

ASME B30.2-2022
(Revision of ASME B30.2-2016)

Overhead and Gantry Cranes

(Top Running Bridge, Single or
Multiple Girder, Top Running
Trolley Hoist)

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

AN AMERICAN NATIONAL STANDARD



The American Society of
Mechanical Engineers

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**The American Society of
Mechanical Engineers**

Two Park Avenue • New York, NY • 10016 USA

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FOREWORD

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

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

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

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

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

New editions were published in 1967, 1983, 1990, 1996, 2001, and 2005. In the 2011 edition, Chapter 2-3 was revised and Maintenance moved to a new Chapter 2-4. This 2022 edition contains the addition of signalpersons, bumpers for gantry cranes, and references to ASME P30.1 as well as updates to training and definitions.

This Volume of the Standard, which was approved by the B30 Committee and by ASME, was approved by ANSI and designated as an American National Standard on February 18, 2022.

ASME B30 COMMITTEE

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

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

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B30 STANDARD INTRODUCTION

SECTION I: SCOPE

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

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

- B30.1 Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries
- B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
- B30.3 Tower Cranes
- B30.4 Portal and Pedestal Cranes
- B30.5 Mobile and Locomotive Cranes
- B30.6 Derricks
- B30.7 Winches
- B30.8 Floating Cranes and Floating Derricks
- B30.9 Slings
- B30.10 Hooks
- B30.11 Monorails and Underhung Cranes (withdrawn 2018 — requirements found in latest revision of B30.17)
- B30.12 Handling Loads Suspended From Rotorcraft
- B30.13 Storage/Retrieval (S/R) Machines and Associated Equipment
- B30.14 Side Boom Tractors
- B30.15 Mobile Hydraulic Cranes (withdrawn 1982 — requirements found in latest revision of B30.5)
- B30.16 Overhead Underhung and Stationary Hoists
- B30.17 Cranes and Monorails (With Underhung Trolley or Bridge)
- B30.18 Stacker Cranes (Top or Under Running Bridge, Multiple Girder With Top or Under Running Trolley Hoist)
- B30.19 Cableways
- B30.20 Below-the-Hook Lifting Devices

- B30.21 Lever Hoists
- B30.22 Articulating Boom Cranes
- B30.23 Personnel Lifting Systems
- B30.24 Container Cranes
- B30.25 Scrap and Material Handlers
- B30.26 Rigging Hardware
- B30.27 Material Placement Systems
- B30.28 Balance Lifting Units
- B30.29 Self-Erecting Tower Cranes
- B30.30 Ropes
- B30.31 Self-Propelled, Towed, or Remote-Controlled Hydraulic Platform Transporters¹
- B30.32 Unmanned Aircraft Systems (UAS) Used in Inspection, Testing, Maintenance, and Lifting Operations

SECTION II: SCOPE EXCLUSIONS

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

SECTION III: PURPOSE

The B30 Standard is intended to

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

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

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

SECTION IV: USE BY REGULATORY AGENCIES

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

¹ This volume is currently in the development process.

SECTION V: EFFECTIVE DATE

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

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

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

SECTION VI: REQUIREMENTS AND RECOMMENDATIONS

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

SECTION VII: USE OF MEASUREMENT UNITS

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

SECTION VIII: REQUESTS FOR REVISION

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

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

Requests should be in the following format:

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

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

SECTION IX: REQUESTS FOR INTERPRETATION

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

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

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

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

SECTION X: ADDITIONAL GUIDANCE

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

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

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

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

(d) the type of attachments

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

(f) environmental conditions causing corrosion or wear

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

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

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ASME B30.2-2022

SUMMARY OF CHANGES

Following approval by the ASME B30 Committee and ASME, and after public review, ASME B30.2-2022 was approved by the American National Standards Institute on February 18, 2022.

ASME B30.2-2022 includes the following changes identified by a margin note, **(22)**.

<i>Page</i>	<i>Location</i>	<i>Change</i>
1	Section 2-0.2	Definitions of <i>lifting device</i> and <i>load block</i> revised
5	Section 2-0.3	Updated
8	2-1.3.1	Subparagraph (g) revised
8	2-1.3.2	Subparagraphs (a)(1), (b)(1), (b)(2), and (b)(3) revised
10	2-1.8.1	Subparagraph (b) revised
10	2-1.8.2	(1) Title revised (2) Subparagraphs (a), (b), (b)(1), (b)(2), (b)(3), (c), (d), and (d)(1) revised
10	2-1.8.3	Subparagraph (b)(3) revised
11	2-1.9.1	Subparagraph (b) added and subsequent subparagraphs redesignated and revised
11	2-1.9.2	Subparagraph (b) added and subsequent subparagraphs redesignated and revised
11	2-1.9.3	Added
13	2-1.13.3	Subparagraph (i) deleted and subsequent subparagraphs redesignated
16	2-1.13.5	(1) Subparagraphs (b) and (c) revised (2) Subparagraph (d) added
15	Figure 2-1.13.3-3	General Note deleted
15	Figure 2-1.13.3-4	General Note deleted
16	2-1.13.8	Revised in its entirety
21	2-2.3.1	Subparagraphs (b)(4) and (b)(4)(-a) revised
21	2-2.3.2	(1) Subparagraph (a) revised (2) Subparagraph (b) added and subsequent subparagraphs redesignated and revised
22	2-3.3.1	Second sentence revised
22	2-3.3.2	Subparagraph (g) revised
23	2-3.3.3	(1) Subparagraph (b) revised (2) Subparagraph (f) added
23	2-3.3.4	(1) Subparagraph (b)(14) revised (2) Subparagraph (c)(16) added and subsequent subparagraphs redesignated
25	2-3.3.5	Subparagraph (l) added
25	2-3.3.6	Added
26	Section 2-3.4	Title revised

<i>Page</i>	<i>Location</i>	<i>Change</i>
26	2-3.4.1	Added and subsequent paragraph redesignated
26	2-3.4.2	Revised in its entirety
26	Section 2-3.5	Second sentence added
29	2-4.1.2	Revised in its entirety

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Chapter 2-0

Scope, Definitions, References, and Personnel Competence

SECTION 2-0.1: SCOPE OF B30.2

Volume B30.2 includes provisions that apply to the construction, installation, operation, inspection, and maintenance of hand-operated and power-driven overhead and gantry cranes that have a top-running single girder or multiple girder bridge, with one or more top-running trolley hoists used for vertical lifting and lowering of freely suspended, unguided loads consisting of equipment and materials (see [Figures 2-0.2-1 through 2-0.2-5](#)). The requirements included in this Volume also apply to cranes having the same fundamental characteristics such as cantilever gantry cranes, semigantry cranes, and wall cranes.

Requirements for a crane used for a special purpose such as, but not limited to, non-vertical lifting service, lifting a guided load, or lifting personnel are not included in this Volume.

(22) SECTION 2-0.2: DEFINITIONS

abnormal operating conditions: environmental conditions that are unfavorable, harmful, or detrimental to or for the operation of a crane, such as excessively high or low ambient temperatures, exposure to adverse weather, corrosive fumes, dust-laden or moisture-laden atmospheres, and hazardous locations.

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

auxiliary hoist: a supplemental hoisting unit usually of lower load rating and higher speed than the main hoist.

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

brake, holding: a friction brake for a hoist that is automatically applied and prevents motion when power to the brake is off.

brake, mechanical load: an automatic type of friction brake used for controlling loads in a lowering direction. This unidirectional device requires torque from the motor to lower a load but does not impose any additional load on the motor when lifting a load.

braking means: a method or device used for stopping/holding motion by friction or power.

braking, control: a method of controlling speed by removing energy from the moving body or by imparting energy in the opposite direction.

braking, countertorque (plugging): a method of controlling speed by reversing the motor line voltage polarity or phase sequence to develop torque in the direction opposite the rotation of the motor.

braking, dynamic: a method of controlling speed by using the motor as a generator, with the energy being dissipated in resistors.

braking, eddy current: a method of controlling or reducing speed by means of an electrical induction load brake.

braking, emergency: a method of decelerating a drive when power is not available. The braking effort may be established as a result of action by the operator or automatically when power to the drive is interrupted.

braking, hydraulic: a method of controlling or reducing speed by means of displacement of a liquid.

braking, mechanical: a method of controlling or reducing speed by friction.

braking, pneumatic: a method of controlling or reducing speed by means of compressed gas.

braking, regenerative: a method of controlling speed in which the electrical energy generated by the motor is fed back into the power system.

braking, service: a method to decelerate crane motion during normal operation.

bridge: that part of a crane consisting of one or more girders, trucks, end ties, footwalks, and drive mechanism, which carries the trolley or trolleys.

bridge travel: the crane movement in a direction parallel to the crane runway.

bumper (buffer): a device for reducing impact when a moving crane or trolley reaches the end of its permitted travel, or when two moving cranes or trolleys come into contact. This device may be attached to the bridge, trolley, or runway stop.

cab: the operator's compartment on a crane.

cab, skeleton: an operator's compartment used for occasional cab operation of a normally floor- or remote-operated crane.

cantilever frame: a structural member that supports the trolley of a wall crane.

clearance: distance from any part of the crane to the nearest obstruction.

collectors, current: contacting devices for collecting current from runway or bridge conductors.

conductors, bridge: the electrical conductors located along the bridge structure of a crane that transmit control signals and power to the trolley(s).

conductors, runway (main): the electrical conductors located along a crane runway that transmit control signals and power to the crane.

controller: a device, or group of devices, that serves to govern, in a predetermined manner, the power delivered directly to the apparatus to which it is connected.

controller, manual: a controller having all of its basic functions performed by devices that are operated by hand.

controller, spring-return: a controller that, when released, will return automatically to a neutral (off) position.

control panel: an assembly of components (magnetic, static, hydraulic, pneumatic, etc.) that governs the flow of power to or from a motor or other equipment in response to signals from a master switch, push-button station, remote control, automatic program control, or other similar device.

crane: a machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism being an integral part of the machine.

crane, automatic: a crane which, when activated, operates through a preset cycle or cycles.

crane, cab-operated: a crane whose movements are controlled by an operator through the use of controllers located in a cab that is attached to the crane.

crane, cantilever gantry: a gantry or semigantry crane in which the bridge girders or trusses extend transversely beyond the crane runway on one or both sides (see Figure 2-0.2-1).

crane, floor-operated: a crane whose movements are controlled by an operator through the use of controllers contained in a pendant station suspended from the crane.

crane, gantry: a crane similar to an overhead crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two or more legs running on fixed rails or other runway (see Figure 2-0.2-2).

crane, manually operated: a crane whose hoist mechanism is driven by pulling an endless chain, or whose travel mechanism is driven in the same manner or by manually moving the load or hook.

crane, molten-material-handling: an overhead crane used for transporting or pouring molten material.

crane, outdoor: an overhead or gantry crane that operates outdoors and for which provisions are not available for storage in an area that provides protection to the crane from weather conditions. An indoor crane that may operate outdoors on a periodic basis is not classified as an outdoor crane.

crane, overhead: a crane with a single or multiple girder movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure (see Figure 2-0.2-3).

crane, polar: an overhead or gantry crane that travels on a circular runway.

crane, power-operated: a crane whose mechanism is driven by electric, pneumatic, hydraulic, or internal combustion means.

crane, pulpit-operated: a crane whose movements are controlled by an operator through the use of controllers located in a control room or a fixed or movable cab or platform, that is independent of the crane.

crane, remote-operated: a crane whose movements are controlled by an operator through the use of controllers contained in a portable operating station not attached to the crane.

crane, semigantry: a gantry with one end of the bridge rigidly supported on one or more legs that run on a fixed rail or runway, the other end of the bridge being supported by an end truck running on an elevated rail or runway (see Figure 2-0.2-4).

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

crane, wall: a crane having a cantilever frame with or without trolley, and supported from a side wall or line of columns of a building. It is a traveling type and operates on a runway attached to the side wall or columns (see Figure 2-0.2-5).

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

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

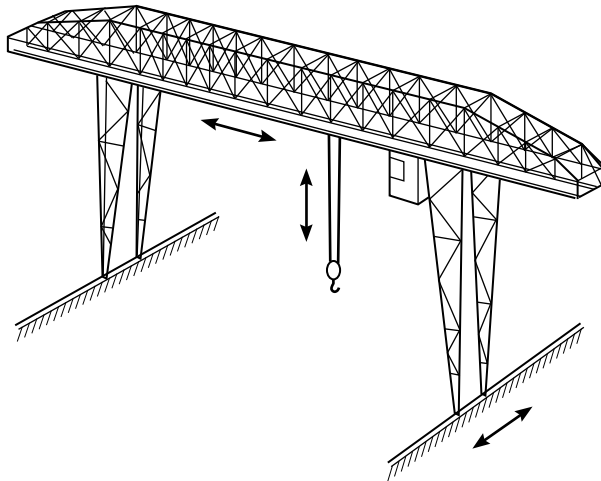
crane service, severe: service that involves normal or heavy service with abnormal operating conditions.

drift point: a point on a travel motion master switch or on a manual controller that maintains the brake released while the motor is not energized. This allows for coasting.

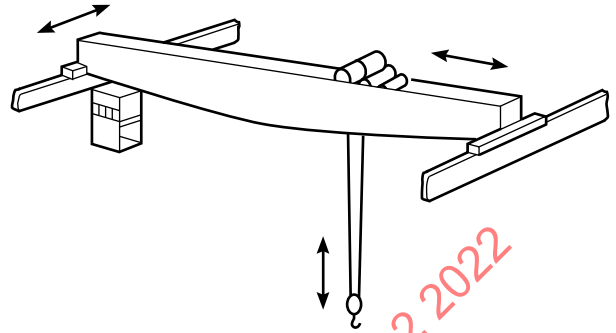
drum: the cylindrical member around which the ropes are wound for lifting or lowering the load.

end tie: a structural member that connects the ends of the bridge girders to maintain squareness of the bridge.

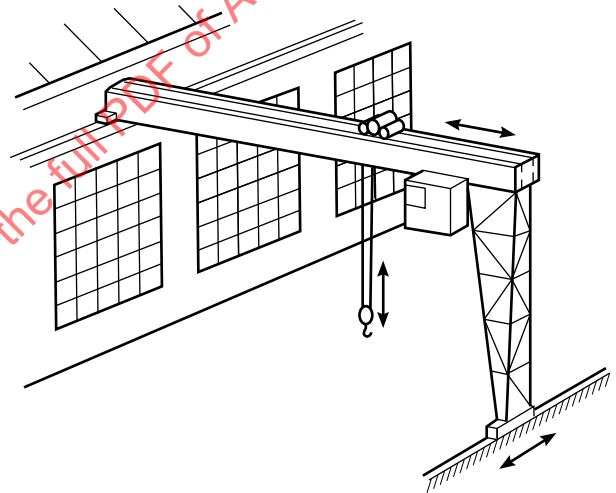
**Figure 2-0.2-1
Cantilever Gantry Crane**



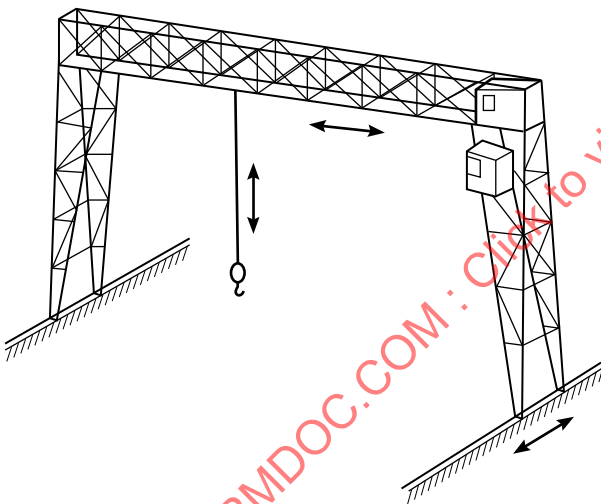
**Figure 2-0.2-3
Overhead Crane**



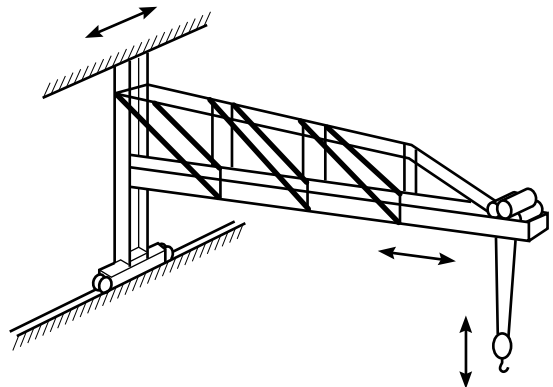
**Figure 2-0.2-4
Semigantry Crane**



**Figure 2-0.2-2
Gantry Crane**



**Figure 2-0.2-5
Wall Crane**



equalizer: a device that compensates for unequal length or stretch of a rope.

exposed: applies to hazardous objects not guarded or isolated and capable of being contacted inadvertently.

gantry leg: the structural member that supports a bridge girder or end tie from the sill.

hazardous (classified) locations: locations where fire or explosion hazards may exist. Locations are classified depending on the properties of the flammable vapors, liquids, or gases, or combustible dusts or fibers that may be present and the likelihood that a flammable or combustible concentration or quantity is present (see National Electrical Code, ANSI/NFPA 70).

hoist: a machinery unit that is used for lifting or lowering a freely suspended (unguided) load.

hoist motion: the motion that lifts or lowers a load.

hook, latch-equipped: a type of hook with a mechanical device to close the throat opening of the hook.

lifting device: a device, other than a load block, used for attaching a load to a hoist. The device may contain components such as slings, hooks, and rigging hardware addressed by other ASME B30 volumes or standards. The weight of these devices is to be considered part of the rated load if it is not reeved onto the hoist ropes.

limit device: a device that is operated by some part or motion of a power-driven hoist, trolley, or bridge to limit motion.

load: the total superimposed weight on the load block or hook.

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

lockout/tagout: the placement of a lock/tag on the energy-isolating device in accordance with an established procedure.

main hoist: the primary hoist mechanism provided for lifting and lowering the rated load.

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

noncoasting mechanical drive: a drive that automatically results in decelerating a trolley or bridge when power is not available.

normal operating conditions (of cab-operated cranes): conditions during which a crane is performing functions within the scope of the original design. Under these conditions, the operator is at the operating control devices, and there is no other person on the crane.

normal operating conditions (of floor-operated cranes): conditions during which a crane is performing functions within the scope of the original design. Under these con-

ditions, the operator is at the operating control devices that are attached to the crane but operated with the operator off the crane, and there is no person on the crane.

normal operating conditions (of remote-operated cranes): conditions during which a crane is performing functions within the scope of the original design. Under these conditions, the operator is at the operating control devices that are not attached to any part of the crane, and there is no person on the crane.

operational aid: an accessory that provides information to facilitate operation of a crane or that takes control of particular functions without action of the operator when a limiting condition is sensed. Examples of such devices include but are not limited to the following: upper and lower limit devices, travel limit devices, rated capacity (load) limiter, and wind speed indicator.

overload: any load greater than the rated load (see para. 2-3.4.2).

parts of line: the number of lines of rope supporting the load block.

pendant station: controls suspended from the crane for operating the unit from the floor.

primary upper-limit device: the first device that, when actuated, limits hoisting motion in the upward direction.

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

rail sweep: a device attached to the crane and located in front of the crane's leading wheels to remove obstructions.

rated load (capacity): the maximum load designated by the manufacturer for which a crane or individual hoist is designed and built.

rated speed: the maximum speed designated by the manufacturer for each motion (bridge, trolley, and hoist) for which a crane is designed and built.

reeving: a system in which a rope travels around drums or sheaves.

rope: refers to wire rope unless otherwise specified.

runway: an assembly of rails, beams, girders, brackets, and framework on which the crane travels.

service platform: a means provided for workers to perform maintenance, inspections, adjustments, and repairs of cranes.

shall: a word indicating a requirement.

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

sheave, nonrunning (equalizer): a sheave used to equalize tension in opposite parts of the rope. Because of its slight movement, it is not termed a running sheave.

sheave, running: a sheave that rotates as the load block is lifted or lowered.

should: a word indicating a recommendation.

side pull: the portion of the hoist pull acting horizontally when the hoist lines are not operated vertically.

sills: horizontal structural members that connect the lower ends of two or more legs of a gantry crane on one runway.

span: the horizontal distance, center to center, between runway rails.

stop: a device to limit travel of a trolley or crane bridge. This device normally is attached to a fixed structure and normally does not have energy-absorbing ability.

switch (valve): a device for making, breaking, or changing the connections in an electric, hydraulic, or pneumatic circuit.

switch, emergency stop: a manually actuated switch to disconnect power independently of the regular operating controls.

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

switch, main (crane disconnect): a switch on the crane controlling the main power supply from the runway conductors.

switch, master: a switch that dominates the operation of contactors, relays, or other remotely operated devices.

switch, master, spring-return: a master switch that, when released, will return automatically to a neutral (off) position.

switch, runway disconnect: a switch, usually at floor level, controlling the main power supply to the runway conductors.

trolley: the unit that travels on the bridge rails and supports the load block.

trolley travel: the trolley movement.

truck: a unit consisting of a frame, wheels, bearings, and axles that supports the bridge girders, the end ties of an overhead crane, or the sill of a gantry crane.

unattended: a condition in which the operator of a crane is not at the operating control devices. However, on a floor-operated crane, if the operating control devices are within sight of the operator and within a distance equal to the span of the crane, the crane should be considered attended.

upper block: a fixed block located on a trolley that, through a system of sheaves, bearings, pins, and frame, supports the load block and its load.

SECTION 2-0.3: REFERENCES

(22)

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

AIST Technical Report No. 6, June 2018, Specification for Electric Overhead Traveling Cranes for Steel Mill Service

Publisher: Association of Iron and Steel Technology (AIST), 186 Thorn Hill Road, Warrendale, PA 15086 (www.aist.org)

ANSI Z244.1 2016, Safety Requirements for the Lock Out/Tag Out of Energy Sources

Publisher: American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036 (www.ansi.org)

ANSI A14.3-2018, Safety Requirements for Fixed Ladders¹

ANSI A1264.1-1995 (R2002), Safety Requirements for Workplace Floor and Wall Openings, Stairs, and Railing Systems¹

Publisher: The American Society of Safety Professionals [ASSP; formerly the American Society of Safety Engineers (ASSE)], 520 N. Northwest Highway, Park Ridge, IL 60068 (www.assp.org)

ANSI Z535.4-2011, Product Safety Signs and Labels¹

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

ANSI/AISC 360-16, Specification for Structural Steel Buildings

Publisher: American Institute of Steel Construction (AISC), 130 East Randolph Street, Suite 2000, Chicago, IL 60601 (www.aisc.org)

ANSI/ASCE 7-2016, Minimum Design Loads for Buildings and Other Structures¹

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

ANSI ECMA 15-2018, Specifications for Cable-less Controls for Electric Overhead Traveling Cranes

Publisher: Material Handling Industry of America (MHI), 8720 Red Oak Boulevard, Charlotte, NC 28217-3992 (www.mhi.org)

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

ANSI/NFPA 70-2020, National Electrical Code¹

Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471 (www.nfpa.org)

ANSI/SAE Z26.1-1996, Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicles Operating on Land Highways — Safety Standard¹

Publisher: Society of Automotive Engineers (SAE International), 400 Commonwealth Drive, Warrendale, PA 15096 (www.sae.org)

ASME B15.1-2000, Safety Standard for Mechanical Power Transmission Apparatus

ASME B30.9-2018, Slings

ASME B30.10-2019, Hooks

ASME B30.20-2018, Below-the-Hook Lifting Devices

ASME B30.26-2015 (R2020), Rigging Hardware

ASME P30.1-2019, Planning for Load Handling Activities

Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

AWS D1.1-2020, Structural Welding Code — Steel¹

AWS D14.1M:2005, Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment¹

Publisher: American Welding Society (AWS), 550 NW Le Jeune Road, Miami, FL 33126 (www.aws.org)

CMAA Specification No. 70-2020, Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes

Publisher: Crane Manufacturers Association of America, Inc. (CMAA), 8720 Red Oak Boulevard, Charlotte, NC 28217 (www.mhi.org/cmaa)

ISO 7000-2012 Graphical symbols for use on equipment — Registered symbols

ISO 7296-1991 Cranes — Graphical symbols — Parts 1–3
Publisher: International Organization for Standardization (ISO), Central Secretariat, Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland (www.iso.org)

SECTION 2-0.4: PERSONNEL COMPETENCE

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

Chapter 2-1

General Construction and Installation

SECTION 2-1.1: MARKINGS

2-1.1.1 Rated Load Markings — Crane

The rated load of the crane shall be marked on each side of the crane and shall be legible from the ground or floor.

2-1.1.2 Rated Load Markings — Hoists

(a) The rated load of the hoist shall be marked on the hoist or trolley unit or its load block and shall be legible from the ground or floor.

(b) If the crane has more than one hoisting unit, each hoist shall have its rated load marked as per (a).

2-1.1.3 Manufacturer's Identification Markings

The crane shall be marked with manufacturer's identification information, on a plate or label attached to the crane, as follows:

- (a) name and address of manufacturer
- (b) manufacturer's model or serial number
- (c) voltage of AC or DC power supply and phase and frequency of AC power supply

2-1.1.4 Multiple Hoist Identification Markings

If the crane has more than one hoisting unit, each hoist shall have an identification marking on the hoist or trolley unit or its load block (i.e., 1 and 2; A and B; north and south; etc.) and shall be legible from the ground or floor. These markings shall also appear on the controllers used by the operator to indicate the controllers that operate each hoist.

2-1.1.5 Warnings

(a) Floor-operated and remote-operated cranes shall have a safety label or labels affixed to the pendant station, portable operating station, or load block. The label or labels shall be in compliance with ANSI Z535.4, and shall include, but not be limited to, cautionary language against

- (1) lifting more than rated load
- (2) operating hoist when load is not centered under hoist
- (3) operating hoist with twisted, kinked, or damaged chain or rope
- (4) operating damaged or malfunctioning crane

- (5) lifting people
- (6) lifting loads over people
- (7) operating a rope hoist with a rope that is not properly seated in its groove
- (8) operating manual motions with other than manual power
- (9) removing or obscuring safety label
- (b) Cab-operated and pulpit-operated cranes shall have a safety label or labels affixed in the cab or pulpit. The label or labels shall be in compliance with ANSI Z535.4 and shall include, but not be limited to, cautionary language against
 - (1) lifting more than rated load
 - (2) operating hoist when load is not centered under hoist

- (3) operating hoist with twisted, kinked, or damaged chain or rope
- (4) operating damaged or malfunctioning crane
- (5) lifting people
- (6) lifting loads over people
- (7) operating a rope hoist with a rope that is not properly seated in its groove
- (8) removing or obscuring safety label
- (c) A safety label shall be affixed on all electrical control enclosures. The label shall be in compliance with ANSI Z535.4 and shall include, but not be limited to, information such as the following:

- (1) Disconnect power and lockout disconnecting means before removing cover or servicing this equipment.
- (2) Do not operate without cover in place.
- (d) Control panels and other electrical equipment, such as switchboards and panelboards, that are likely to require inspection, adjustment, servicing, or maintenance while energized shall be marked to warn of potential electric arc flash hazards. The marking shall be located as to be clearly visible to personnel before inspection, adjustment, servicing, or maintenance of the equipment.

2-1.1.6 Controls

- (a) Each controller shall be legibly marked to indicate the function and direction of movement.
- (b) In locations or areas where multiple cranes are used, the arrangement of control markings for function and direction should be the same.

(c) Directional markings (e.g., north, south, east, west or forward, reverse, left, and right) shall be provided on the equipment or facility. These markings shall be legible to the operator and consistent with the direction of movement markings on the controllers.

SECTION 2-1.2: CLEARANCES

2-1.2.1 Clearance From Obstruction

(a) Clearance shall be maintained between the crane and the building, as well as parallel running cranes and cranes operating at a different elevation, under all normal operating conditions. In the design of new cranes, all factors that influence clearance, such as wheel float, truss sag, bridge skewing, or trolley positions and configurations shall be considered.

(b) Where passageways or walkways are provided on the structure supporting the crane, obstructions shall not be placed so that personnel will be jeopardized by movements of the crane.

2-1.2.2 Clearance Between Parallel Cranes

If the runways of two cranes are parallel and there are no intervening walls or structures, there shall be clearance provided and maintained between the two bridges.

SECTION 2-1.3: GENERAL CONSTRUCTION — RUNWAYS AND SUPPORTING STRUCTURE

(22) 2-1.3.1 Foundations and Anchorages

(a) Permanent concrete or masonry foundations shall rest on footings below the frost line except in permafrost.

(b) Every outdoor crane shall be provided with secure fastenings convenient to apply and to hold the crane against a wind pressure of 30 lb/ft² (1436 Pa). Parking brakes may be considered minimum compliance with this rule.

(c) Where wind forces are specified to be in excess of 30 lb/ft² (1436 Pa), special anchorages, such as latches or tie-downs at the home position or remotely operated rail clamps for all positions to supplement the primary braking system, shall be provided (ANSI/ASCE 7-98 may be used as a reference for this condition).

(d) Outdoor gantry cranes shall be provided with remotely operated rail clamps or other equivalent devices. Parking brakes may be considered minimum compliance with this rule.

(e) Rail clamps should only be applied when the crane is not in motion.

(f) When rails are used for anchorages, they shall be secured to withstand the resultant forces applied by the rail clamps. If the clamps act on the rail, any projection or obstruction in the clamping area shall be avoided.

(g) A wind speed indicating device shall be provided for cranes used outdoors. The device shall be mounted on the crane or the crane runway structure and shall give a visible and audible alarm to the crane operator at a predetermined wind speed. A single wind speed indicating device may serve as an alarm for more than one crane.

2-1.3.2 Crane Runways

(22)

(a) Construction of Runways and Rails

(1) The crane runways and supporting structures shall be designed to withstand the loads and forces imposed by the crane. Steel crane runways and supporting structures should conform to the design parameters as specified in ANSI/AISC 360-16.

(2) Runway columns shall be securely anchored to foundations.

(3) The structure shall be free from detrimental vibration under normal operating conditions.

(4) Rails shall be level, straight, joined, and spaced to the crane span within tolerances as specified in CMAA Specification No. 70, or within tolerances that are compatible with special conditions specified by the crane manufacturer or a qualified person.

(5) Where curves are required, special design will be necessary.

(6) Where grades are required, special design will be necessary.

(b) Runway Stops

(1) Stops shall be provided at the limits of travel of the bridge or gantry structure.

(2) Stops shall engage the bumpers mounted on the bridge or gantry structure.

(3) Stops shall be designed to withstand the forces applied by the bumpers, as specified in [para. 2-1.8.2\(b\)](#).

SECTION 2-1.4: CRANE CONSTRUCTION

2-1.4.1 Welded Construction

All welding procedures and welding operator qualifications to be used on load-sustaining members shall be in accordance with ANSI/AWS D1.1, except as modified by ANSI/AWS D14.1. Where special steels or other materials are used, the manufacturer or qualified person shall provide welding procedures.

2-1.4.2 Structural Components

All crane load-bearing structural components such as, but not limited to, bridge girders, end ties, end trucks, and trolleys should conform to the design parameters as specified, and applicable, in CMAA Specification No. 70 or AIST Technical Report No. 6.

2-1.4.3 Modifications

Cranes may be modified or rerated provided such modifications and the supporting structure are analyzed thoroughly and approved by a qualified person or manufacturer of cranes. A rerated crane or one whose load-supporting components have been modified shall be tested in accordance with [para. 2-2.3.2](#). The new rated load shall be displayed in accordance with [paras. 2-1.1.1](#) and [2-1.1.2](#).

SECTION 2-1.5: CABS — NORMAL OR SKELETON (IF PROVIDED)

2-1.5.1 Cab Location

(a) The general arrangement of the cab and the location of the control and protective equipment should be such that all operating handles are within reach of the operator when facing the area to be served by the load block or while facing the direction of travel of the cab.

(b) The arrangement of the cab should allow the operator a full view of the load block in all positions. This is an important and desirable condition, but it is recognized that there are physical arrangements that may make this impossible, and, when the load block is in these positions, the operator shall be aided by other means such as, but not limited to, closed-circuit TV, mirrors, radio, telephone, or a signalperson.

(c) The cab shall be clear of all fixed structures within the area of possible movement.

(d) The clearance of the cab above the working floor or passageway should be not less than 7 ft (2.1 m), except when operations require dimensions that are less. In this case, precautions shall be taken during the operation of the crane to keep personnel and other obstructions clear of the low overhead.

2-1.5.2 Cab Construction

(a) The cab shall be constructed and attached to the crane to minimize swaying or vibrations.

(b) If an integral outside platform is provided, the door (if provided) shall be a sliding type or shall open outward.

(c) In the absence of an outside platform, the door (if provided) shall open inward or slide and shall be self-closing. It shall be equipped with positive latching devices to prevent inadvertent opening.

(d) The width of a doorway shall have a clear opening of not less than 18 in. (460 mm).

(e) A trapdoor (if provided) above the cab or in the cab roof shall have a clear opening of not less than 24 in. (610 mm) on each side. There should be no obstructions in the opening path of the trap door that prevents opening of the trap door for the purpose for which it is designed.

(f) Guard railings and toeboards shall be in compliance with ANSI A1264.1.

(g) Outdoor cabs should be enclosed. All cab glazing shall be safety-glazing material, as defined in ANSI/SAE Z26.1.

(h) The cab construction shall offer protection from falling objects, if this possibility exists. The protection shall support 50 lb/ft² (2 400 Pa) static load.

(i) If the cab of a molten material crane is exposed to heat, it shall be provided with the following, or equivalent, protection:

(1) cab enclosed as for outdoor protection

(2) windows with metal sash and heat-resisting, safety-glazing material, as defined in ANSI/SAE Z26.1

(3) floor insulated with heat-resistant material

(4) a shield of metal at least $\frac{1}{8}$ in. (3 mm) thick located at least 6 in. (152 mm) below bottom of cab floor

(5) materials that will not propagate combustion or rekindle

2-1.5.3 Access to Crane

Access to the cab or bridge walkway shall be by a fixed ladder, stairs, or platform. The ladder shall be in conformance with ANSI A14.3, except as modified to meet the requirements of this Volume.

2-1.5.4 Toolbox

If a receptacle is provided for the stowing of tools and oil cans, it shall be made of a noncombustible material and shall be securely fastened in the cab or on the service platform.

2-1.5.5 Fire Extinguisher

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

2-1.5.6 Lighting

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

SECTION 2-1.6: LUBRICATION

If lubrication is required, accessible means for lubrication should be provided.

SECTION 2-1.7: SERVICE PLATFORMS (FOOTWALKS)

2-1.7.1 Construction of Service Platforms

Service platforms, when provided with or added to the crane and attached to the crane, shall conform to the following requirements:

(a) The dimension of the working space in the vertical direction from the floor surface of the platform to the nearest overhead obstruction shall be a minimum of

48 in. (1 220 mm) at the location where a person is performing a function while on the platform.

(b) Crane travel shall be prohibited or restricted while a person is on a service platform and the overhead platform clearance is less than 78 in. (1 980 mm) at any location in the path of travel of the crane.

(c) Service platforms shall have a clear passageway at least 18 in. (457 mm) wide, except at the bridge drive mechanism where not less than 15 in. (380 mm) of clear passageway shall be allowed.

(d) The dimension of the working space in the direction of access to live (energized) electrical parts which are likely to require examination, adjustment, servicing, or maintenance while energized shall be a minimum of 30 in. (762 mm).¹

(e) The door(s) of electrical control cabinets shall either open at least 90 deg or be removable.¹

(f) Service platforms shall be designed to sustain a distributed load of at least 50 lb/ft² (2 400 Pa).

(g) Service platforms shall have a slip-resistant walking surface.

(h) Service platforms shall be provided with guard railings and toeboards.

(1) Guard railings and toeboards shall be in compliance with ANSI A1264.1.

(2) Guard railings shall be at least 42 in. (1 065 mm) high and shall be provided with an intermediate railing.

2-1.7.2 Ladders and Stairways

(a) Gantry cranes shall be provided with ladders or stairways extending from the runway elevation to the footwalk or cab platform.

(b) Stairways shall be equipped with metal handrails and should be at an angle of not more than 50 deg with the horizontal. Walking surfaces shall be of a slip-resistant type.

(c) Ladders shall be fastened in place and shall be constructed in compliance with ANSI A14.3, except as modified to meet the requirements of this Volume.

2-1.7.3 Egress

There should be a means of egress from cab-operated cranes to permit departure under emergency conditions. The means of egress should depend on the facts of the situation.

SECTION 2-1.8: STOPS AND BUMPERS

(22) 2-1.8.1 Trolley Stops

(a) Stops shall be provided at the limits of travel of the trolley.

(b) Stops shall engage the bumpers mounted on the trolley, as specified in [para. 2-1.8.3](#).

(c) Stops shall be designed to withstand the forces applied by the bumpers, as specified in [para. 2-1.8.3](#).

2-1.8.2 Bridge and Gantry Bumpers

(22)

(a) Power-operated bridge and gantry cranes shall be provided with bumpers or other automatic means providing equivalent effect.

(b) Bridge and gantry bumpers shall have the following minimum characteristics:

(1) energy-absorbing (or energy-dissipating) capacity to stop the bridge or gantry structure when traveling with power off in either direction at a speed of at least 40% of rated load speed.

(2) the capability of stopping the bridge or gantry (but not the load block or lifted load unless they are guided vertically) at a rate of deceleration not to exceed an average of 3 ft/sec² (0.9 m/s²) when traveling with power off in either direction at 20% of rated load speed.

(3) be designed and installed with a means of retaining the bumper in case of broken or loosened mounting connections. The retention requirement for elastomeric bumpers may be omitted if determined unnecessary by a qualified person.

(c) Multiple power-operated bridge or gantry cranes operating on the same runway shall have contact bumpers that meet the requirements of (b)(2).

(d) Consideration should be given to providing bumpers with greater capacity for energy absorption (or energy dissipation) than that specified in (b)(1) and providing bridge or gantry runway end stops with corresponding increased strength when any one of the following conditions are present:

(1) The crane has a maximum bridge or gantry speed of 320 ft/min (100 m/min) or greater.

(2) The crane is a remote-operated crane.

(3) The crane is a pulpit-operated crane.

(4) The location of the runway end stops is obscured or uncertain.

As an example, the bumper force applied at 100% of rated load speed is 625% greater than the bumper force applied at 40% of rated load speed.

2-1.8.3 Trolley Bumpers

(22)

(a) A power-operated trolley shall be provided with bumpers or other automatic means providing equivalent effect.

(b) Trolley bumpers shall have the following minimum characteristics:

(1) energy-absorbing (or energy-dissipating) capacity to stop the trolley when traveling with power off in either direction at a speed of at least 50% of rated load speed.

¹ Source: ANSI/NFPA 70, National Electrical Code.

(2) the capability of stopping the trolley (but not the load block or lifted load unless they are guided vertically) at a rate of deceleration not to exceed an average of 4.7 ft/sec^2 (1.4 m/s^2) when traveling with power off in either direction at one-third of rated load speed.

(3) be designed and installed with a means of retaining the bumper in case of broken or loosened mounting connections. The retention requirement for elastomeric bumpers may be omitted if determined unnecessary by a qualified person.

(c) Multiple power-operated trolleys operating on the same bridge shall have contact bumpers that meet the requirements of (b)(2).

(d) Consideration should be given to providing bumpers with greater capacity for energy absorption (or energy dissipation) than that specified in (b)(1) and providing bridge end stops with corresponding increased strength when any one of the following conditions are present:

- (1) The trolley has a maximum speed of 150 ft/min (46 m/min) or greater.
- (2) The trolley is on a remote-operated crane.
- (3) The trolley is on a pulpit-operated crane.
- (4) The location of the trolley end stops is obscured or uncertain.

SECTION 2-1.9: RAIL SWEEPS

(22) 2-1.9.1 Bridge Rail Sweeps

- (a) Bridge truck rail sweeps shall be provided in front of the leading wheels on both ends of the bridge end truck.
- (b) Rail sweeps shall extend below the top of the rail.
- (c) The rail sweep shall clear the rail of objects on the runway which, if they came into contact between the wheel and rail, could cause damage to the wheel or derail the wheel.

(22) 2-1.9.2 Trolley Rail Sweeps

- (a) Trolley truck rail sweeps shall be provided in front of the leading wheels on both ends of the trolley end truck.
- (b) Rail sweeps shall extend below the top of the rail.
- (c) The rail sweep shall clear the rail of objects on the bridge which, if they came into contact between the wheel and rail, could cause damage to the wheel or derail the wheel.

(22) 2-1.9.3 Gantry Rail Sweeps

- (a) Gantry truck rail sweeps shall be provided in front of the leading wheels on both ends of the gantry end truck.
- (b) Rail sweeps should extend below the top of the rail.
- (c) The rail sweep shall clear the rail of objects on the runway which, if they came into contact between the wheel and rail, could cause damage to the wheel or derail the wheel.

SECTION 2-1.10: GUARDS FOR MOVING PARTS

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

(b) Each guard shall be capable of supporting, without permanent deformation, the weight of a 200 lb (90 kg) person, unless the guard is located where it is not probable that a person will step on it (see ASME B15.1).

SECTION 2-1.11: TRUCK FRAME DROP

Means shall be provided to limit the drop of bridge and trolley truck frames to 1 in. (25 mm) in case of wheel, axle, or bearing breakage.

SECTION 2-1.12: BRAKES AND BRAKING MEANS

2-1.12.1 Hoist Holding Brakes

(a) Each hoisting unit of the crane shall be equipped with at least one holding brake. The holding brake shall be applied to the motor shaft or a gear reducer shaft and shall have a torque rating not less than the percentage of rated load hoisting torque at the point where the brake is applied as follows:

- (1) 125% of rated load hoisting torque when used with a control braking means other than mechanical
- (2) 100% of rated load hoisting torque when used with a mechanical control braking means
- (3) 100% of rated load hoisting torque for each brake if two holding brakes are provided

(b) For a crane that handles molten material, each hoisting unit that handles or tips molten material shall be equipped with one of the following arrangements:

(1) Two holding brakes shall be provided, one of which is applied to a gear reducer shaft, plus control braking means. Each holding brake shall have a torque rating not less than 100% of rated load hoisting torque at the point where the brake is applied.

(2) One holding brake shall be provided if the hoisting unit has a mechanical load brake or a control braking means that provides controlled lowering of the load upon loss of power. The holding brake shall have a torque rating not less than 150% of rated load hoisting torque at the point where the brake is applied.

(c) When an auxiliary hoist is not to be used to handle or tip molten material, one hoist brake may be used as per (a).

(d) Each hoist holding brake shall have thermal capacity for the frequency of operation required by the service.

(e) Hoist holding brakes shall be applied automatically when power to the brake is removed.

(f) Hoist holding brakes shall be provided with means to adjust for lining wear.

2-1.12.2 Hoist Control Braking Means

(a) Each hoisting unit of the crane shall be equipped with a control braking means that will control the load during lowering to a maximum speed of 120% of rated lowering speed for the load being handled.

(b) Hoist control braking means can be electrical, such as regenerative, dynamic, countertorque, or eddy-current; mechanical; hydraulic; or a worm-gear hoist where the angle of the worm is such as to prevent the load from accelerating in the lowering direction.

(c) Hoist control braking means shall have thermal capacity for the frequency of operation required by the service.

2-1.12.3 Trolley Brakes and Braking Means

(a) Each power-driven trolley unit of the crane shall be equipped with either a braking means or have trolley drive frictional characteristics that will provide stopping and holding functions, under conditions where the rails are dry and free of snow and ice, as follows:

(1) have torque capability to stop trolley travel within a distance in feet (meters) equal to 10% of rated load speed in ft/min (m/min) when traveling at rated speed with rated load

(2) have torque capability to impede horizontal motion of the trolley against a horizontal force equal to 1% of the combined weight of the trolley, hoist, and rated load when the trolley is in a parked condition

(b) A power-driven, cab-operated crane with the cab on the trolley shall be equipped with a trolley brake that will provide the stopping and holding functions described in (a)(1) and (a)(2).

(c) Each trolley brake shall have thermal capacity for the frequency of operation required by the service.

2-1.12.4 Bridge Brakes and Braking Means

(a) A power-driven bridge shall be equipped with either a braking means or have bridge drive frictional characteristics that will provide stopping and holding functions, under conditions where the rails are dry and free of snow and ice, as follows:

(1) have torque capability to stop bridge travel within a distance in feet (meters) equal to 10% of rated load speed in ft/min (m/min) when traveling at rated speed with rated load

(2) have torque capability to impede horizontal motion of the bridge against a horizontal force equal to 1% of the combined weight of the bridge, trolley, hoist, and rated load when the bridge is in a parked condition

(b) A power-driven, cab-operated crane shall be equipped with a bridge brake that will provide the stopping and holding functions described in (a)(1) and (a)(2).

(c) Each bridge brake shall have thermal capacity for the frequency of operation required by the service.

2-1.12.5 Trolley and Bridge Brake Provisions

General provisions as outlined below apply to, as merited, trolley and bridge brakes.

(a) Brakes may be applied by mechanical, electrical, pneumatic, hydraulic, or gravitational means.

(b) Brakes shall be provided with means of adjustment to compensate for lining wear.

(c) Brake pedals, latches, and levers should allow release without the exertion of greater force than was used in applying the brake.

(d) Foot-operated brakes shall require an applied force of not more than 70 lb (310 N) to develop rated brake torque.

(e) Foot-operated brake pedals shall be so constructed that the operator's foot will not readily slip off the pedal.

(f) Foot-operated brake pedals should be so located that they are convenient to the operator at the controls.

(g) Foot-operated brakes shall be equipped with a means for positive release when force is released from the pedal.

(h) When provided, a parking brake shall

(1) be applied automatically or manually

(2) impede horizontal motion of the trolley or bridge in accordance with the requirements of [para. 2-1.12.3\(a\)\(2\)](#) or [para. 2-1.12.4\(a\)\(2\)](#)

(3) not prohibit the use of a drift point in the control circuit

(i) When provided, a service brake shall

(1) be applied manually by the operator during normal operation

(2) stop trolley or bridge travel in accordance with the requirements of [para. 2-1.12.3\(a\)\(1\)](#) or [para. 2-1.12.4\(a\)\(1\)](#)

(j) When provided, a drag brake shall provide a continuous retarding torque without external control.

(k) When provided an emergency brake shall

(1) be applied when initiated by the operator or automatically upon loss of power

(2) stop trolley or bridge travel in accordance with the requirements of [para. 2-1.12.3\(a\)\(1\)](#) or [para. 2-1.12.4\(a\)\(1\)](#)

(3) impede horizontal motion of the trolley or bridge in accordance with the requirements of [para. 2-1.12.3\(a\)\(2\)](#) or [para. 2-1.12.4\(a\)\(2\)](#)

SECTION 2-1.13: ELECTRICAL EQUIPMENT

2-1.13.1 General

(a) Wiring and equipment shall comply with Article 610 of ANSI/NFPA 70.

(b) The control circuit voltage shall not exceed 600V for AC or DC.

(c) The control circuit voltage in pendant push buttons shall not exceed 150 V for AC or 300 V for DC.

(d) Where multiple conductor cable is used with a suspended push-button station, the station shall be supported so that the electrical conductors are protected from strain.

(e) Pendant control stations shall be constructed to prevent electrical shock. The push-button enclosure shall be at ground potential and marked for identification of functions.

(f) When cranes are used in hazardous locations as defined by ANSI/NFPA 70, additional safety requirements may be necessary. In these locations, cranes shall be designed and installed in a manner suitable for the conditions expected to be encountered.

2-1.13.2 Equipment

(a) Electrical equipment shall be located or enclosed so that, under normal operating conditions, energized parts will not be exposed to inadvertent contact.

(b) Energized parts of electrical equipment shall be protected from direct exposure to grease, oil, and moisture, and they should be protected from dirt.

(c) If guards are provided for energized parts, the guards shall be constructed or located so that they cannot be deformed, under normal operating conditions, to make inadvertent contact with energized parts.

(22) 2-1.13.3 Controllers

(a) Cranes not equipped with spring-return controllers, spring-return master switches, or momentary contact push buttons shall be provided with a device that will disconnect all motors from the line in the event of a power failure. This disconnect device shall not permit any motor to be restarted until the controller or master switch handle is brought to the "OFF" position, or a reset switch or power-on button is operated.

(b) For cab- or pulpit-operated cranes, lever-operated manual controllers and master switches shall be provided with a spring-return arrangement, off-point detent, or off-point latch.

(c) For cab- or pulpit-operated cranes, the manual controller or master switch operating handle shall be located within reach of the operator.

(d) For cab- or pulpit-operated cranes, the movement and arrangement of controllers or master switches should conform to Figures 2-1.13.3-1 and 2-1.13.3-2.

(e) If a magnet controller is provided, the on (lift) direction shall be toward the operator and the off (drop) direction away from the operator.

(f) For floor-operated cranes, the controller or controllers, if rope operated, shall automatically return to the "OFF" position when released by the operator.

(g) Push buttons in pendant stations shall return to the "OFF" position when pressure is released by the crane operator.

(h) Push buttons of pendant stations shall be guarded or shrouded to prevent accidental actuation of crane motion.

(i) Remote-operated cranes shall function so that if the control signal for any crane motion becomes ineffective, that crane motion shall stop, and, conversely, signals received from any source other than the operating station (transmitter) shall not result in operation of any motion of the crane.

(j) The arrangement of pendant push-button stations and radio-control transmitters should conform to Figures 2-1.13.3-3 and 2-1.13.3-4, respectively. Compass directions may be substituted for "right-left" and "forward-reverse" in Figure 2-1.13.3-3, and for W, X, Y, and Z in Figure 2-1.13.3-4.

(k) In locations or areas where multiple electric-powered cranes are used, the arrangement of control markings for directions of motion should be the same for all cranes.

(l) Radio control (cableless) systems shall be in accordance with ANSI ECMA 15.

(m) A minimum of two collectors for each runway conductor shall be furnished when the crane uses inverters (variable frequency drives).

(n) For hoists utilizing brake failure detection, a unique visual or audible warning should be provided to alert the operator of a brake failure.

(o) Overspeed protection shall be provided when inverters (variable frequency drives) are used. A mechanical load brake may be considered as overspeed protection for hoisting drives. Dynamic braking resistors may be considered as overspeed protection for traversing drives.

(p) Basic controls (Figures 2-1.13.3-1 through 2-1.13.3-4) used during crane operating cycle shall be located within reach of the operator while at the operating station.

2-1.13.4 Resistors

(a) Resistor units shall be supported to minimize vibration effect.

(b) Provisions shall be made to prevent broken parts or molten metal from falling on the operator or from the crane.

(c) If resistor enclosures are provided, the enclosures shall be installed to limit exposure to combustible materials.

(d) Conductors connected to resistors shall have a flame-resistant outer covering or be covered with flame-resistant tape.

Figure 2-1.13.3-1
Recommended Arrangement of Controllers or Master Switches (Three-Motion Crane)

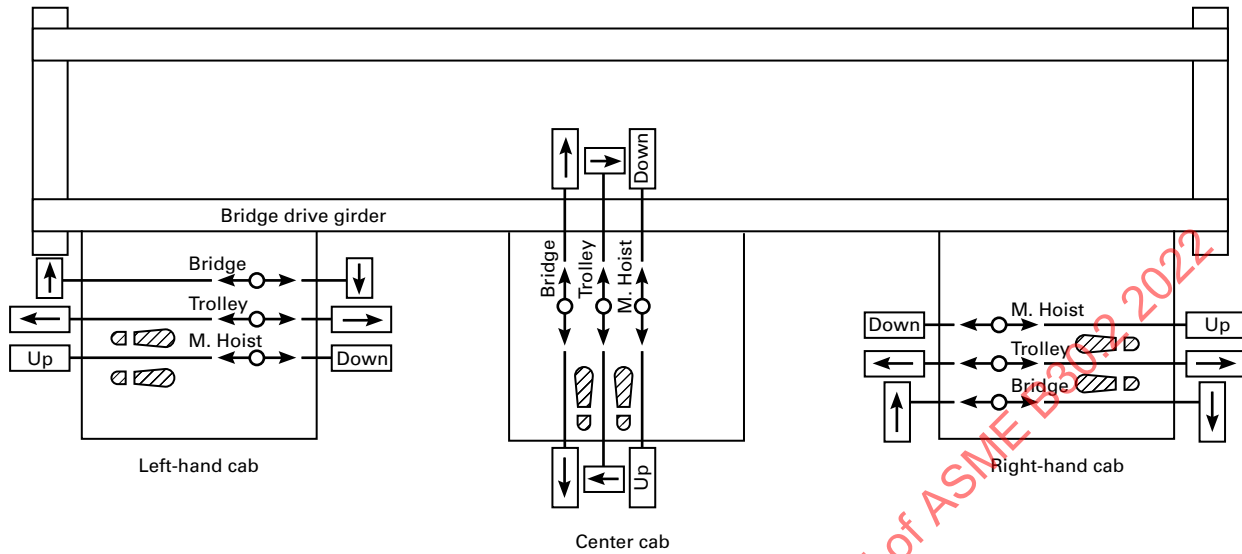


Figure 2-1.13.3-2
Recommended Arrangement of Controllers or Master Switches (Four-Motion Crane)

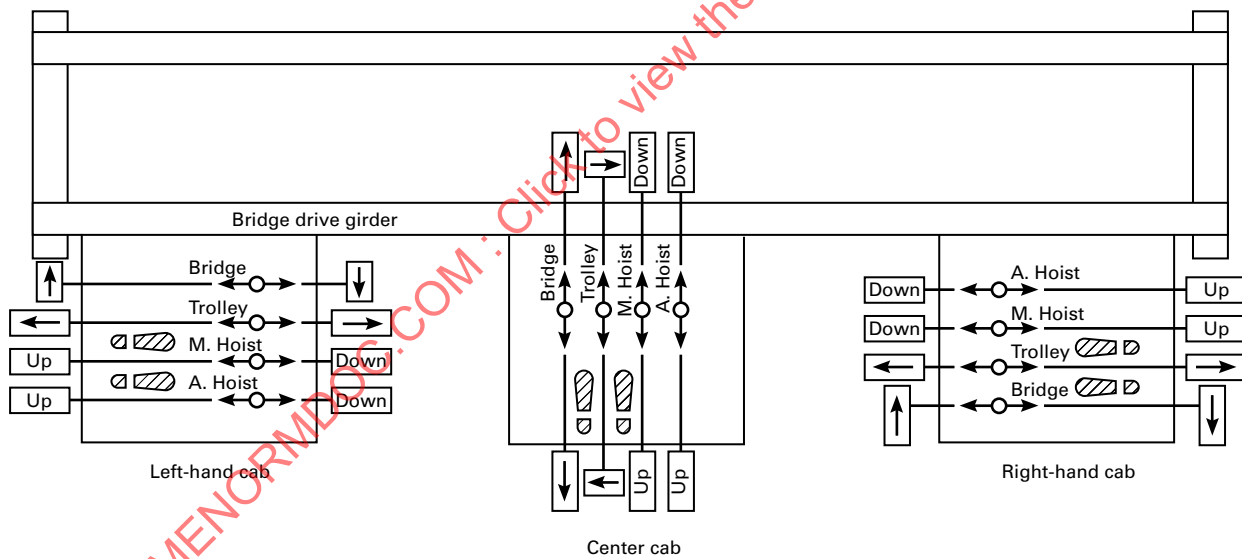


Figure 2-1.13.3-3

(22) Recommended Arrangement of Controllers (Pendant Push-Button Station Arrangement)

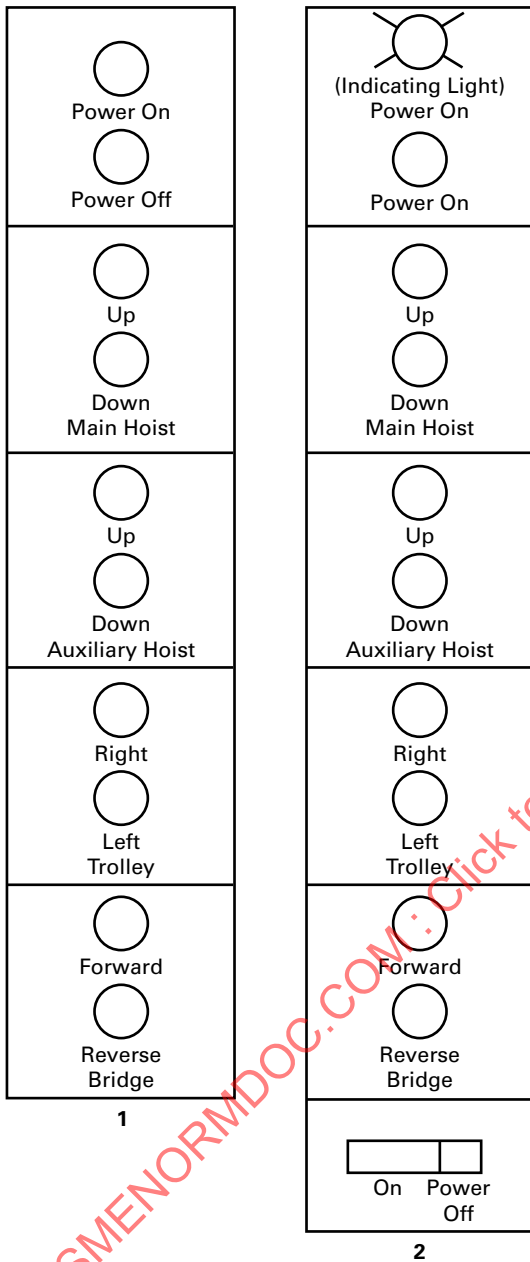
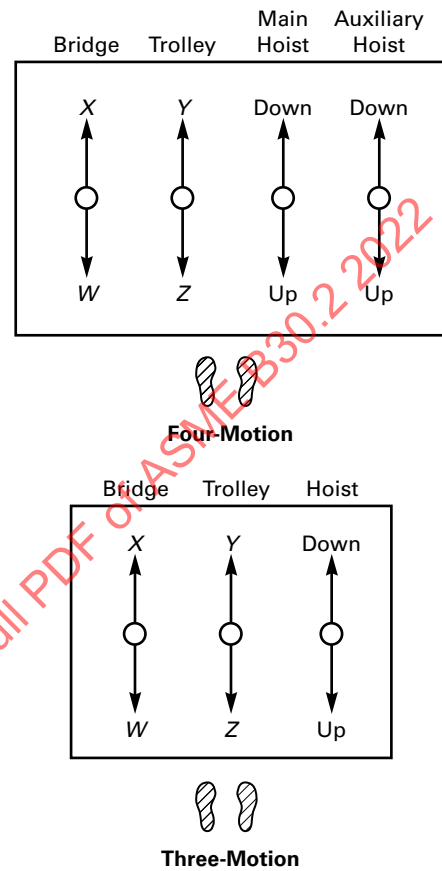


Figure 2-1.13.3-4

Recommended Arrangement of Controllers (Radio Crane Control Transmitter Lever Arrangement) (22)



(22) 2-1.13.5 Disconnecting Means

(a) The power supply to the runway conductors shall be controlled by a switch or circuit breaker located on a fixed structure, readily accessible and operable from the ground or floor level, placed within view of the runway conductors, and arranged to be locked in the open position. Means for locking shall remain in place with or without the lock installed.

(b) A switch or circuit breaker of the enclosed type with provision for locking in the open position shall be provided in the leads from the runway conductors. Means for locking shall remain in place with or without the lock installed. The disconnecting means may be omitted for equipment when the controls enclosure is mounted remotely from the equipment.

(c) A method for opening the disconnecting means in (b) or a push button or switch operating a main line contactor shall be located within the reach of the operator when the operator is in the operating position. For remote operated cranes, a power disconnecting circuit shall be used. Operation of this device shall set the holding brake(s) and open the power circuit to all motors unless the condition of (d) is met.

(d) When operation of the push button or switch controlling the main line contactor in (c) will result in uncontrolled movement of the load (such as when a hoist that is equipped with a brake failure detection circuit detects a brake failure), the control circuit may temporarily maintain power to the crane to prevent uncontrolled movement of the load.

2-1.13.6 Hoist Limit Switches

(a) Power-driven hoists shall be designed and constructed so that the load block, either loaded or empty, shall not exceed the upper limit of travel. On wire-rope hoists, if a geared or other limit switch or device that operates in relation to drum turns is used, an additional limit switch or device that operates independent of drum turns shall be provided.

(b) Lower-travel-limit devices should be provided for power-driven hoists used in applications where the load block enters pits or hatchways in the floor.

(c) The trip point of all limit switches shall be located to allow for maximum deceleration distance of the motion being stopped for the braking system that is used.

2-1.13.7 Runway and Bridge Conductor Systems

(a) Conductors of the open type, mounted on the crane runway beams or overhead crane, shall be so located or guarded that persons cannot inadvertently come into contact with the energized conductors under normal operating conditions or under maintenance procedures as stated in [para. 2-4.2.3](#).

(b) For grounding purposes, a separate grounding conductor shall be provided.

2-1.13.8 Crane Powered Lifting Devices

(22)

(a) When a loss of power to a lifting device would cause uncontrolled movement of the load, a separate lifting device disconnect switch shall be connected on the line side (power supply side) of the crane disconnect switch. The lifting device disconnect switch shall be of the enclosed type with provision for locking in the open (off) position.

(b) For lifting magnets, a means shall be provided for discharging the inductive load.

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

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

(e) A minimum of two collectors for each runway conductor shall be furnished when the crane is used with a powered lifting device.

(f) Lifting devices shall comply with the provisions of ASME B30.20.

2-1.13.9 Service Receptacle

If a service receptacle is provided in the cab or on the bridge, it shall be a grounded-type permanent receptacle not exceeding 300 V.

SECTION 2-1.14: HOISTING EQUIPMENT**2-1.14.1 Sheaves**

(a) Sheave grooves shall be free from surface defects that could cause rope damage. The cross-sectional radius at the bottom of the groove should be such as to form a close-fitting saddle for the size of rope used. The sides of the groove shall be tapered 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, which can be momentarily unloaded, shall be provided with close-fitting guards, or other devices, to guide the rope back into the groove when the load is reapplied.

(c) The sheaves in the bottom block shall be equipped with close-fitting guards that will minimize the possibility of ropes becoming fouled when the block is lying on the ground with the ropes loose.

(d) All running sheaves shall be equipped with means for lubrication. Permanently lubricated, sealed, or shielded bearings shall be acceptable.

2-1.14.2 Drums

Rope drums shall be grooved, except when the crane is provided by the manufacturer for a special application. This requirement does not preclude the use of multiple layer spooling. The grooves shall be free from surface

defects that could cause rope damage. The cross-sectional radius at the bottom of the groove should be such as to form a close-fitting saddle for the size of rope used.

2-1.14.3 Ropes

(a) The hoisting ropes shall be of a recommended construction for crane service. The total load (rated load plus weight of load block) divided by the number of parts of line shall not exceed 20% of the minimum breaking force of the rope or 12.5% for cranes that handle or tip molten material.

(b) Socketing shall be done in a manner recommended by the rope or fitting manufacturer or a qualified person.

(c) Rope shall be secured to the drum as follows:

(1) No less than two wraps of rope shall remain on the drum at each anchorage of the hoisting drum when the hook is in its extreme low position unless a lower-limit device is provided, in which case no less than one wrap shall remain.

(2) The rope end shall be anchored by a clamp attached to the drum, or by a socket arrangement specified by the crane or rope manufacturer. The rope clamps shall be tightened evenly to the manufacturer's recommended torque.

(d) Eye splices shall be made in recommended manner. Rope thimbles should be used in the eye.

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

(f) Swaged or compressed fittings shall be applied as recommended by the rope, crane, or fitting manufacturer or qualified person.

(g) Wherever exposed to 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.

(h) Replacement rope shall be the same size, grade, and construction as the original rope furnished by the crane manufacturer, unless otherwise recommended by a rope or crane manufacturer or qualified person due to actual working condition requirements.

2-1.14.4 Equalizers

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

2-1.14.5 Hooks

Hooks shall meet the manufacturer's recommendations and shall not be overloaded. If hooks are of the swiveling type, they should rotate freely. Latch-equipped hooks shall be used unless the application makes the use of the latch impractical or unnecessary. When required, a latch or mousing shall be provided to bridge the throat opening of the hook for the purpose of retaining slings, chains, or other similar parts under slack conditions (see ASME B30.10).

2-1.14.6 Guards for Hoisting Ropes

(a) If it is possible for hoisting ropes to foul or chafe on adjacent parts of the crane under normal operating conditions, guards shall be installed to minimize damage to the rope.

(b) A guard shall be provided to prevent contact between bridge or runway conductors and hoisting ropes if, under normal operating conditions, they can come into contact.

SECTION 2-1.15: WARNING DEVICES OR MEANS FOR A CRANE WITH A POWER-TRAVELING MECHANISM

2-1.15.1 Cab- and Remote-Operated Cranes

(a) A warning device shall be provided.

(b) Refer to [paras. 2-3.3.4\(b\)\(18\)](#) and [2-3.3.4\(c\)\(19\)](#) for operation of the device.

2-1.15.2 Floor-Operated Cranes

(a) A warning device should be provided for installations where the ability of the operator to warn persons in the path of the load is impaired.

(b) Refer to [paras. 2-3.3.4\(b\)\(18\)](#) and [2-3.3.4\(c\)\(19\)](#) for operation of the device.

2-1.15.3 Types of Devices

One or more of the following devices shall be provided when required:

- (a) manually operated gong
- (b) power-operated bell, siren, or horn
- (c) rotating beacon
- (d) strobe light

SECTION 2-1.16: MANUAL

2-1.16.1 General Information

The crane manufacturer shall furnish with each crane at least one copy of the manual. The manual shall include general information applicable to the following:

- (a) installation
- (b) operation
- (c) inspection
- (d) testing
- (e) lubrication
- (f) maintenance
- (g) parts
- (h) wiring diagram (may be supplied separately)

2-1.16.2 Safety Personnel

Personnel responsible for the supervision, installation, operation, inspection, or maintenance of the crane shall be familiar with the applicable contents of the manual furnished with the crane.

SECTION 2-1.17: TRANSLATION OF SAFETY-RELATED INFORMATION AND CONTROL DESIGNATIONS

(a) Translation of non-English documentation into English

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

- (-a) translation of the complete paragraph message, instead of word by word
- (-b) grammatical accuracy
- (-c) respectfulness of the source document content without omitting or expanding the text
- (-d) accurate translation of the terminology
- (-e) reflection of the level of sophistication of the original document

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

(3) Pictograms used to identify controls shall be described in the manuals. The pictograms should comply with ISO 7000, ISO 7296, or another recognized source, if previously defined. The text of the descriptions shall meet the criteria of (1) and (2).

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

Chapter 2-2

Inspection and Testing

SECTION 2-2.1: INSPECTION

2-2.1.1 General

(a) This Chapter establishes and defines the criteria for determining whether cranes can be expected to perform as intended.

(b) Five types of inspections are defined, each with the common purpose of keeping equipment performing as intended. Each inspection is directed toward a different set of circumstances. The five types of inspection are

- (1) initial inspection
- (2) functional test inspection
- (3) frequent inspection
- (4) periodic inspection
- (5) inspection of equipment not in regular use

(c) In addition to the five types of inspection listed in (b), the inspection provisions found in manuals supplied by the manufacturer(s) of the crane and the crane components shall be followed.

(d) 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 and, if so, what additional steps need to be taken to address the hazard.

2-2.1.2 Initial Inspection

(a) An initial inspection is a visual and audible examination of the crane.

(b) New, reinstalled, altered, repaired, and modified equipment shall be inspected prior to initial use to verify compliance with the applicable provisions of Chapter 2-1.

(c) Inspection of altered, repaired, and modified cranes may be limited to the parts of the crane affected by the alteration, repair, or modification, as determined by a qualified person.

(d) The cranes shall be tested in accordance with the requirements of Section 2-2.3.

(e) Adjustments, repairs, or replacements necessary to satisfy requirements shall be made in accordance with para. 2-4.2.4 prior to initial use if the inspection and test reveal that there are items and conditions that do not comply with the provisions.

(f) Records of the inspection and test shall be made.

2-2.1.3 Functional Test Inspection

(a) A functional test inspection is a visual and audible operational examination of the crane and shall be conducted at the beginning of each shift or before the crane is first used during each shift. In special applications, where the suspended load is transferred from operator to operator at shift change, the functional test inspection shall be performed when that lift is completed.

(b) Items that shall be inspected during performance of the functional test inspection are the following:

- (1) operational controls
- (2) upper and lower limit devices in accordance with para. 2-3.5(a)
- (3) rope in accordance with para. 2-2.2.2

(c) Adjustments, repairs, or replacements necessary to satisfy requirements shall be made in accordance with para. 2-4.2.4 prior to initial use if the functional test inspection reveals that there are items and conditions that do not comply with the provisions.

(d) Records of the inspection should be made.

2-2.1.4 Frequent Inspection

(a) A frequent inspection is a visual and audible examination of the crane.

(b) Equipment shall be inspected at intervals dependent on the use of the equipment as follows:

- (1) normal service — monthly
- (2) heavy service — weekly to monthly
- (3) severe service — daily to weekly

(c) The following items shall be inspected:

(1) operating mechanisms for proper operation, proper adjustment, and unusual sounds such as, but not limited to, squeaking, grinding, grating, etc.

(2) upper limit device(s) in accordance with para. 2-3.5(a)

(3) tanks, valves, pumps, lines, and other parts of air or hydraulic systems for leakage

(4) hooks and latches, if used, in accordance with the provisions of ASME B30.10

(5) hook attachment and securing means

(6) rope for proper spooling onto the drum(s) and sheave(s)

(7) warning device(s) for proper operation

(8) rope in accordance with para. 2-2.2.2

(d) Adjustments, repairs, or replacements shall be made, as necessary, in accordance with [para. 2-4.2.4](#).

(e) Records of the inspection should be made.

2-2.1.5 Periodic Inspection

(a) A periodic inspection is a visual and audible examination of the crane.

(b) Equipment shall be inspected at intervals dependent on the use of the equipment as follows:

- (1) normal service — yearly
- (2) heavy service — yearly
- (3) severe service — quarterly

(c) The inspection shall include the items listed in [para. 2-2.1.4\(c\)](#) and the following items, as applicable:

- (1) deformed, cracked, or corroded members.
- (2) loose or missing fasteners such as, but not limited to, bolts, nuts, pins, or rivets.
- (3) cracked or worn sheaves and drums.
- (4) worn, cracked, or distorted parts such as pins, bearings, wheels, shafts, gears, rollers, locking and clamping devices, bumpers, and stops.

(5) hooks, in accordance with the provisions of ASME B30.10.

(6) excessive wear of brake system parts.

(7) excessive wear of drive chain sprockets and excessive drive chain stretch.

(8) deterioration of controllers, master switches, contacts, limit switches, and push-button stations, but not limited to these items.

(9) wind speed indicators for proper operation in accordance with device/crane manufacturer's or qualified person's recommendations.

(10) gasoline, diesel, electric, or other power plants for proper operation in accordance with device/crane manufacturer's or qualified person's recommendations.

(11) motion limit devices that interrupt power or cause a warning to be activated for proper performance. Each motion shall be inched or operated at low speed into the limit device with no load on the crane.

(12) rope reeving for compliance with crane manufacturer's design.

(13) function, instruction, and safety information signs, labels, or plates for legibility and replacement.

(14) rope and end connections in accordance with [para. 2-2.2.3](#).

(15) lower limit device(s), if provided. Verify function and a minimum of one wrap of rope remains on the drum at the lowest possible position.

(d) Adjustments, repairs, or replacements shall be made, as necessary, in accordance with [para. 2-4.2.4](#).

(e) Dated records shall be made of apparent external conditions found in (c) to provide a basis for a continuing evaluation and placed on file.

2-2.1.6 Inspection of Cranes Not in Regular Use

(a) A crane that has been idle for a period of 1 month or more, but less than 1 year, shall be inspected before being placed in service in accordance with the requirements listed in [para. 2-2.1.4](#).

(b) A crane that has been idle for a period of 1 year or more shall be inspected before being placed in service in accordance with the requirements listed in [para. 2-2.1.5](#).

SECTION 2-2.2: ROPE INSPECTION

2-2.2.1 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 and if so, what additional steps need to be taken to address the hazard.

2-2.2.2 Frequent Rope Inspection

(a) All ropes should be visually inspected at the start of each shift. These visual observations should be concerned with discovering gross damage, such as listed below, that may be a hazard.

- (1) distortion of the rope, such as kinking, crushing, unstranding, birdcaging, main strand displacement, or core protrusion
- (2) general corrosion
- (3) broken or cut strands
- (4) number, distribution, and type of visible broken wires [see [paras. 2-4.3.1\(b\)\(1\)](#) and [2-4.3.1\(b\)\(2\)](#) for further guidance]

(b) When damage as described in (a)(1) through (a)(4) is discovered, the rope shall either be removed from service or be given an inspection as detailed in [para. 2-2.2.3\(b\)](#).

2-2.2.3 Periodic Rope Inspection

(a) The inspection frequency shall be determined by a qualified person and shall be based on such factors as

- (1) expected rope life as determined by experience on the particular installation or similar installations
- (2) severity of environment
- (3) percent of capacity lifts
- (4) frequency rates of operation
- (5) exposure to shock loads

Inspections need not be at equal calendar intervals and should be more frequent as the rope approaches the end of its useful life.

(b) This inspection shall cover the entire length of rope. The individual outer wires in the strands of the rope shall be visible to the person during the inspection. Any deterioration resulting in appreciable loss of original strength, such as described below, shall be noted and determination

shall be made as to whether further use of the rope would constitute a hazard.

(1) points listed in [para. 2-2.2.2\(a\)](#).

(2) reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires. See [para. 2-4.3.1\(b\)\(5\)](#).

(3) severely corroded or broken wires at end connections.

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

(c) Special care should be taken when inspecting sections of 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 visual inspection, such as parts passing over sheaves

(d) In order to establish data as a basis of judging the proper time for replacement, a continuing inspection record should be maintained. This record should cover points of deterioration listed.

SECTION 2-2.3: TESTING

(22) 2-2.3.1 Operational Tests

(a) New, reinstalled, altered, repaired, and modified cranes shall be tested by a designated person prior to initial use to confirm that the crane performs in compliance with the provisions of this Volume.

(b) Tests shall include, as applicable, the following functions:

(1) lifting and lowering

(2) trolley travel

(3) bridge travel

(4) hoist limit devices (switches)

(-a) The trip setting of hoist limit devices shall be determined by tests under no-load conditions comprising a series of runs, each at increasing speed up to the maximum speed, unless the hoist has only a single speed.

(-b) The actuating mechanism of the upper-limit device shall be located or adjusted so that it will trip the device in sufficient time to prevent contact of the load block or load with any part of the trolley or bridge.

(5) bridge/trolley travel-limiting devices, if provided, shall be tested with an empty hook or loaded and at a sequence of increasing speeds up to the maximum speed. The speeds and crane loading(s)

shall be determined by a crane manufacturer or a qualified person.

(6) locking and indicating devices, if provided

(7) wind speed indicators for proper operation in accordance with the device/crane manufacturer's or qualified person's recommendations.

(c) Operational testing of altered, repaired, and modified cranes may be limited to the functions affected by the alteration, repair, or modification, as determined by a qualified person.

2-2.3.2 Load Test

(22)

(a) New cranes shall be load tested prior to initial use.

(b) Reinstalled, altered, repaired, and modified cranes shall be load tested prior to initial use, unless otherwise determined by a qualified person.

(c) Load testing of altered, repaired, and modified cranes may be limited to the functions affected by the alteration, repair, or modification, as determined by a qualified person.

(d) The replacement of load chain and rope is specifically excluded from this load test; however, an operational test of the hoist shall be made in accordance with [para. 2-2.3.1](#) prior to putting the crane back in service.

(e) If a load test is conducted, the load shall be not less than 100% of the rated load of the crane or hoist(s), whichever governs, or more than 125% of the rated load of the crane or hoist(s), whichever governs, unless otherwise recommended by the manufacturer or a qualified person.

(f) If a load test is conducted, the person conducting the load test shall prepare a written report of the load sustained during the test and the operations performed during the test. Reports shall be placed on file.

(g) If a load test is conducted, operations shall be performed as outlined below or as modified by a qualified person.

(1) Hoist the test load a distance to ensure that the load is supported by the crane and held by the hoist brake(s).

(2) Transport the test load by means of the trolley for the full length of the bridge.

(3) Transport the test load by means of the bridge for the full length of the runway in one direction with the trolley as close to the extreme right-hand end of the crane as practical, and in the other direction with the trolley as close to the extreme left-hand end of the crane as practical.

(4) Lower the test load, and stop and hold the load with the brake(s).

Chapter 2-3

Operator Training and Operation

SECTION 2-3.1: CRANE OPERATOR TRAINING

2-3.1.1 Purpose of Crane Operator Training

Crane operator training shall be provided to promote proficient performance of a crane operator in conformance with the provisions of this Volume.

2-3.1.2 Crane Operator Training: General

(a) Training shall include those items that apply to the crane and the particular application of the crane. Refer to [para. 2-3.1.3](#) as a guide for sources of training material.

(b) Training programs and their contents shall be based upon but not limited to

(1) physical characteristics of the workplace.
(2) performance characteristics and complexity of the crane.

(3) type of load to be handled, such as, but not limited to, the following:

- (-a) multiple piece loads
- (-b) raw materials
- (-c) bulk materials
- (-d) machine assemblies
- (-e) hot molten materials
- (-f) hot materials
- (-g) fragile or durable materials

(4) responsibilities of the crane operator and other persons involved in the movement of the load. Refer to [paras. 2-3.3.2](#) and [2-3.3.4](#).

2-3.1.3 Sources of Training Material

Examples of sources of training material are as follows:

- (a) information outlined in the manual provided with the equipment
- (b) information available through trade associations
- (c) government training resources such as the Department of Labor
- (d) organized labor groups
- (e) courses, seminars, and literature offered by manufacturers of cranes, consultants, trade schools, continuing education schools, employers, and manufacturers of crane component parts
- (f) requirements and recommendations found in National Consensus Standards such as this Volume

SECTION 2-3.2: TRAINING FOR PERSONS OTHER THAN CRANE OPERATORS

2-3.2.1 Scope

Other persons, such as, but not limited to, maintenance personnel, test personnel, and crane inspectors, when it is necessary to operate a crane in the performance of their duties, shall be trained in accordance with the training requirements of this Volume.

SECTION 2-3.3: OPERATION

2-3.3.1 Scope of Crane Operation

(22)

The operation of overhead and gantry cranes shall be in accordance with the provisions included in this Volume and in manuals furnished by the manufacturer of the crane as required in [para. 2-1.16](#). The requirements of [Section 2-3.3](#) apply to both dedicated operators, whose primary job is the operation of a crane (cab or pulpit), and nondedicated operators who use a crane (floor or remote) as another tool in performing their job.

2-3.3.2 General Requirements

(22)

The following requirements shall be followed by all personnel involved with the crane operation:

(a) A warning sign, lock, or tag that is on any switch that controls power to the crane, such as, but not limited to the crane disconnect, motion disconnect, or runway disconnect, shall not be removed by any person other than the person who placed the sign, lock or tag on the device.

(b) Warning or safety signs, labels, plates, or tags furnished on the lifting equipment shall not be removed or obscured.

(c) The crane shall not lift, lower or travel while anyone is on the load or hook.

(d) The hoist rope shall be free from kinks or twists and shall not be wrapped around the load.

(e) A hook latch shall be used when provided (see [para. 2-1.14.5](#)).

(f) The hook latch (when provided) shall be closed and shall not be used to support any part of the load.

(g) The load, sling, or lifting device (when not reeved into the hoist ropes) shall be seated in the bowl of the hook.

(h) The hoist rope shall be seated in the drum grooves and the sheave grooves.

- (i) Persons shall stay clear of a suspended load.
- (j) Caution shall be exercised when using a crane having a lifting magnet, due to hazard of possible falling metal.
- (k) The crane shall be used to lift loads vertically without side pull except when specifically authorized by a qualified person who has determined that
 - (1) the various parts of the crane will not be overstressed
 - (2) the hoist rope will not bear or rub against other members of the crane, such as girders or trolley frame, except members specifically designed for such contact
 - (3) such side pulls will not cause the hoist rope to be pulled out of the sheave or across drum grooves
- (l) The crane shall not be used to lift loads in excess of the rated load of the crane except during properly authorized tests or planned engineered lifts in accordance with [Section 2-3.4](#).
- (m) A load-limiting device shall not be used to measure the weight of the load.
- (n) The hoist rope shall be protected so far as is practical from weld spatter or other damaging contaminants.

(22) 2-3.3.3 Responsibilities of Management (Owners/Users)

- Management (owners/users) shall
- (a) identify, document, and assign responsibilities of the crane operator and other persons involved in the movement of the load for each crane installation. (See [paras. 2-3.3.2](#) and [2-3.3.4](#).)
 - (b) provide training for persons who will operate a crane.
 - (c) provide written and practical examinations that verify that the person has acquired the knowledge and skill to operate the particular crane(s) that will be operated by the person. The examinations shall be defined by the owner/user and in accordance with any local, state, and federal provisions that may apply.
 - (d) issue a certificate or formal record, that verifies that the person has been trained and has passed the examination required in (c), or confirm that the person has a valid certificate or formal record that satisfies the requirements of (c).
 - (e) provide operators that are physically and mentally fit to operate the equipment to which they are assigned.
 - (f) establish medical and vision criteria, if required, for persons who will operate crane(s).

(22) 2-3.3.4 Responsibilities of Crane Operators

- (a) *Lifting and Moving the Load*
 - (1) Three phases of lifting and moving the load shall be addressed as follows:
 - (-a) before the lift
 - (-b) during the lift
 - (-c) after the lift
 - (2) In most crane operations, all of the requirements listed in (b) are the responsibility of the operator of the crane.
 - (3) Rigging the load, attaching the load to the crane hook, and other tasks related to moving the load are sometimes handled by persons other than the crane operator.
 - (4) Crane operation characteristics such as, but not limited to, the type of crane, cab, floor, pulpit, or remote operated, the vantage point of the operator, and the purpose for which the crane is being used are conditions that determine whether the crane operator or another person is responsible for lift and move functions.
 - (5) Assignment of responsibilities is determined, identified, and documented by management for each crane application.
- (b) *Before the Lift*. Crane operators shall
 - (1) read and be familiar with the applicable provisions of crane equipment safety standards and the instructions listed in manual(s) provided with the equipment
 - (2) be familiar with controls, instructions, and warnings located on the lifting equipment
 - (3) operate the equipment only when physically and otherwise fit
 - (4) not energize the main switch (crane disconnect) if a warning sign, lock, or tag is on the device until the sign, lock, or tag is removed by the person who placed it on the device or by a designated person
 - (5) not remove a warning sign, lock, or tag that is on any switch that controls power to the crane, such as, but not limited to, the crane disconnect, motion disconnect, or runway disconnect, if the sign, lock, or tag was placed on the device by another person
 - (6) place all controllers in the off position before closing the main line disconnect device
 - (7) verify that no worker is on or adjacent to the crane before closing the main switch (crane disconnect)
 - (8) perform a functional test inspection and test in accordance with the requirements of [para. 2-2.1.3](#)
 - (9) not remove or obscure the warning or safety labels, plates, or tags furnished on the lifting equipment
 - (10) be familiar with and understand hand signals (see [Section 2-3.6](#) and [Figure 2-3.6.1-1](#))
 - (11) verify that the hook, bridge, and trolley travel in the same direction as shown on the controls
 - (12) verify that the hoist rope is free from kinks or twists and is not wrapped around the load
 - (13) attach the load to the hook or have the load attached to the hook by means of slings or other lifting devices
 - (14) verify that the load, sling, or lifting device (when not reeved into the hoist ropes) is seated in the bowl of the hook
 - (15) use a hook latch when provided
 - (16) verify that the hook latch (when provided) is closed and not supporting any part of the load