loads.

### **29-1.2.3 Rated Load Chart**

Durable rating charts with legible letters and figures shall be provided with each crane, one attached to the crane and one in the operator's manual. The content of these charts shall include, but not be limited to, the following:

(a) a full and complete range of crane rated loads at all stated operating radii, jib lengths, hoist line reeving, and, where appropriate, for each available hoist line speed range and counterweight configuration.

(b) precautionary or warning notes relative to limitations on equipment and operating procedures.

(c) maximum permissible in-service wind velocity.

(d) notification that slings and lifting attachments are part of the load. If the lower load block is considered as part of the load, the rating chart shall so state.

(e) notification that the weight of hoist ropes beyond a stated suspended length are to be taken as part of the load.

(f) erection and dismantling clearances.

## **SECTION 29-1.3: STABILITY**

### **29-1.3.1 Backward Stability**

An unloaded crane exposed to in-service wind forces in the unfavorable direction, and to an upward force at the trolley or jib tip equal to 30% of the rated load at any operating radius, shall not tip over backward. Additionally, the crane shall not tip over backward with 100% of the actual weight of the jib plus the fixed load handling attachments and the full unfavorable in-service wind. Outriggers or counterweight/ballast shall be specified to achieve backward stability.

### 29-1.3.2 Out-of-Service Stability

(a) Self-erect tower cranes shall not become unstable when exposed to 120% of the force induced by out-of-service winds in each recommended configuration. For weathervaning jibs, the jib shall be taken in the attitude dictated by its wind area balance. Nonweathervaning jibs shall be taken in the least favorable attitude. Traveling cranes shall not slide when exposed to out-of-service wind. Rail clamps can be used to resist sliding, but they shall not be used to meet stability requirements.

(b) The out-of-service wind velocity shall be specified. Recommendations on permitted configurations at several wind velocity levels should be given [see para. 29-1.4.1(a)(2)].

(c) Out-of-service stability requirements may be satisfied by using outriggers or counterweight/ballast when necessary, but rail clamps shall not be used for this purpose.

### 29-1.3.3 Outriggers

(a) The manufacturer's documentation for the crane shall describe the use of outriggers and whether they are required for in-service, out-of-service, or backward stability.

(b) Means shall be provided to hold all outriggers in the retracted position while traveling, and in the extended position when set for operating.

(c) Power-actuated jacks, where used, shall be provided with the means (such as integral load hold check valves on hydraulic cylinders, mechanical locks, etc.) to prevent uncontrolled cylinder movement.

(d) Means shall be provided for fastening outrigger floats to outriggers when in use.

### 29-1.3.4 Altered or Modified Cranes

The following requirements shall be met when cranes are altered or modified:

(a) The alteration or modification shall be done by or approved by the manufacturer or a qualified person [see para. 29-3.1.3.1.1(d)].

(b) The manufacturer or a qualified person should reply in writing to requests for modifications, alterations, or deviations. If the manufacturer reviews the request and provides a written denial based on technical merit, approval from a qualified person shall not be obtained to override the manufacturer's denial. The written denial shall include details specific to the technical reasoning supporting the denial.

(c) Signed and dated copies of the calculations, drawings, and other documents prepared for the alteration or modification shall be maintained by the owner of the crane.

(d) The alteration or modification shall comply with the applicable requirements of this Volume.

(e) The crane shall be tested in accordance with Section 29-2.2 with records kept. The records shall

include a description of the tests performed, the rationale for selecting those test conditions, the date and weather conditions at the time of testing, and the signature of the qualified person who supervised the tests.

## SECTION 29-1.4: DOCUMENTATION

Documentation shall be provided in English. Non-English documentation shall be translated into English in accordance with the following guidelines:

(a) The wording of written, non-English safety information and manuals regarding use, inspection, and maintenance shall be translated into English by professional translation industry standards, which include, but are not limited to

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

(2) grammatically accurate

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

(4) accurate translation of the terminology

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

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

(c) Pictograms used to identify controls shall be described in the manuals. The pictograms should comply with ISO 7000, ISO 7296, or other recognized sources, if previously defined. The text of the description shall meet the criteria of paras. (a) and (b) above.

(d) Any non-English documentation provided in addition to English shall be translated and reviewed in accordance with the requirements listed above.

### 29-1.4.1 Informational Literature

Each crane shall be provided with informational literature in accordance with Section 29-1.4 and include, but not be limited to, information on the following:

(a) installation preparation instructions, which shall provide

(1) maximum outrigger pad load including vertical, horizontal, and torsional forces

(2) jib length, configuration, or mast height limitations based on various wind velocity levels for out-of-service conditions

(3) maximum wind velocity for which traveling cranes possess adequate resistance to sliding in each permitted configuration

(4) precautions that must be taken to secure cranes installed in geographical areas of higher wind velocity

(5) outrigger or counterweight/ballast requirements

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



- (7) crane dimensional data
- (b) erection and dismantling instructions, which shall provide, when applicable
  - (1) weight and dimensions for components and subassemblies
  - (2) recommended attachment points for crane components routinely lifted during erection, reconfiguration, and dismantling
  - (3) the method and recommended sequence of erection and dismantling of components and subassemblies
  - (4) means for deploying outriggers (see para. 29-1.3.3)
  - (5) 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 high-strength bolts; the point in time in the erection process for applying torque or tension; and the means for retaining pins, etc.
  - (6) environmental limitations including, but not limited to, wind velocity and temperature
  - (7) environmental hazards including, but not limited to, exposure to salinity and chemicals
- (c) operating instructions, limitations, and precautions
  - (d) proper use of radio remote controls if so equipped
  - (e) maintenance, service, inspection, and repair information
  - (f) location, function, proper settings, and adjustments of limiting and indicating devices including operational aids
  - (g) electrical requirements showing the voltage, amperage, phasing, grounding, and any other information specific to the crane
  - (h) location and required settings of hydraulic or pneumatic pressure-relief valves and locations of points where circuit pressures can be checked [see paras. 29-1.19.8(a) and (b)]

## SECTION 29-1.5: HOISTING AND ERECTING MECHANISM

### 29-1.5.1 General Requirements

- (a) Unless directly coupled to an electric or hydraulic motor power source, load-hoisting mechanisms shall be provided with a clutching or power-disengaging device.
- (b) Electric motor-operated cranes that are powered by a generator shall be provided with overspeed protection or the generator shall be sized to absorb the regenerative power produced by the crane.
- (c) *Load Hoists*
  - (1) The load hoist shall be capable of hoisting and lowering rated loads when fitted with recommended reeving.
  - (2) Hooks shall be equipped with latches unless the application makes use of the latch impractical. When

provided, the latch shall bridge the throat of the hook to retain slings, chains, etc., under slack conditions. Refer to ASME B30.10.

### 29-1.5.2 Hoist Drums

- (a) The drum end of the rope shall be attached to the drum as recommended by the crane or rope manufacturer.
- (b) The drum flanges shall extend a minimum of  $\frac{1}{2}$  in. (13 mm) or one-half rope diameter, whichever is greater, over the top of the rope during operation.
- (c) The diameter of the drum shall be sufficient to provide a first layer rope pitch diameter not less than 18 times the nominal diameter of the rope used.
- (d) No less than three full wraps of rope shall remain on the load hoist drum(s) at any time during operation.
- (e) Load hoist drums shall be arranged so that load lowering shall be done only under power control.

### 29-1.5.3 Hoist Brakes

- (a) Hoists shall be equipped with at least one braking means that is capable of providing a minimum of 125% of the full load-hoisting torque at the point where the braking is applied.
- (b) Each load hoist shall be equipped with braking means capable of providing controlled lowering speeds.
- (c) Automatic means shall be provided to apply the hoist brake in the event of loss of brake-actuating power.
- (d) When automatic braking is provided, a means such as a manual release should be furnished to permit controlled lowering of the load in the event of loss of power or pressure.

### 29-1.5.4 Hoist Sheaves

- (a) Sheave grooves shall be free from surface conditions 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 outward and rounded at the rim 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 with permanently lubricated bearings.
- (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. The pitch diameters of trolley sheaves shall not be less than 15 times the nominal diameter of the rope used.
- (e) The sheaves in the lower load block shall be equipped with close-fitting guards that will guard

against ropes becoming fouled when the block is lying on the ground with ropes loose.

#### **29-1.5.5 Hoist Ropes**

(a) All ropes shall be of construction recommended for their service by the crane or rope manufacturer or by a qualified person.

(b) The design factor for hoist ropes shall not be less than five.

(c) Design factors shall be the total minimum breaking force of all the supporting ropes divided by the static load imposed on those ropes when supporting their maximum loads.

(d) For ambient temperatures at the rope in excess of 180°F (82°C), rope having an independent wire rope or wire strand core or other temperature damage-resistant core shall be used.

(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 wire rope or fitting.

### **SECTION 29-1.6: SLEWING (SWING) MECHANISM**

#### **29-1.6.1 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 to render the rotating superstructure free to rotate.

#### **29-1.6.2 Swing Brakes**

A braking means with holding power in both directions shall be provided to prevent movement of the rotating superstructure 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.

### **SECTION 29-1.7: TRAVEL EQUIPMENT**

#### **29-1.7.1 General Requirements**

(a) Rail-mounted cranes shall be equipped with means to prevent running into the buffers or stops while under power.

(b) Drives shall be capable of smooth starts and stops, and provide varying degrees of acceleration and deceleration.

(c) An audible signal shall automatically sound whenever the crane travels in order to warn persons in the vicinity.

#### **29-1.7.2 Bogies**

(a) Bogies shall be fitted with sweeps extending below the top of the rail and placed in front of the leading

wheel in either direction unless the construction of the rail foundation prohibits such extension.

(b) Bogie wheels shall be guarded.

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

### **SECTION 29-1.8: MAST ERECTION EQUIPMENT**

(a) Positive means shall be provided to hold the raised portion of the crane in position at the completion of a telescoping intermediate step and at the position where the crane will be put back into service.

(b) Steel wedges, when used, shall be provided with means to hold them in the engaged position and prevent their dropping when disengaged.

(c) Ropes, when used for or in conjunction with telescoping, shall be equalized and shall have a design factor of not less than 3.5 to 1. Means shall be provided to minimize the possibility of the crane jamming during raising and lowering or to protect the rope from being excessively loaded.

### **SECTION 29-1.9: JIB ERECTION EQUIPMENT**

(a) Positive means shall be provided to hold the portion of the elevated jib in position where the crane will be put into service.

(b) Ropes, when used for or in conjunction with jib erecting or suspension, shall be equalized and shall have a design factor not less than 3.5 to 1.

### **SECTION 29-1.10: TROLLEYS**

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

(b) Both ends of the jib shall be equipped with stops or buffers.

(c) The body or frame of the trolley shall be fitted with means to restrain the trolley from becoming detached from its guide rail(s) in the event of trolley wheel or axle breakage or side loading.

(d) 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.

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

**SECTION 29-1.11: BRAKES**

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

(b) Braking means, whether functioning mechanically, pneumatically, hydraulically, or electrically, shall have heat dissipation capability consistent with service needs.

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

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

**SECTION 29-1.12: OPERATIONAL AIDS**

(a) Indicating devices shall be provided to display

- (1) the weight of the load on the hook
- (2) the operating radius
- (3) ambient wind velocity (see para. 29-1.19.7)

(b) Where radio remote controls are used they shall incorporate the displays as required in (a) above.

(c) Limiting devices shall be provided to

(1) decelerate the trolley travel at both ends of the jib prior to final limit activation

(2) limit trolley travel at both ends of the jib

(3) limit jib telescoping at inner and outer position

(4) limit tower telescoping at upper and lower positions

(5) decelerate the hook block prior to final limit activation

(6) stop load block upward motion before two-blocking occurs, and when necessary to reconfigure the reeving, a means to override the upper limit shall be provided

(7) stop load block downward motion to prevent the last three wraps of wire rope from spooling off the hoist drum

(8) limit crane travel at both ends of the runway tracks

(9) limit weight of the lifted load to within the crane's rated capacity

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

(11) limit pressures in hydraulic or pneumatic circuits [see para. 29-1.19.8(a)]

(d) Load-limiting devices and acceleration/deceleration limiters should be installed in enclosures that can be locked or sealed to prevent tampering and unauthorized adjustment.

**SECTION 29-1.13: PENDANTS AND STAY ROPES**

(a) For standing ropes, the minimum design factor shall be three. Fiber core ropes with swaged fittings shall not be used for pendants or stay ropes.

(b) Standing ropes that are used as live ropes during erection shall have a minimum design factor of three for the loads occurring during erection, but shall comply with (a) above for the erected condition.

(c) The design factors in (a) and (b) above shall be the total minimum breaking force of all the supporting ropes divided by the static load imposed on those ropes when supporting their maximum loads.

(d) Sheaves used during erection and dismantling that remain in the support system shall comply with para. 29-1.5.4.

**SECTION 29-1.14: REEVING ACCESSORIES**

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

(b) Swaged, compressed, or wedge socket fittings shall be applied as recommended by the rope, crane, or fitting manufacturer.

(c) Wire rope clips used in conjunction with wedge sockets shall be attached to the unloaded dead end of the rope only. This does not preclude the use of devices specially designed for dead ending rope in a wedge socket. See Fig. 29-1.14-1.

**SECTION 29-1.15: COUNTERWEIGHT AND BALLAST**

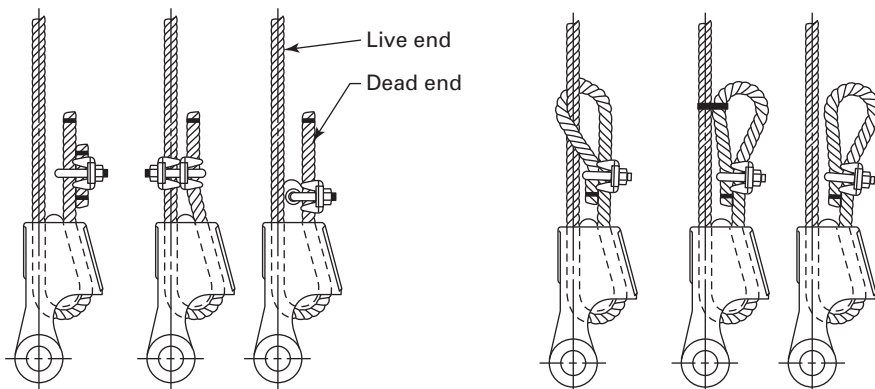
(a) Superstructures shall be arranged to receive counterweights, made in accordance with the crane manufacturer's specifications, and to hold them in position. Means shall be provided to guard against shifting or dislodgement during crane operation.

(b) For cranes using ballast, bases shall include provisions to support and position the ballast. Means shall be provided to guard against shifting or dislodgement during crane operation.

**SECTION 29-1.16: CRANE FUNCTION CONTROLS**

(a) At the control station, all controls used during the crane operating cycle shall be located within reach of the operator.

(b) Controls shall be labeled in English or symbols in accordance with ISO 7296-3 to indicate their function and, where appropriate, the direction of the function. When the label wording information is a translation into

**Fig. 29-1.14-1 Wedge Sockets**

English, the translation shall have been verified by a qualified person as being accurate as to its meaning prior to erecting the crane [see para. 29-1.4(a)].

(c) Controls for hoisting, lowering, trolleying, slewing, and travel shall discontinue the function when engagement pressure is released. Controls that are not provided with an interlock that prevents restart unless in the neutral position shall return to the neutral position when released unless intentionally restrained for functional purposes.

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

(e) Electrically powered 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.

(f) Electrically powered cranes shall be provided with means for the operator to interrupt the main power circuit from the operating position.

(g) Remote control shall include provisions for emergency stop.

(h) A means shall be provided to place the crane in the out-of-service position in the event of failure, damage, or loss of remote control.

(i) When multiple control stations are provided, only one control station at a time shall be active.

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

### **SECTION 29-1.17: ELECTRICAL EQUIPMENT: GENERAL REQUIREMENTS**

(a) Each electrically powered crane shall have an over-current-protected main disconnect switch mounted at or near the base of the crane. This switch shall have provisions for locking in the off position.

(b) Electrical equipment shall be so located or guarded such that under normal operating conditions, workers are not exposed to energized parts.

(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 ICS 18-2001.

(e) Provision shall be made to guard against any crane function operating in the opposite intended direction due to reversed phase connections.

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

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

(h) Lightning protection for personnel shall be provided. Lightning protection for crane and electrical components should be considered.

### **SECTION 29-1.18: OPERATOR'S CAB**

#### **29-1.18.1 Construction**

(a) Cabs, if equipped, shall

(1) be constructed of material that will not support combustion and have means for ventilation.

(2) include an adjustable operator's seat with backrest and be arranged and constructed to minimize operator fatigue.

(3) have cab doors, whether of the sliding or swinging type, that are provided with a means to prevent

inadvertently opening or closing during travel or operation of the crane.

(4) be glazed with safety glazing material as defined in ANSI/SAE Z26.1.

(5) include windows in the front and on both sides of the cab and, if provided with opening portions, have a means to prevent inadvertent movement.

(6) include an operating windshield wiper on the front window.

(7) provide cab lighting, either natural or artificial. The minimum level of illumination shall be 5 lumens (50 lux).

(8) be mounted on the rotating portion of the crane and be positioned so as to protect the operator and be clear of the jib when lowered to horizontal.

(b) Durable signs shall be installed in the operator's cab, if so equipped, and also in a location on at least two sides of the crane visible at ground level, 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, as stated in para. 29-3.3.3(a)(1) are required as increasing voltages are encountered. These signs shall be revised when local jurisdiction requires greater clearances.

#### **29-1.18.2 Tool Box**

A durable receptacle should be secured to the machine for the storage of small hand tools and lubricating equipment.

#### **29-1.18.3 Fire Extinguisher**

An accessible location shall be provided in the cab or at the machinery housing where a portable fire extinguisher can be installed.

#### **29-1.18.4 Signal Device**

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

### **SECTION 29-1.19: GENERAL REQUIREMENTS**

#### **29-1.19.1 Access**

(a) When an elevated control station is provided, an access ladder and platform with railings shall be provided.

(b) When access to the mast or jib in the erected position is permitted by the manufacturer, ladders and, if necessary, platforms and railings shall be provided.

(c) Access to the counterweight/ballast shall be provided, including, but not limited to

(1) hand grip(s)

(2) step(s)

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

#### **29-1.19.2 Footwalks and Ladders**

(a) Access ladders to the cab, machinery platforms, mast, and elevated control station shall conform to ANSI A14.3, as applicable.

(b) Footwalks, platforms, ladders, and railings shall be capable of supporting the weight of a 300-lb (136-kg) person without permanent distortion. Holding lines should be installed so as not to deflect laterally more than 6 in. (150 mm) when a 300-lb (1 334-N) lateral force is applied. Footwalks, when provided, should be 18 in. (450 mm) or more in width.

#### **29-1.19.3 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 that may constitute a hazard under normal operating conditions shall be guarded.

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

#### **29-1.19.4 Lubrication Points**

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

#### **29-1.19.5 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 they are performing normal duties.

#### **29-1.19.6 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 material required for the repair of load-sustaining members shall be identified or supplied by the manufacturer [see para. 29-3.1.3.1.1(d)].

#### **29-1.19.7 Wind Velocity Device**

A wind velocity-measuring device shall be mounted at or near the top of the crane. The device shall be equipped with a visible readout and an audible signal, discernible by the operator while at the control station, that is activated when a preset wind velocity has been encountered.

#### **29-1.19.8 Hydraulic Systems**

(a) Relief valves to limit maximum pressure shall be provided in hydraulic circuits carrying fluid pressurized

by a power-driven pump to limit the maximum pressure. 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. An integrally mounted holding device (such as a load hold check valve) shall be provided with support hydraulic cylinder(s) to prevent uncontrolled movement in the event of a hydraulic system failure (e.g., supply hose rupture).

## Chapter 29-2

# Inspection, Testing, and Maintenance

### SECTION 29-2.1: INSPECTION

#### 29-2.1.1 General

All inspections shall be performed by a designated person. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard.

#### 29-2.1.2 Inspection Classification

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

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

(1) *Frequent Inspection.* Visual examination with records not required at a daily to monthly interval.

(2) *Periodic Inspection.* A detailed examination at 1-mo to 12-mo intervals or as specifically recommended by the manufacturer or a qualified person. Records shall be kept to provide a basis for continuing evaluation.

#### 29-2.1.3 Frequent Inspection

(a) The items in (b) below shall be inspected at intervals defined in para. 29-2.1.2(b)(1) or as specifically indicated, including observation during operation for any deficiencies that might appear between regular inspections.

(b) Items to be inspected shall include, but not be limited to

(1) crane support for settling or other deficiency that causes an out-of-level condition — prior to each shift.

(2) all control mechanisms for proper operation — daily, when in use.

(3) all control and operating mechanisms for maladjustment, excessive wear of components, and contamination by lubricants or other foreign matter.

(4) motion-limiting devices for proper operation with the crane unloaded; each motion should be operated at slow speed with care exercised — daily, when in use.

(5) load-limiting devices for proper operation and accuracy of settings — monthly.

(6) all hydraulic hoses, particularly those that flex in normal operation.

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

(8) hooks and latches for deformation, chemical damage, cracks, and wear. Refer to the manufacturer's instructions or, in the absence thereof, ASME B30.10.

(9) hydraulic system for leakage — daily, when in use.

#### 29-2.1.4 Periodic Inspection

(a) Inspections of the crane shall be performed at intervals defined in para. 29-2.1.2(b)(2).

(b) These inspections shall include the requirements of para. 29-2.1.3 and, in addition, items such as, but not limited to, the following:

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

(2) loose bolts or pins

(3) cracked or worn sheaves, sheave guards, and drums

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

(5) excessive wear on brakes, linings, pawls, and ratchets

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

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

(8) crane hooks inspected in accordance with the manufacturer's instructions or, in the absence thereof, ASME B30.10

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

(10) hydraulic pumps, motors, valves, hoses, fittings, and tubing for excessive wear or damage

(c) When necessary for access or to meet manufacturer requirements, inspections shall be performed with the crane lowered into the stowed position.

(d) High-strength bolts shall be checked for proper tension at intervals recommended by the manufacturer

or as stated in (a) above. Bolts found to be loose shall be checked for permanent deformation or other damage. Visible cracks, difficulty in threading or unthreading a nut by hand, or observable necking are reasons for replacement.

(e) Sheaves and sheave guards shall be checked for wear, deformation, and cracks. When external evidence of possible damage is found, it may be necessary to remove the sheave from its mounting for further examination.

#### 29-2.1.5 Operational Aids

(a) Prior to daily operation, indicating devices for load, drum rotation, radius, jib angle, and wind velocity shall be checked to determine if they are operating properly, as specifically recommended by the manufacturer or a qualified person. If not operating properly, and repairs cannot be made immediately, refer to paras. 29-2.3.3 and 29-3.1.4.1(b)(5).

(b) Load-limiting device accuracy is a frequent inspection item under para. 29-2.1.3(b)(5).

(c) Load, wind, and other indicator accuracy are periodic inspection items under para. 29-2.1.4(b)(6).

(d) Limiting devices for trolley travel, crane travel, and two-block protection are frequent inspection (daily) items under para. 29-2.1.3(b)(4). If not functioning properly, and repairs cannot be made immediately, refer to paras. 29-2.3.3 and 29-3.1.4.1(b)(5).

#### 29-2.1.6 Inspection Records

Written and dated records for periodic inspections shall be made. Records shall include, but not be limited to, items inspected, inspector's signature, crane make, model, serial number, and observed deficiencies. Records shall be maintained until the next periodic inspection. Records should be kept where they are available to designated personnel.

### SECTION 29-2.2: TESTING

#### 29-2.2.1 Operational Tests

Cranes shall be tested in accordance with para. 29-1.1.3. Altered or modified cranes shall be tested under the direction of a qualified person to verify compliance with the applicable portions of this Volume, including functional tests in accordance with para. 29-1.1.3.

#### 29-2.2.2 Load Limit Device Test

Load limit device settings shall be verified by using freely suspended test loads of known weight sufficient to activate the load limit device.

#### 29-2.2.3 Test Records

Dated records shall be made for all tests required under paras. 29-2.2.1 and 29-2.2.2. The most current test record shall be maintained.

### SECTION 29-2.3: MAINTENANCE AND REPAIRS

#### 29-2.3.1 Maintenance Program

(a) A maintenance program shall be established. At a minimum, the program shall be based on the recommendation of the crane manufacturer [see para. 29-3.1.3.1.1(i)]. Records should be kept where they are available to appointed personnel.

(b) Replacement parts should be obtained from the original equipment manufacturer. Replacement parts not obtained from the original equipment manufacturer shall meet or exceed the manufacturer's specifications.

#### 29-2.3.2 Maintenance Procedures

(a) Before starting any major adjustments or repairs that can affect crane capacity or operation, the following precautions shall be taken:

(1) Cranes should be positioned to minimize interference with other cranes and operations in the area.

(2) All controllers shall be at the off position unless required to be engaged for adjustments or repairs.

(3) The main disconnect switch shall be tagged and locked in the open position, except for test purposes and unless required to be closed for adjustments or repairs.

(4) Where other cranes are in operation on the same runway, means shall be implemented to prevent contact with the idle crane.

(b) After adjustments or repairs have been made, the crane shall not be returned to service until all guards have been reinstalled, limit and protective devices reactivated, trapped air removed from hydraulic systems, and maintenance equipment removed.

#### 29-2.3.3 Adjustments and Repairs

(a) Any hazardous condition disclosed by the inspection requirements of Section 29-2.1 shall be corrected before operation of the crane is resumed. However, if an indicating device or limiting device is not functioning properly, operation may continue until such time as repairs can be made, provided the specific conditions under paras. 29-3.1.4.1(b)(5) and (6) are satisfied. Adjustments and repairs shall be performed only by a designated person.

(b) Adjustable settings shall be maintained to ensure correct functioning of components including, but not limited to

(1) functional operating mechanisms

(2) limit devices

(3) operational aids

(4) control systems

(5) braking systems

(6) erecting mechanisms and devices

(c) Repairs or replacements shall be provided as needed for operation. Repairs and replacements include, but are not limited to



(1) crane hooks showing defects described in the manufacturer's instructions or, in the absence thereof, ASME B30.10

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

(d) Illegible or missing function identification labels shall be replaced.

#### 29-2.3.4 Lubrication

(a) All moving parts of the crane for which lubrication is specified shall be lubricated in accordance with the manufacturer's instructions. Lubricating systems, if provided, shall be checked for delivery of lubricant. Manufacturer's or qualified person's recommendations shall be followed 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 (unless the application requires movement), and protection shall be provided as called for in paras. 29-2.3.2(a)(1) through (4), unless equipped for automatic lubrication.

### SECTION 29-2.4: ROPE INSPECTION, REPLACEMENT, AND MAINTENANCE

#### 29-2.4.1 General

All inspections shall be performed by a designated person. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard.

#### 29-2.4.2 Inspection

##### (a) Frequent Inspection

(1) *Daily Inspection.* A visual inspection consisting 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 the following, which may be an immediate hazard:

(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) broken or cut strands.

(c) core failure in rotation-resistant ropes (see Fig. 29-2.4.2-1).

(2) *Monthly Inspection (Load Hoist Rope).* A detailed visual and physical inspection of all rope that can reasonably be expected to be in use during the day's operations. This inspection shall consist of

(a) the requirements of para. 29-2.4.2(a)(1)

(b) number, distribution, and type of visible broken wires [see paras. 29-2.4.3(b)(1) and (2) for further guidance]

(c) general corrosion

(3) When gross damage is discovered, the rope shall either be removed from service or inspected as outlined in para. 29-2.4.2(b).

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

(5) Particular care shall be taken when inspecting rotation-resistant ropes because of their susceptibility to damage from handling and misuse and their potential for deterioration when used on equipment with limited design parameters. Internal deterioration of rotation-resistant ropes may not be readily observable.

(6) Erection ropes and counterweight/ballast assembly/disassembly ropes shall be visually inspected prior to their use.

##### (b) Periodic Inspection

(1) Inspection frequency is based on many different variables and shall be determined by a qualified person. 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 performed at least annually.

(2) Periodic inspections shall cover the entire length of each rope. Inspection items shall include, but not be limited to, the following:

(a) the requirements of para. 29-2.4.2(a)

(b) reduction of rope diameter below nominal diameter [see para. 29-2.4.3(b)(1)(g)]

(c) severely corroded or broken wires at end connections

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

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

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

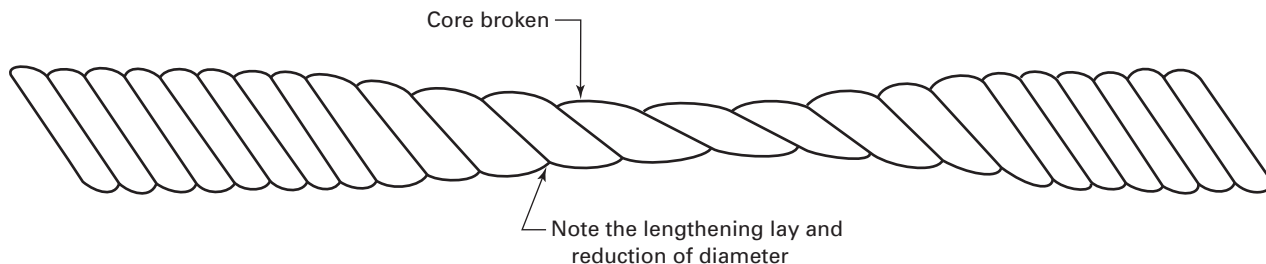
(2) sections of the rope at or near terminal ends where corroded or broken wires may protrude

(3) sections subject to reverse bends

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

#### 29-2.4.3 Rope Replacement

(a) No precise rules can be given for determination of the exact time for rope replacement, since many factors are involved. Once a rope reaches any one of the specified removal 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 prior to the equipment being used by the next work shift.

**Fig. 29-2.4.2-1 Core Failure in Rotation-Resistant Ropes**

(b) Removal criteria for rope replacement shall be in accordance with the crane or rope manufacturer's specifications. In the absence of specifications, the following shall apply:

(1) *Running Ropes*

(a) in rotation-resistant ropes, two randomly distributed broken wires in six rope diameters, or four randomly distributed broken wires in 30 rope diameters

(b) other than rotation-resistant rope, six randomly distributed broken wires in one lay, or three broken wires in one strand in one lay

(c) three broken wires at an end connection

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

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

(f) evidence of heat damage from any cause

(g) reduction from nominal diameter of more than 5%

(h) severe corrosion

(2) *Standing Ropes*

(a) three broken wires in one lay, except at an end connection

(b) two broken wires at an end connection

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

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

(e) evidence of heat damage

(f) severe corrosion.

(c) Replacement rope and connections shall have a minimum breaking force at least as great as the original rope and connections specified by the crane manufacturer. Any deviation from the original size, grade, or construction shall be specified by the rope manufacturer, the crane manufacturer, or a qualified person.

(d) *Inspection Records*

(1) frequent inspection (daily) — no records required.

(2) frequent inspection (monthly) — a dated report of rope condition; the most current report of rope condition shall be maintained.

(3) periodic inspection — a dated report of rope condition covering points of deterioration listed in para. 29-2.4.2(b)(2). If the rope is replaced, only that fact need be recorded at each periodic inspection. The most current report shall be kept on file.

#### 29-2.4.4 Rope Maintenance

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

(b) Unreeling or uncoiling of rope shall be done as recommended by the rope manufacturer and with care to avoid kinking or inducing twist.

(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, avoid dragging the rope in dirt or around objects that will scrape, nick, crush, or induce sharp bends in it.

(e) Rope shall be lubricated in accordance with the rope manufacturer's specifications.

(f) Lubricant shall be of a type that does not hinder visual inspection.

(g) Those sections of rope that are located over sheaves or otherwise hidden during inspection and maintenance require special attention during lubrication. The objective of rope lubrication is to reduce internal friction and to inhibit corrosion.

## Chapter 29-3

### Operation

#### SECTION 29-3.1: QUALIFICATIONS FOR AND CONDUCT OF OPERATORS AND OPERATING PRACTICES

##### 29-3.1.1 Operators

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

(1) operators who have met the requirements of paras. 29-3.1.2(a) through (c) and (f).

(2) trainees who have met the requirements of para. 29-3.1.2(d) and who are training for the type of crane being operated. While operating the crane, the trainee must be under the direct supervision of a designated, qualified operator.

(3) maintenance and inspection personnel who have satisfactorily completed training covering safety, operational characteristics and limitations, and controls of the crane in an out-of-operation condition. Operation by these persons shall be limited to those crane functions necessary to perform maintenance on the crane or to verify the performance of the crane after maintenance has been performed.

(b) No one other than personnel specified in para. 29-3.1.1(a) shall enter a crane cab (when equipped) or approach the operator 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.

##### 29-3.1.2 Qualifications for Operator

Operators shall be required to successfully meet the qualifications for the crane (see Figs. 29-0.2.1-1 and 29-0.2.1-2) that they are operating.

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

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

(2) ability to distinguish colors, regardless of position, if color differentiation is required.

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

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

(5) normal depth perception, field of vision, reaction time, manual dexterity, and coordination, and no tendencies to dizziness or similar undesirable characteristics.

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

(7) no evidence of having physical defects or emotional instability that could render a hazard to the operator or others, or that in the opinion of the examiner could interfere with the operator's performance. If evidence of this nature is found, it may be sufficient cause for disqualification.

(8) no evidence of being subject to seizures or loss of physical control, such evidence shall be sufficient reason for disqualification. Specialized medical tests may be required to determine these conditions.

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

(1) evidence of successfully passing a physical examination as defined in para. 29-3.1.2(a)

(2) satisfactory completion of a written examination covering operational characteristics, controls, and emergency control skills, such as response to fire, power line contact, loss of stability, or control malfunction, as well as characteristic and performance questions

(3) demonstrated ability to read, write, comprehend, and use arithmetic and a load/capacity chart in the crane manufacturer's operation and maintenance instruction materials

(4) satisfactory completion of a written test on load/capacity chart usage that covers a selection of the configurations the crane may be equipped to handle

(5) proficiency in crane operations, including performing hoist, lower, trolley, telescope, and slew functions at various radii, as well as shutdown, as demonstrated by practical methods

(6) proficiency in daily inspections, securing procedures, and traveling, as demonstrated by appropriate written, oral, or practical methods

(7) demonstrated understanding of the applicable sections of the B30 volume and federal, state, and local requirements

(c) Operators who have successfully qualified to operate the crane shall be required to be requalified if the crane user deems it necessary. Requalification shall include, but not be limited to, the following:

(1) evidence of successfully passing a current physical examination as defined in para. 29-3.1.2(a)

(2) satisfactory completion of a written examination covering operational characteristics, controls, and emergency control skills, such as response to fire, power line contact, loss of stability, or control malfunction, as well as characteristic and performance questions

(3) demonstrated ability to read, write, comprehend, and use arithmetic and a load/capacity chart in the crane manufacturer's operation and maintenance instruction materials

(4) satisfactory completion of a written test on load/capacity chart usage that covers a selection of the configurations the crane may be equipped to handle

(5) proficiency in crane operations, including performing hoist, lower, trolley, telescope, and slew functions at various radii, as well as shutdown, as demonstrated by practical methods

(6) proficiency in daily inspections, securing procedures, and traveling, as demonstrated by appropriate written, oral, or practical methods

(7) demonstrated understanding of the applicable sections of the B30 volume and federal, state, and local safety requirements

(d) Trainee qualification requirements shall include, but not be limited to, the following:

(1) evidence of successfully passing a current physical examination as defined in para. 29-3.1.2(a)

(2) satisfactory completion of a written examination covering safety, operational characteristics and limitations, and controls

(3) demonstrated ability to read, write, comprehend, and use arithmetic and a load/capacity chart, in the crane manufacturer's operations and maintenance instruction materials

(4) satisfactory completion of a written test on load/capacity chart usage covering various crane configurations

(e) Trainee qualification, operator qualification, and operator requalification shall be performed by a designated person.

(f) Operator physical examinations shall be required every 3 yr as defined in para. 29-3.1.2(a), or more frequently if the site supervisor deems it necessary.

### 29-3.1.3 Responsibilities

While the organizational structure of various projects may differ, the following roles are described here for purposes of delineating responsibilities. All responsibilities listed below shall be assigned in the worksite organization. (A single individual may perform one or more of these roles.)

(a) *Crane Owner*. Has custodial control of a crane by virtue of lease or ownership.

(b) *Crane User*. Arranges the crane's presence on a worksite and controls its use there.

(c) *Site Supervisor*. Exercises supervisory control over the worksite on which a crane is being used and over the work that is being performed on that site.

(d) *Lift Director*. Directly oversees the work being performed by a crane and the associated rigging crew.

(e) *Crane Operator*. Directly controls the crane's functions.

#### 29-3.1.3.1 Responsibilities of the Crane Owner and Crane User.

In some situations the owner and the user may be the same entity and are therefore accountable for all of the following responsibilities. In other cases, the user may lease or rent a crane from the owner without supervisory, operational, maintenance, support personnel, or services from the owner. In these situations the following shall apply.

##### 29-3.1.3.1.1 Crane Owner's Responsibilities.

The crane owner's responsibilities shall include

(a) providing a crane that meets the requirements of Chapters 29-1 and 29-2, as well as specific job requirements defined by the user.

(b) using personnel that meet the requirements for a qualified or designated person as defined in para. 29-0.2.2, for inspections as required in Section 29-2.1.

(c) providing a crane and all necessary components, specified by the manufacturer, that meet the user's requested configuration and capacity.

(d) obtaining approval from the manufacturer as required when alterations or modifications are not consistent with the original design. When the manufacturer is not available or refuses to consider the request, the owner may obtain approval from a qualified person.

If the manufacturer reviews the request and provides a written denial based on technical merit, approval from a qualified person shall not be obtained to override the manufacturer's denial.

(e) providing all applicable load/capacity chart and diagrams.

(f) providing additional technical information pertaining to the crane that is necessary for crane operation when requested by the crane user.

(g) providing information for field erection, dismantling, operation, and maintenance.

(h) ensuring warning decals and placards are installed as prescribed by the crane manufacturer.

(i) establishing an inspection, testing, and maintenance program in accordance with Chapter 29-2 and informing the crane user of the requirements of this program.

(j) using personnel that meet the requirements for a designated person as defined in para. 29-0.2.2 for the

purposes of maintenance, repair, transport, erection, and dismantling when provided by the owner.

**29-3.1.3.1.2 Crane User's Responsibilities.** The crane user's responsibilities shall include

(a) complying with the requirements of this Volume, manufacturer's requirements [see para. 29-3.1.3.1.1(c)], and those regulations applicable at the worksite

(b) using supervisors for crane activities that meet the requirements for a designated person as defined in para. 29-0.2.2

(c) ensuring that the crane is in proper operating condition prior to initial use at the worksite by

(1) verifying that the crane owner has provided documentation that the crane meets the requirements of para. 29-2.1.6

(2) verifying that a frequent inspection has been performed as defined in para. 29-2.1.3

(d) verifying that the crane has the necessary lifting capacity to perform the proposed lifting operations in the planned configuration

(e) using crane operators that meet the requirements of para. 29-3.1.1 and are qualified to perform the tasks that will be required with the crane that they are assigned to operate

(f) ensuring the assigned operator has been notified of adjustments or repairs that have not yet been completed prior to commencing crane operations

(g) using personnel that meet the requirements for inspections as required in Section 29-2.1

(h) using personnel that meet the requirements for a designated person as defined in para. 29-0.2.2 for the purposes of maintenance, repair, transport, erection, and dismantling

(i) ensuring that all personnel involved in maintenance, repair, transport, erection, dismantling, and inspection are aware of their responsibilities, assigned duties, and associated hazards

(j) ensuring that the inspection, testing, and maintenance programs specified by the crane owner are followed

**29-3.1.3.2 Responsibilities of Site Supervisor and Lift Director.** In some situations, the site supervisor and the lift director may be the same person.

**29-3.1.3.2.1 Site Supervisor's Responsibilities.** The site supervisor's responsibilities shall include:

(a) ensuring that the crane meets the requirements of Chapter 29-2 prior to initial site usage.

(b) determining if additional regulations are applicable to crane operations.

(c) ensuring that a qualified person is designated as the lift director.

(d) ensuring that crane operations are coordinated with other jobsite activities that will be affected by or will affect lift operations.

(e) ensuring that the area for the crane is adequately prepared. The preparation includes, but is not limited to, the following:

(1) access roads for the crane and associated equipment

(2) sufficient room to erect and dismantle the crane

(3) an operating area that is suitable and maintained for the crane with respect to levelness, surface conditions, support capability, proximity to power lines, excavations, slopes, underground utilities, subsurface construction, and obstructions to crane operation

(4) traffic control as necessary to restrict unauthorized access to the crane's working area

(f) ensuring that work involving the erection, dismantling, and reconfiguring of a crane is performed by designated persons.

(g) ensuring that work involving the erection, dismantling, and reconfiguring of a crane is supervised by a designated person.

(h) ensuring that crane operators meet the requirements of para. 29-3.1.1.

(i) verifying through practical demonstration that the operator is competent prior to assigning an operator to a specific crane for the first time.

(j) ensuring that conditions that may adversely affect crane operations are addressed. Such conditions include, but are not limited to

(1) poor support conditions

(2) wind velocity or gusting winds

(3) heavy rain

(4) fog

(5) extreme cold

(6) artificial lighting

(k) allowing crane operation near electric power lines only when the requirements of para. 29-3.3.3 have been met.

(l) permitting special lifting operations only when equipment and procedures required by this Volume and the crane manufacturer are employed [see para. 29-3.1.3.1.1(c)]. Such operations include, but are not limited to

(1) multiple crane lifts

(2) lifting personnel

(3) traveling with load

(m) ensuring that work performed by the rigging crew is supervised by a designated person.

(n) ensuring that crane maintenance is performed by a designated person.

**29-3.1.3.2.2 Lift Director's Responsibilities.** The lift director's responsibilities shall include

(a) being present at the jobsite during lifting operations.

(b) stopping crane operations if alerted to an unsafe condition affecting those operations.

(c) ensuring that the preparation of the area needed to support crane operations has been completed before crane operations commence.

(d) ensuring necessary traffic controls are in place to restrict unauthorized access to the crane's work area.

(e) ensuring that personnel involved in crane operations understand their responsibilities, assigned duties, and the associated hazards.

(f) addressing safety concerns raised by the operator or other personnel and being responsible if he decides to overrule those concerns and directs crane operations to continue. In all cases, the manufacturer's criteria for safe operation and the requirements of this Volume shall be adhered to. If the manufacturer no longer exists, the criteria of a qualified person shall be adhered to.

(g) appointing the signalperson, if required, that meets the requirements of para. 29-3.2.3, and conveying that information to the crane operator.

(h) allowing crane operation near electric power lines only when the requirements of para. 29-3.3.3 and any additional requirements determined by the site supervisor have been met.

(i) ensuring precautions are implemented when hazards associated with special lifting operations are present. Such operations include, but are not limited to

- (1) multiple crane lifts
- (2) lifting personnel
- (3) travel with load
- (4) operating on barges
- (5) out-of-service conditions

(j) ensuring that the applicable requirements of ASME B30.23 are met when lifting personnel.

(k) informing the crane operator of the weight of loads to be lifted, as well as the lifting, moving, and placing locations for these loads, and obtaining the operator's verification that this weight does not exceed the crane's rated capacity.

(l) ensuring that a crane's load rigging is performed by a designated person.

(m) ensuring that the load is properly rigged and balanced before it is lifted more than a few inches.

**29-3.1.3.3 Responsibilities of Crane Operators.** The operator shall not be responsible for hazards or conditions that are not under his direct control and that adversely affect the lift operations. Whenever the operator has doubt as to the safety of crane operations, the operator shall stop the crane's functions in a controlled manner. Lift operations shall resume only after safety concerns have been addressed or the continuation of crane operations is directed by the lift director.

**29-3.1.3.3.1 Operator's Responsibilities.** The operator's responsibilities shall include

(a) reviewing the requirements for the crane with the lift director before operations.

(b) ensuring that control lines, warning lines, railings, or similar barriers and warning signs are present to prevent inadvertent access to the hazard area of the rotating superstructure.

(c) knowing what types of site conditions could adversely affect the operation of the crane and consulting with the lift director concerning the possible presence of these conditions.

(d) understanding and applying the information contained in the crane manufacturer's operating manual.

(e) understanding the crane's functions and limitations as well as its particular operating characteristics.

(f) using the crane's load/capacity chart and diagrams and applying all notes and warnings related to the charts to confirm the correct crane configuration to suit the load, site, and lift conditions.

(g) refusing to operate the crane when any portion of the load or crane would enter the danger zone of energized power lines except as defined in para. 29-3.3.3(a).

(h) performing a daily inspection as specified in paras. 29-2.1.3(b)(2), (4), and (9), and 29-2.4.2(a)(1).

(i) promptly reporting the need for any adjustments or repairs to a designated person.

(j) following applicable lock out/tag out procedures.

(k) not operating the crane when physically or mentally unfit.

(l) ensuring that all controls are in the off or neutral position and that all personnel are in the clear before energizing the crane or starting the engine.

(m) not engaging in any practice that will divert his attention while actually operating the crane controls.

(n) testing the crane function controls that will be used and operating the crane only if those function controls respond properly.

(o) operating the crane's functions, under normal operating conditions, in a smooth and controlled manner.

(p) knowing and following the procedures specified by the manufacturer or approved by a qualified person for erection, reconfiguring, dismantling, setting up, and reeving the crane.

(q) observing or using a signalperson to observe each outrigger during extension, setting, or retraction.

(r) ensuring that the load and rigging weight have been provided.

(s) calculating or determining the net capacity for all configurations that will be used and verifying, using the load/capacity chart, that the crane has sufficient net capacity for the proposed lift.

(t) considering all factors known that may affect the crane capacity and informing the lift director of the need to make appropriate adjustments.

(u) knowing the standard and special signals as specified in Section 29-3.2 and responding to such signals from the appointed signalperson. When a signalperson

is not required as part of the lift operation, the operator is then responsible for the movement of the crane. However, the operator shall obey a stop signal at all times, no matter who gives it.

(v) understanding basic load rigging procedures. For responsibility of rigging the load and ensuring that the load is rigged properly, see paras. 29-3.1.3.2.1(m) and 29-3.1.3.2.2(l) and (m).

(w) if power fails during operations

(1) setting all brakes and locking devices

(2) moving all clutches or other power controls to the off or neutral position

(3) landing any load suspended below the hook under brake control if practical

(x) before leaving the crane unattended

(1) landing any load suspended below the hook, unless the requirements of para. 29-3.1.4.1(d)(1) are met.

(2) putting controls in the off or neutral position.

(3) setting brakes and other locking devices.

(4) disengaging the main control circuit.

(5) stopping the engine. An exception to this may exist when crane operation is frequently interrupted during a shift and the operator must leave the crane. Under these circumstances, the engine may remain running and paras. (1) through (4) above shall apply. The operator shall be situated where any entry to the crane can be observed.

(y) before placing a crane out of service, requirements shall include the requirements of 29-3.1.3.3.1(x) above and the following items, including, but not limited to:

(1) bringing the empty load block to the highest position

(2) releasing of the slewing brake, unless provisions for nonweathervaning have been specified by the manufacturer [see para. 29-3.1.3.1.1(c)]

(3) restraining the crane from travel with rail clamps or other means provided

(4) disengaging main disconnect, unless power must be maintained for ancillary equipment

(5) following the recommendations of the manufacturer for securing the crane [see para. 29-3.1.3.1.1(c)]

#### 29-3.1.4 Operating Practices

(a) While using a remote control, the operator shall

(1) be stationary when any crane function is engaged

(2) deactivate the remote control when changing locations

(3) be in a position to visually verify that actual crane movement corresponds with the remote control function engaged

(b) *Preoperational Tests*

(1) The activation of motion-limiting devices shall be determined by test. Testing shall include

(a) trolley travel deceleration and final stop at the innermost and outermost positions.

(b) crane travel at each end of the rail track.

(c) load block deceleration at the upper position.

(d) load block stop at the upper and lower position. The upper stop shall be tested with an empty hook at the maximum hoist speed.

#### 29-3.1.4.1 Handling the Load

(a) *Size of Load*

(1) No crane shall be loaded beyond the rated loads given in the rating chart except for out-of-operation load testing as provided in paras. 29-1.1.3 and 29-2.2.2.

(2) When in service, the load to be lifted shall be within the rated load of the crane in its existing configuration, unless approved in writing by the manufacturer [see para. 29-3.1.3.1.1(d)].

(b) *Operational Aids*

(1) Indicating devices shall be checked at the beginning of each shift before the crane is put in operation. See para. 29-2.1.5(a).

(2) Load indicator readings shall be used to guide crane operations within the specifications of the rated load chart, except when load weight is accurately known from another source.

(3) Jib angle or radius indicator readings shall be used to guide crane operations within the specifications of the rated load chart; however, measured operating radii shall always govern over indicated radii.

(4) When a load-limiting device is not functioning properly, the crane shall be taken out of operation until such time that the device is functioning properly.

(5) When an indicating or limiting device other than a load-limiting device is not functioning properly, the crane may be kept in service while awaiting repair, provided all of the following conditions are met:

(a) No operations shall be conducted if more than one of the indicating and/or limiting devices is not functioning properly. Each individual lift or the first of a series of repetitive lifts that are similar with respect to load weight, operating radii, lift heights, and crane motions shall be specifically approved by the qualified person before the lift is made.

(b) All crane operations shall be conducted under the direct supervision of a lift director other than the signalperson or operator.

(c) Radio or direct communications between the lift director, the signalperson(s), and the crane operator shall be established.

(6) When the wind velocity indicating device is not functioning properly, crane operations may continue if another crane on the site is equipped with a functional wind velocity indicator or if a qualified person determines wind velocity is within permitted limits.

(c) *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.

*(d) Holding the Load*

(1) The operator shall not leave the controls while the load is suspended, except where a load is to be held suspended for a period of time exceeding normal lifting operations. Prior to that time, the lift director and operator shall establish the requirements for restraining the load, swing, travel, and trolleying functions, and provide barricades, or whatever other precautions may be necessary.

(2) Personnel should be prohibited from standing or passing under a suspended load.

*(e) Moving the Load*

(1) Slings and other lifting attachments shall meet the requirements of applicable B30 volumes.

(2) The load shall be well secured and balanced in the sling or lifting device before it is lifted more than a few inches.

(3) The lift and swing path shall be clear of obstructions.

(4) Crane tail swing barricades shall be in place.

(5) Consideration shall be given to the effect of wind on the load and on the crane.

(6) Lifting/lowering shall be stopped if multiple part lines become twisted around each other.

(7) It shall be determined that the load is free and not caught or attached to other objects before lifting.

(8) There should be no sudden acceleration of a load or deceleration of a moving load.

(9) Side loading of jibs shall be limited to freely suspended loads.

(10) Cranes shall not be used for dragging or pulling loads horizontally.

(11) When swinging the jib, trolleying a load, or traveling the crane, sudden starts and stops shall be avoided. Swing, trolley, and travel speeds shall be such that the load does not swing out beyond the radius at which it can be controlled.

(12) The load shall not be lowered below the point where less than three full wraps of rope remain on the drum or as required by the manufacturer, whichever is greater.

(13) The brakes shall be tested each time a load approaching the rated load is handled by lifting it a few inches and applying the brakes.

(14) Loads should not be carried over people.

(15) Tag or restraint line(s) should be used when uncontrolled rotation of the load creates a hazard.

**29-3.1.4.2 Personnel Lifting.** This Volume recognizes that self-erect cranes are designed and intended for handling materials and not personnel. Personnel are only permitted to ride in a personnel platform supported by the crane load line when used in accordance with the requirements of ASME B30.23 and the crane manufacturer's instructions [see para. 29-3.1.3.1.1(c)]. The crane shall not be used for other purposes while handling personnel.

**SECTION 29-3.2: SIGNALS****29-3.2.1 General**

(a) Communication between the crane operator and the signalperson shall be maintained continuously during all crane movements. If at any time communication is disrupted, the operator shall stop all crane movements until communication is restored and a proper signal is given and understood.

(b) If the operator has any concerns regarding the requested movement of the crane or needs to communicate with the signalperson, the operator shall stop all crane movement. Crane movement shall not resume until the operator and the signalperson agree the issue at hand has been resolved.

(c) If it is desired to give instructions to the operator other than those provided by the established signal system, all crane movements shall be stopped.

**29-3.2.2 Standard Signals**

Standard signals to the operator shall be in accordance with the standards prescribed in para. 29-3.2.4 or para. 29-3.2.5. Signals shall be discernible or audible at all times. No response shall be made unless signals are clearly understood.

**29-3.2.3 Signalperson Qualifications**

Prior to signaling crane operations, all signalpersons shall satisfactorily complete a test administered by a designated person and satisfactorily demonstrate their qualifications in the following areas:

(a) basic understanding of crane operation and limitations

(b) standard hand signals described in para. 29-3.2.4 whenever hand signals are used.

(c) standard voice signals described in para. 29-3.2.5 whenever voice signals are used.

**29-3.2.4 Standard Hand Signals**

Hand signals shall be as shown in Fig. 29-3.2.4-1 and shall be posted conspicuously at the jobsite.

**29-3.2.5 Standard Voice Signals**

Prior to beginning lifting operations using voice signals, the signals shall be discussed and agreed upon by the lift director, the crane operator, and the appointed signalperson.

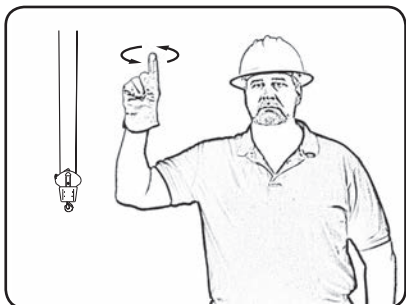
(a) Intercoms, radios, or equivalent, if used, shall be tested before lifting operations begin.

(b) Prior to commencing a lift, the operator and signalperson shall contact and identify each other.

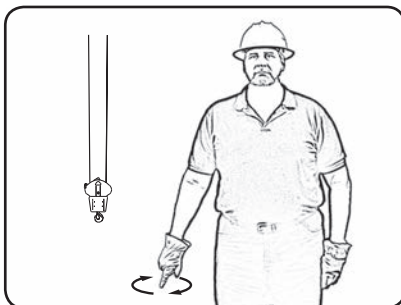
(c) All directions given to the crane operator by the signalperson shall be given from the operator's direction perspective (e.g., swing right).



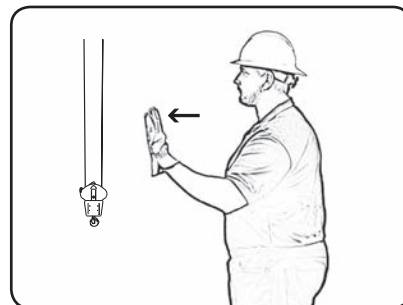
**Fig. 29-3.2.4-1 Standard Hand Signals for Controlling Self-Erect Tower Cranes**



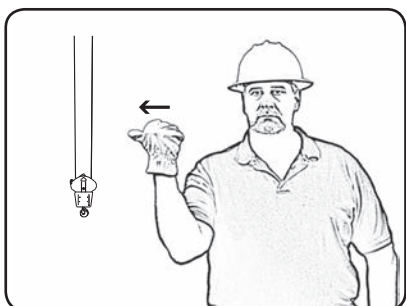
**HOIST:** With forearm vertical, forefinger pointing up, move hand in small horizontal circle.



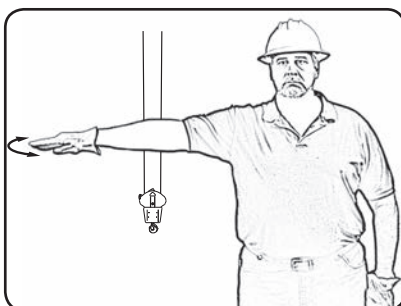
**LOWER:** With arm extended downward, forefinger pointing down, move hand in small horizontal circles.



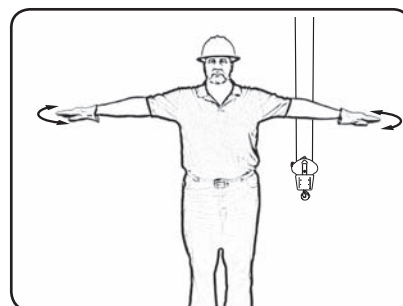
**TOWER TRAVEL:** Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.



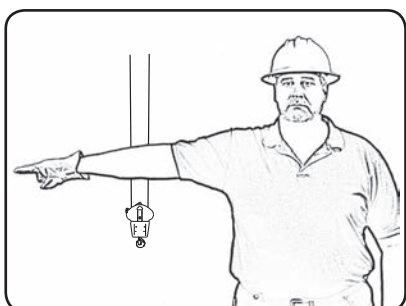
**TROLLEY TRAVEL:** Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.



**STOP:** Arm extended, palm down, move arm back and forth.



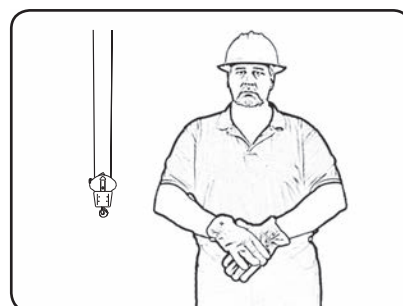
**EMERGENCY STOP:** Both arms extended, palms down, move arms back and forth.



**SWING:** Arm extended, point with finger in direction of swing of boom.



**MOVE SLOWLY:** Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. *(Hoist slowly shown as example.)*



**DOG EVERYTHING:** Clasp hands in front of body.

(d) Each series of voice signals shall contain three elements stated in the following order:

- (1) function and direction
- (2) distance and/or speed
- (3) function stop

NOTE: These are some examples of signals.

- (a) Swing right 50 ft, 25 ft, 15 ft, 10 ft, 5 ft, 2 ft, swing stop.
- (b) Lower 100 ft, 50 ft, 40 ft, 30 ft...2 ft, lower stop.
- (c) Hoist slow, slow, slow, hoist stop.

(e) For lifting operations using voice signals, the lift director shall consider the complexity of the lift, the capabilities of the particular crane, the experience and skill of the operator and signalperson, and the ability to communicate the necessary signals before permitting multiple simultaneous crane function signals.

### 29-3.2.6 Special Signals

For operations not covered by para. 29-3.2.4 or para. 29-3.2.5, additions to or modifications of the standard signal procedures may be required. In all such cases, the required special signals shall be agreed upon in advance by the lift director, crane operator, and signalperson. These special signals should not be in conflict with the standard signals.

### 29-3.2.7 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 29-3.3: MISCELLANEOUS

### 29-3.3.1 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 a crane from tipping.

### 29-3.3.2 Counterweights/Ballast

Cranes shall not be placed in service without the counterweights/ballast in place as specified by the manufacturer. During crane assembly, reconfiguration, or disassembly, the manufacturer's recommendations for the amount of partial counterweight/ballast shall be followed. The maximum counterweight/ballast approved by the manufacturer shall not be exceeded.

### 29-3.3.3 Operating Near Electric Power Lines

(a) Cranes shall be operated so that no part of the crane or load enters the danger zone shown in Fig. 29-3.3.3-1 unless approved by the utility authority and the power lines have been, and continue to be, de-energized and visibly grounded.

(1) For lines rated 50 kV or below, minimum clearance between the lines and any part of the crane or load (including slings and other lifting attachments) shall be 10 ft (3 m). For higher voltages, see Table 29-3.3.3-1.

(2) Caution shall be exercised when working near overhead lines as they can move horizontally or vertically due to wind, moving the danger zone to new positions.

(3) A designated signalperson shall be assigned to observe the clearance when the crane, its load line, lifting attachments, or load are capable of entering the danger zone. The designated signalperson shall use an audible signaling device to warn the operator when the crane, its load line, lifting attachments, or load encroach the specified clearance distance.

(b) If devices such as an insulating link or proximity warning device are used on cranes, such devices shall not be a substitute for the requirements of para. 29-3.3.3(a), even if such devices are required by law or regulation. Electrical hazards are complex, invisible, and lethal. To lessen the potential for false security, instructions relating to the devices and hazards shall be understood by the crane operator, crew, and load-handling personnel. Instructions shall include information about the electrical hazard(s) involved, operating conditions for the devices, limitations of such devices, and testing requirements prescribed by the device manufacturer, if used. The required clearances to electrical lines, established in Table 29-3.3.3-1, shall be maintained regardless of any devices used on the crane.

(c) All power lines shall be considered energized unless the utility owner/operator confirms that the power line has been and continues to be de-energized and visibly grounded.

(d) The necessity for grounding of de-energized wiring that has a manufacturer's applied coating of insulation and is a 600-V service or less shall be determined by electrical utilities or the owner of the power line.

(e) When a crane is erected in proximity to power lines, a qualified person shall determine the appropriate action to isolate the operator from the crane or electrical ground when a hard-wired remote control is used.

### 29-3.3.4 Cabs and Operating Stations

(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 or operating station.

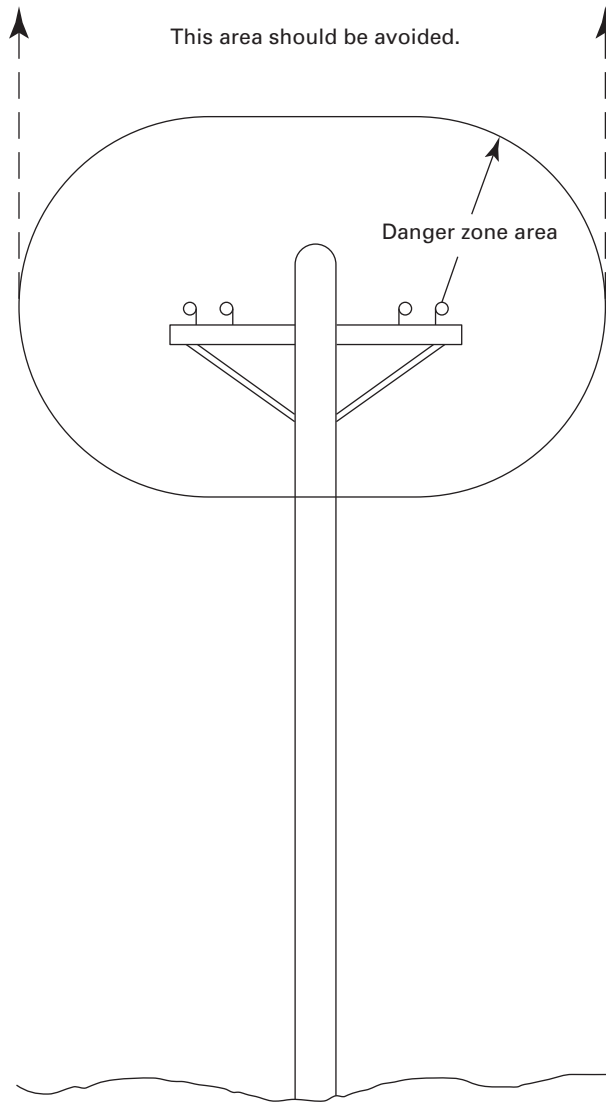
(c) Cab or operating stations shall be kept clean.

### 29-3.3.5 Fire Extinguishers

(a) A Class ABC portable fire extinguisher shall be kept in the cab or on the machinery platform of the crane.

(b) Operating and maintenance personnel shall be familiar with the use and care of the fire extinguishers provided.

**Fig. 29-3.3.3-1 Danger Zone for Cranes and Lifted Loads Operating Near Electrical Transmission Lines**



**Table 29-3.3.3-1 Required Clearance for Normal Voltage in Operation Near High-Voltage Power Lines and Operation in Transit With No Load and Boom or Mast Lowered**

Normal Voltage, kV (Phase to Phase)	Minimum Required Clearance, ft (m) [Note (1)]
<b>Operation Near High-Voltage Power Lines</b>	
Up to 50	10 (3.05)
Over 50 to 200	15 (4.60)
Over 200 to 350	20 (6.10)
Over 350 to 500	25 (7.62)
Over 500 to 750	35 (10.67)
Over 750 to 1,000	45 (13.72)
<b>Operation in Transit With No Load and Boom or Mast Lowered</b>	
Up to 0.75	4 (1.22)
Over 0.75 to 50	6 (1.83)
Over 50 to 345	10 (3.05)
Over 345 to 750	16 (4.87)
Over 750 to 1,000	20 (6.10)

## NOTE:

- (1) Environmental conditions such as fog, smoke, or precipitation may require increased clearances.

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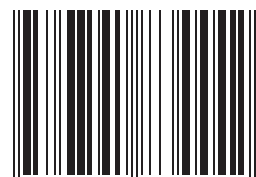
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