



**ASME B30.24-2018**  
(Revision of ASME B30.24-2013)

# Container Cranes

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

**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**



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Mechanical Engineers**

Two Park Avenue • New York, NY • 10016 USA



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The next edition of this Standard is scheduled for publication in 2023. This Standard will become effective 1 year after the Date of Issuance.

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

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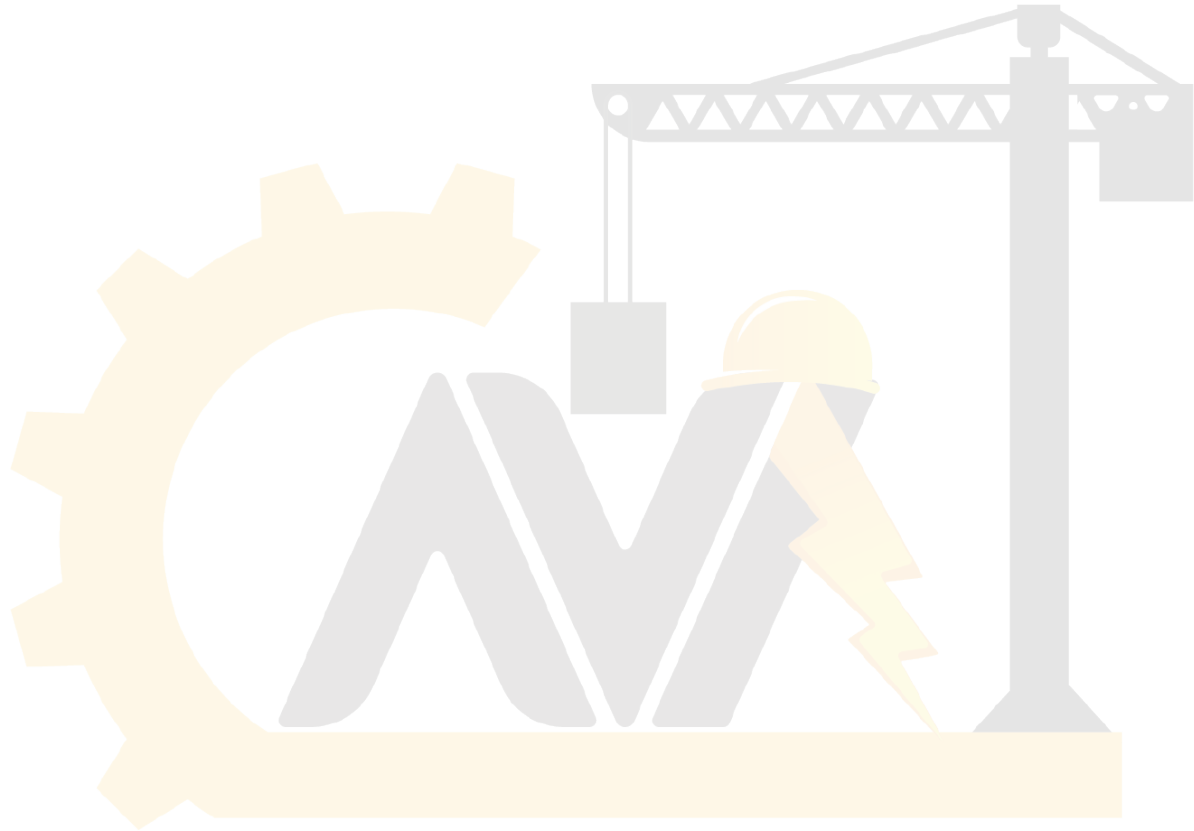


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## FOREWORD

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

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

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

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

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

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

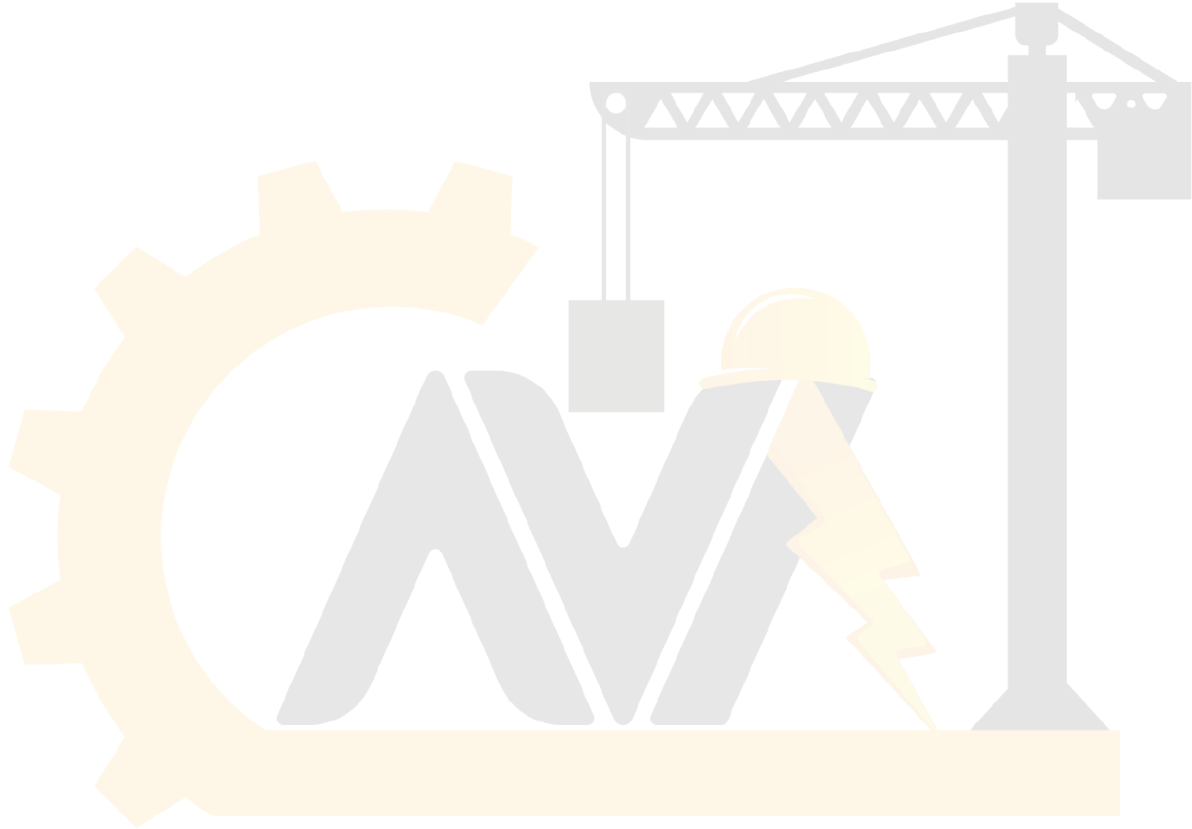
Safety codes and standards are intended to enhance public safety. Revisions result from committee consideration of factors such as technological advances, new data, and changing environmental and industry needs. Revisions do not imply that previous editions were inadequate.

B30.24, Container Cranes, was first published in 2008 and provides requirements applicable to rail-mounted and rubber-tired cranes designed to handle shipping containers and other types of cargo at marine terminals. The 2013 revision added requirements for personnel competence, pedestrian clearance, truck sweeps, and wheel guards and translation of non-English documentation into English. This 2018 edition contains revisions throughout the document



consistency between the B30 Volumes, which also include information regarding translations, and technical related instructions and manuals.

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 August 21, 2018.



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## 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 Transporters<sup>1</sup>
- B30.32 Unmanned Aircraft Systems (UAS) Used in Inspection, Testing, Maintenance, and Lifting Operations<sup>1</sup>

### SECTION II: SCOPE EXCLUSIONS

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

### SECTION III: PURPOSE

The B30 Standard is intended to

- (a) prevent or minimize injury to workers, and otherwise provide for the protection of life, limb, and property by prescribing safety requirements
- (b) provide direction to manufacturers, owners, employers, users, and others concerned with, or responsible for, its application
- (c) guide governments and other regulatory bodies in the development, promulgation, and enforcement of appropriate safety directives

### SECTION IV: USE BY REGULATORY AGENCIES

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

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



## EFFECTIVE DATE

*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 Codes and Standards  
Two Park Avenue  
New York, NY 10016-5990

Requests should be in the following format:

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

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

## SECTION IX: REQUESTS FOR INTERPRETATION

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

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

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

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

## SECTION X: ADDITIONAL GUIDANCE

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

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

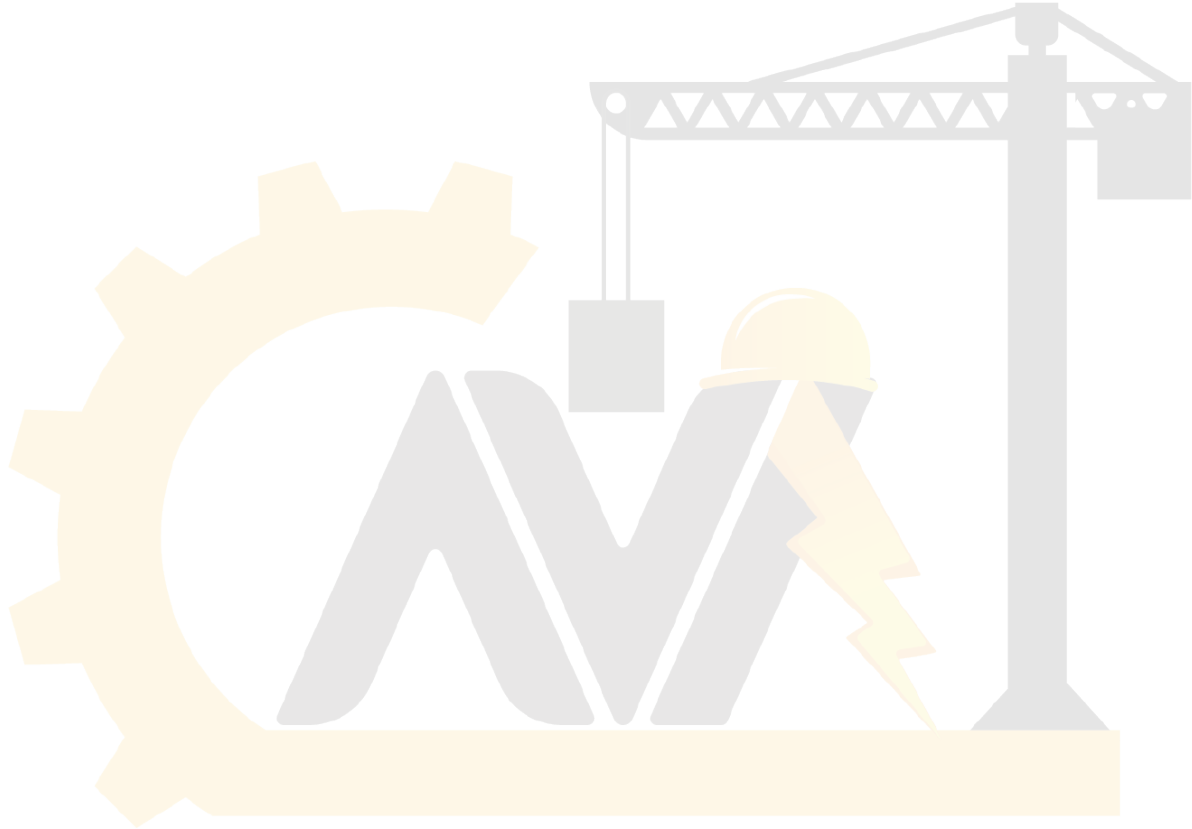
- (a) the condition of the equipment or material
- (b) the loads



- (d) acceleration or speed of the ropes, chains, sprockets, or drums
- (e) 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.



# آریا ایمن آوات

## ASME B30.24-2018 SUMMARY OF CHANGES

Following approval by the ASME B30 Committee and ASME, and after public review, ASME B30.24-2018 was approved by the American National Standards Institute on August 21, 2018.

ASME B30.24-2018 includes editorial changes, revisions, and corrections, as well as the following changes identified by a margin note, **(18)**.

Page	Location	Change
ix	B30 Standard Introduction	Revised
1	Chapter 24-0	Title revised
1	Section 24-0.2	(1) Definitions of <i>administrative or regulatory authority</i> ; <i>brake, parking</i> ; <i>equalizer</i> ; <i>gantry leg</i> ; <i>sill beam</i> ; <i>switch, main (crane disconnect)</i> ; and <i>switch, spring return</i> deleted (2) Definitions of <i>brake, holding</i> ; <i>controller, spring return</i> ; <i>crane, automatic</i> ; <i>crane, container</i> ; <i>crane, dockside container</i> ; <i>crane, service</i> ; <i>crane, yard container, rail-mounted</i> ; <i>crane, yard container, rubber-tired</i> ; <i>hoist, main</i> ; <i>runway, gantry</i> ; <i>sheave, equalizer</i> ; <i>stop, runway or trolley</i> ; <i>switch, emergency stop</i> ; <i>switch, limit</i> ; and <i>switch, master</i> revised (3) Definitions of <i>original language(s)</i> ; <i>shall</i> ; and <i>should</i> added
3	Section 24-0.3	Former Section 24-0.4 renumbered
3	Section 24-0.4	Added
5	Section 24-0.5	Former Section 24-0.3 renumbered and revised
14	Section 24-1.16	Revised in its entirety
15	24-2.1.1	Revised
17	Section 24-2.4	New 24-2.4.1 added and subsequent paragraphs renumbered as 24-2.4.2 and 24-2.4.3, respectively



## Chapter 24-0

### Scope, Definitions, Personnel Competence, Translations, and References

(18)

#### SECTION 24-0.1: SCOPE OF B30.24

Volume B30.24 includes provisions that apply to the construction, installation, operation, inspection, testing, and maintenance of container cranes used for lifting purposes, in conjunction with equipment described in other volumes of the B30 Standard. This Volume includes power-operated cranes of the above type whose power source is either self-contained or provided externally; single, double, or box girder construction, utilizing a trolley and a container-handling spreader or other applicable lifting apparatus (cargo hook, cargo beam, magnet, etc.); and rail- or rubber tire-mounted with through-the-legs or between-the-legs operation. Use of the same hardware for purposes other than lifting is excluded from the provisions of this Volume. This Volume does not apply to small industrial truck-type cranes, container-handling toploaders and sideloaders, or mobile straddle-type industrial lifts.

#### (18) SECTION 24-0.2: DEFINITIONS

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

*boom:* an extension of the trolley runway on dockside container cranes that may be raised (luffing boom) or retracted (shuttle boom) to obtain clearance for gantry travel.

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

*bumper (buffer):* a device for reducing the force of impact at the end of permitted travel.

*cab:* a compartment with crane controls for the operator to control the operating functions of a container crane.

*container crane:* a crane with single or multiple girders carrying a movable or fixed hoisting mechanism used primarily to lift intermodal shipping containers. It utilizes a trolley(s) and a container-handling spreader assembly.

*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.

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

*dockside container crane:* a rail-mounted cantilever gantry crane in which the trolley girder(s) extends transversely beyond the crane runway on one or both sides and is used primarily to lift intermodal shipping containers on and off ships. The crane may have a luffing boom or a shuttle boom (see Figure 24-0.2-1).

*drum:* a cylindrical member around which wire rope is wound for moving the load, boom, or trolley.

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

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

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

*gantry frame:* a structural assembly that supports the trolley girder beams.

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

*headblock:* an assembly of sheaves, pins, and frame suspended from the crane for connecting container-handling devices, such as lift beams and spreaders.

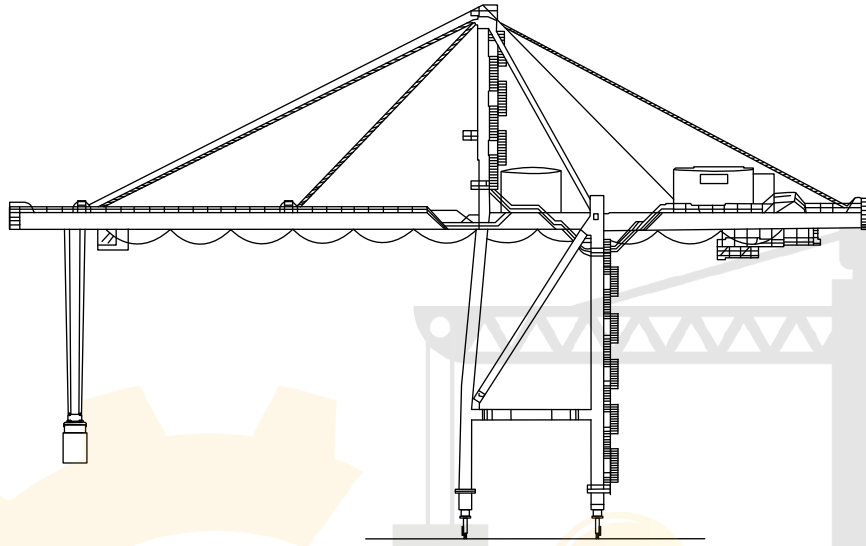
*hoist:* a machinery unit that is used for lifting or lowering a freely suspended load.

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

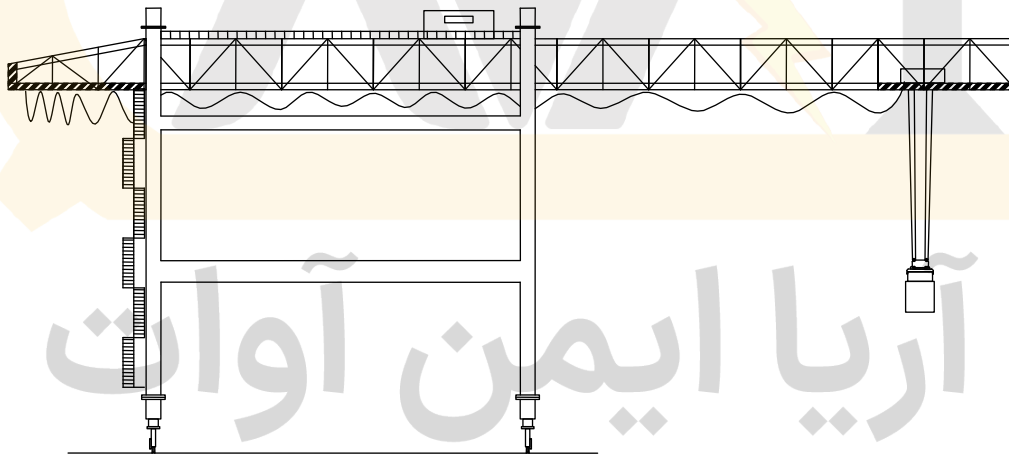
*lifting apparatus:* spreaders, cargo beams, heavy lift beams, cargo hooks, and other devices attached to the headblock for lifting loads.

*limit device (crane motion):* a device that limits crane motion or takes control of particular functions without action of the operator when a limiting condition is reached.

Figure 24-0.2-1 Dockside Container Crane



(a) Luffing Boom Type



(b) Shuttle Boom Type



**hook:** a device that is actuated by the motion of a power-driven machine or equipment to alter or connect the electric, hydraulic, or pneumatic circuit associated with the machine or equipment.

**load:** the total superimposed weight on the spreader or hook.

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

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

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

**normal operating conditions:** conditions under which a crane is performing functions within the scope of the original design.

**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 reached. Examples of such devices are hoist, trolley, and boom hoist limit switches.

**original language(s):** used by the manufacturer to develop product instructions and manual(s).

**parts of line:** the number of ropes supporting the load.

**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-mounted yard container crane:** a crane consisting of overhead girders supporting a trolley, mounted on rigid legs, and running on rails (see Figure 24-0.2-2).

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

**rated load:** the maximum allowable working load designated by the manufacturer for which a crane or individual hoist is designed and built. The term "safe working load" is commonly used to describe the rated load.

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

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

**rubber-tired yard container crane:** a crane consisting of overhead girders supporting a trolley, mounted on rigid legs, and running on rubber tires (see Figure 24-0.2-2).

**runway:** the path on which the gantry travels.

**service crane:** an overhead crane, jib crane, monorail, or similar crane mounted in the machinery enclosure or other location on a container crane and used for servicing the container crane.

**service platform:** a means provided for workers to perform maintenance, inspection, adjustment, or repair 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.

**shock load:** any condition that causes a momentary increase in the forces in a load-supporting component beyond the weight of the actual load being lifted.

**should:** a word indicating a recommendation.

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

**slap block:** a sacrificial protective device or guard to protect the wire rope or other parts of the crane from rope contact.

**span:** the horizontal distance, center to center, between runway rails or tire centers.

**spreader:** a fixed or telescoping frame attached to the headblock that is used for lifting containers (see Figure 24-0.2-3).

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

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

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

**torque proving:** a feature that ensures sufficient motor torque is applied to the motor shaft prior to release of the brake(s) and the start of drive operation.

**trolley:** the unit that travels on the trolley rails and supports the load and lifting apparatus.

**truck:** an assembly that includes a pivot, frame, axle(s), and wheels on which a crane rides on rails.

**twist-lock:** a latching device whose rotatable motion locks or unlocks the spreader to an intermodal shipping container.

### SECTION 24-0.3: PERSONNEL COMPETENCE (18)

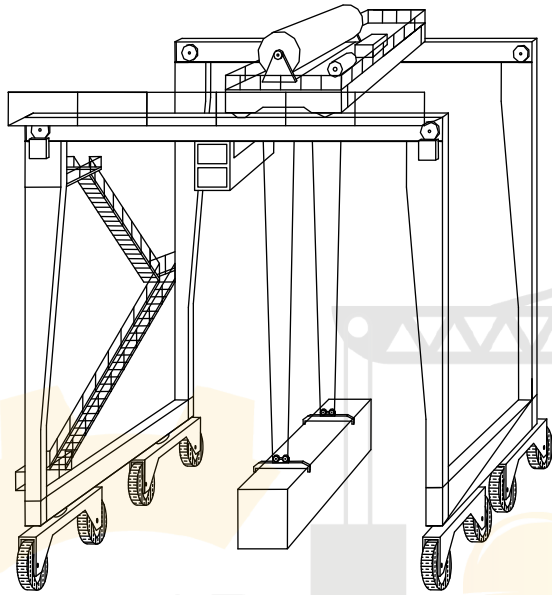
Persons performing the functions identified in this Volume shall meet the applicable qualifying criteria stated in this Volume and shall, through education, training, experience, skill, and physical fitness, as necessary, be competent to perform the assignments as determined by the employer or employer's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

### SECTION 24-0.4: TRANSLATIONS (18)

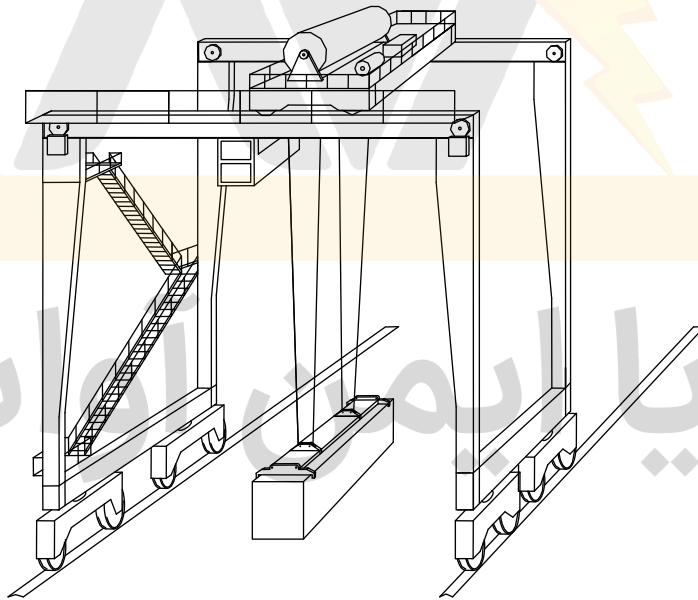
The entities performing the operation, use, inspection, testing, maintenance, assembly, and disassembly of the crane shall have the instructions and manuals available in a language that their employees can read and



Figure 24-0.2-2 Yard Container Crane

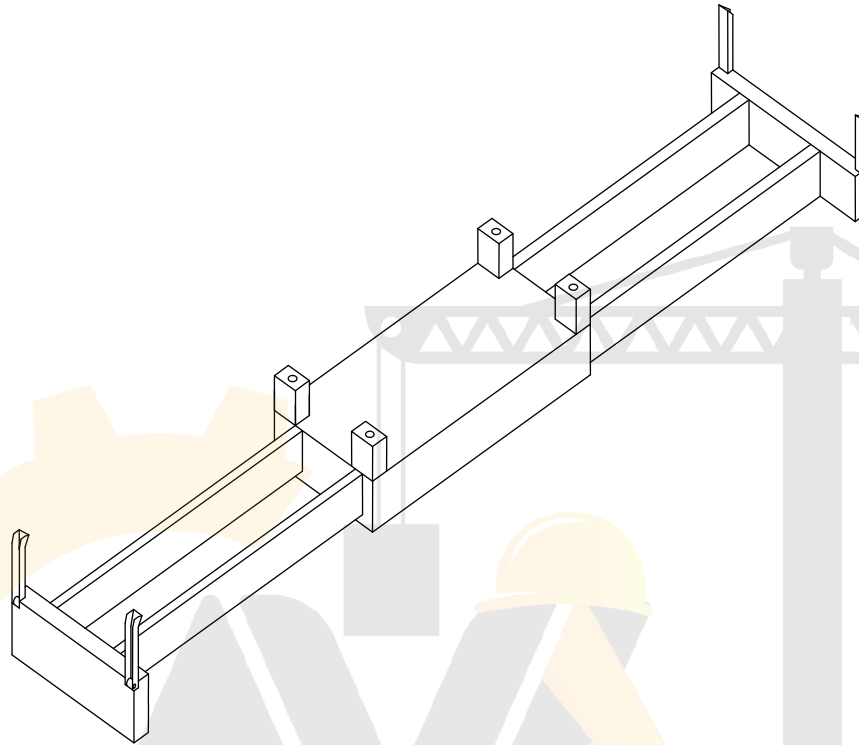


(a) Rubber Tired



(b) Rail Mounted

Figure 24-0.2-3 Spreader



understand. If the information is not available in a language understood by their employees, the entities shall obtain a translation of the original manufacturer's instructions and manuals from the manufacturer or from a translation service provider. The translation(s) shall meet the requirements of [Section 24-1.16\(c\)](#) and [Section 24-1.16\(d\)](#).

(18) **SECTION 24-0.5: REFERENCES**

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

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

ANSI/AWS D1.1-2010, Structural Welding Code — Steel  
 ANSI/AWS D14.1-2005, Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment  
 Publisher: American Welding Society (AWS), 8669 NW 36 Street, No. 130, Miami, FL 33166 ([www.aws.org](http://www.aws.org))

ANSI/NFPA No. 70-2011, National Electrical Code  
 Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471 ([www.nfpa.org](http://www.nfpa.org))

ASCE/SEI 7-10-2010, Minimum Design Loads for Buildings and Other Structures  
 Publisher: American Society of Civil Engineers (ASCE), 1801 Alexander Bell Drive, Reston, VA 20191 ([www.asce.org](http://www.asce.org))

ASME A17.1-2010, Safety Code for Elevators and Escalators

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

ASME B30.10-2010, Hooks

ASME B30.20-2010, Below-the-Hook Lifting Devices

ASME B30.23-2011, Personnel Lifting Systems

ASME B30.26-2010, Rigging Hardware

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

ASSE A1264.1-2007, Safety Requirements for Workplace Walking/Working Surfaces and Their Access; Workplace, Floor, Wall, and Roof Openings; Stairs and Guardrails Systems

Publisher: The American Society of Safety Professionals (ASSP), 520 N. Northwest Highway, Park Ridge, IL 60018 ([www.assp.org](http://www.assp.org))

FAA FED AC 150/5345-43F, Specification for Obstruction Lighting Equipment



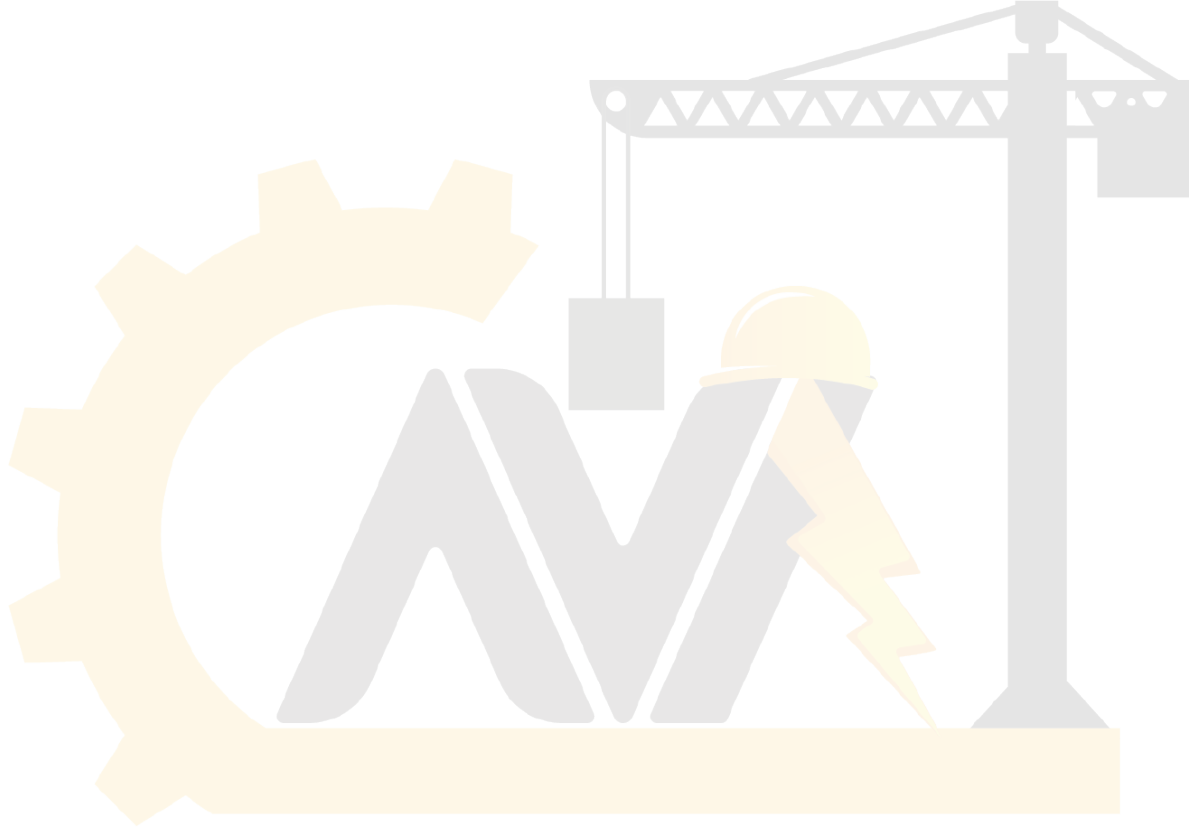
Federal Aviation Administration (FAA), 800  
Independence Avenue, SW, Washington, DC 20591  
(www.faa.gov)

ISO 7000, Graphical symbols for use on equipment  
ISO 7296, Cranes — Graphical symbols  
Publisher: International Organization for Standardization  
(ISO), Chemin de Blandonnet 8, Case Postale 401, 1214  
Vernier, Geneva, Switzerland (www.iso.org)

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

SAE J 386/97, Operator Restraint System for Off-Road  
Work Machines

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



آریا ایمن آوات



## Chapter 24-1 Construction and Installation

### SECTION 24-1.1: MARKINGS

(a) The rated load for each lifting apparatus used with the crane shall be marked on the crane and shall be legible from the ground level. The same information shall be posted in the operator's cab and shall be legible from the operator's seat.

(b) Service crane(s) shall be marked in accordance with the manufacturer's rating and the applicable B30 crane volume.

(c) The crane shall be fitted with a durable nameplate listing

- (1) manufacturer's name and address
- (2) manufacturer's serial number
- (3) year manufactured

(d) Each lifting apparatus (spreader assembly, heavy lift beam, etc.) shall be marked with its rated load and weight.

(e) The headblock shall be marked with its rated load.

### SECTION 24-1.2: CLEARANCES

#### 24-1.2.1 Clearance From Obstruction

Clearance shall be maintained between rail-mounted cranes and any structures or parallel running, rail-mounted cranes under all normal operating conditions. In the design of new cranes, all factors that influence clearance, such as wheel float, gantry frame, or trolley positions and configurations, shall be considered. Minimum clearance shall be 2 in. (50.8 mm).

#### 24-1.2.2 Pedestrian Clearance

If the track area is used for employee passage or for work, a minimum clearance of 3 ft (0.91 m) shall be provided between trucks or the structures of rail-mounted cranes and any other structure or obstruction. When the required clearance is not available on at least one side of the crane's trucks, the area shall not be used by pedestrians and shall be marked to identify the hazard.

### SECTION 24-1.3: RUNWAYS — RAIL-MOUNTED CRANES

#### 24-1.3.1 Construction of Runways and Rails

(a) The crane runways and supporting structures shall be designed to withstand the loads and forces imposed by the crane.

(b) Rails shall be level, straight, joined, and spaced to the crane span so as to be compatible with the design of the crane.

(c) Where curves are required, the rail designer should consult with the crane manufacturer to ensure the radius of curvature is compatible with the crane design, so that detrimental forces are not induced on the crane travel or rail systems. The crane travel trucks (wheel spacing, float, wheel diameter, flange design, etc.) shall be designed to traverse the rail curves.

#### 24-1.3.2 Runway Stops

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

(b) Stops shall engage the bumpers or bumper pads mounted on the gantry frame.

(c) Stops shall be capable of resisting the stall load of the drive motor.

(d) Each stop shall be capable of stopping the motion of the gantry from full speed at a deceleration not to exceed  $16 \text{ ft/sec}^2$  ( $4.9 \text{ m/s}^2$ ), unless stability considerations require a lower deceleration. The overturning moment created by the deceleration force shall not exceed 80% of the stabilizing moment due to the mass of the crane.

### SECTION 24-1.4: CRANE CONSTRUCTION (GENERAL)

#### 24-1.4.1 Wind

(a) The crane shall be provided with means to hold the crane from moving under stowed conditions with wind conditions of the geographic area per ASCE/SEI 7.

(b) Dockside container-handling cranes shall be provided with an automatic gantry holding/locking system acting on the wheel or rail capable of holding the crane under the specified nonoperating wind load.



-indicating device shall be provided. The device shall give a visible and audible alarm at a pre-determined wind velocity discernible in the operator's cab and at the ground level.

(d) Cranes shall be prevented from tipping when subjected to nonoperating wind conditions. The overturning moment shall not exceed 80% of the stabilizing or resisting moment. When the crane is stowed, external restraints may be used to achieve the required resisting moment.

(e) The crane manufacturer shall provide data indicating the design maximum operating wind velocities and the wind velocity at which the use of external restraints of the crane is required.

(f) Operating instructions for high wind conditions shall be provided in the operator's cab. The instructions shall include procedures for responding to high wind alerts.

#### 24-1.4.2 Welded Construction

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 are used, the manufacturer or qualified person shall provide welding procedures.

#### 24-1.4.3 Crane Structural Members

Cranes shall be constructed to withstand all stresses imposed on members and components under normal operating conditions when installed and handling loads not exceeding the manufacturer's load ratings.

#### 24-1.4.4 Truck Frame Drop

Means shall be provided to limit the drop of a rail-mounted crane's trolley and gantry truck frames to a maximum of 1 in. (25.4 mm) in case of wheel or axle breakage.

#### 24-1.4.5 Machinery House

(a) The machinery house, when furnished, shall be weather-resistant and equipped with two doors for egress. The doors shall be equipped with latches to hold the doors in the closed position. Hinged doors shall open outward.

(b) Machinery shall be arranged to be accessible for repair, maintenance, lubrication, and inspection.

#### 24-1.4.6 Gantry Drive

The gantry drive shall provide adequate traction and power under normal operating conditions to include acceleration and deceleration with and against the specified operating wind.

#### 24-1.4.7 Spreader

(a) The spreader shall be constructed so that the twist-locks will engage the corner castings of intermodal shipping containers.

(b) The control of the spreader shall be from the operator's cab.

(c) A mechanical, hydraulic, and/or electrical interlocking system(s) shall be provided to prevent unlocking the twist-locks when carrying a container and to prevent locking action of the twist-lock system until all twist-locks are seated in the corner castings.

(d) A means shall be provided to enable the operator to determine that the container corner castings have been properly engaged.

#### 24-1.4.8 Electromagnetic Interference

For cranes operating in areas susceptible to electromagnetic interference (EMI), crane electrical systems shall be shielded and grounded to protect from EMI.

#### 24-1.4.9 Guards for Moving Parts

Exposed moving parts, such as gears, set screws, projecting keys, chains, and chain sprockets, that constitute a hazard, shall be guarded with guards meeting the requirements of ASME B15.1.

#### 24-1.4.10 Service Cranes

Service cranes shall be designed, constructed, and installed in accordance with the applicable ASME B30 volume.

#### 24-1.4.11 Lubrication Accessibility

Lubricating points shall be accessible from walkways, floors, or platforms.

#### 24-1.4.12 Fire Extinguishers

A portable fire extinguisher with a minimum extinguisher rating of 10 BC shall be installed at the following locations:

(a) in the cab.

(b) at each door of the machinery house, if provided. If the machinery house has only one door, an additional fire extinguisher should be located at the far end from the door.

(c) in the diesel engine/generator compartment, if provided.

#### 24-1.4.13 Modifications

(a) Cranes may be modified or rerated by or under the direction of a qualified person or the crane manufacturer.

(b) A rerated crane or one whose load-supporting components have been modified shall be tested in accordance with [para. 24-2.2.2](#).



The new rated load shall be displayed in accordance with Section 24-1.1. Documentation verifying compliance with the requirements of this Volume, including calculations and drawings, shall be retained when cranes are modified or rerated.

## SECTION 24-1.5: OPERATOR'S STATIONS

### 24-1.5.1 Cab Design and Construction

(a) The cab shall be designed and constructed to withstand the stresses imposed on it under normal operating conditions.

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

(c) Cabs shall be constructed of fire-resistant material.

(d) The operator's cab shall be designed and mounted in a location to provide the operator with a view of the crane's work area.

(e) Cab glass shall be clear safety glazing material meeting the requirements of ANSI Z26.1.

(f) If necessary to afford the operator vision of operations below the cab, glass of  $\frac{1}{2}$  in. (1.3 cm) minimum thickness shall be provided in the floor.

(g) Floor glass shall be protected with gratings designed to support the weight of a 250-lb (113.4-kg) person.

(h) Glazing shall be from the inside of the cab.

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

(j) Means shall be provided to keep windows from fogging up.

(k) Windshield wipers should be installed on the front windows.

(l) Access to the operator's cab shall be by means of a platform and access door at the rear or side of the cab. See also paras. 24-1.8.2 and 24-1.8.3.

(m) The door shall be self-closing and shall be equipped with a positive latching device to prevent inadvertent opening. The door shall open outward.

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

(o) 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. The trapdoor shall not be the sole means of egress or access and shall comply with the requirements of ANSI A1264.1. If a trapdoor is provided, the roof shall be designed to support the weight of a 250-lb (113.4-kg) person.

(p) A means shall be provided to prevent the cab from trolleying from the docking area when a person is entering or exiting the cab from/to the crane structure.

(q) An adjustable seat shall be provided and located such that crane controls can be conveniently reached and the seat is easily accessed from the cab door.

(r) A seat belt meeting SAE J386 shall be provided for all seats.

### 24-1.5.2 Boom Control Station — Dockside Cranes

Operating and indicating devices for the boom hoist control shall be installed in a location that provides the operator with an unobstructed view of the boom, boom hoist ropes, boom stops, pendants, and boom latches, through the total raising and lowering of the boom.

## SECTION 24-1.6: LIGHTING SYSTEMS

### 24-1.6.1 Ladders, Stairs, and Walkways

(a) A system of lights mounted on the crane structure shall be provided to produce an average of 2 fc (21.5 lx) of illumination on all ladders, stairs, and walkways.

(b) Light switches shall be located in the cab, on the gantry frame at ground level near the access ladder or stairs, and on the landing where the operator's cab is parked.

### 24-1.6.2 Machinery Areas

Lighting in machinery areas shall provide a general illumination of 20 fc (215.2 lx). Switches shall be mounted near the machinery house door.

### 24-1.6.3 Operator's Cab

(a) Lighting in the operator's cab shall be capable of providing a maximum illumination level of 35 fc (376.6 lx).

(b) A light switch shall be provided near the cab door.

(c) A dimmer switch shall be provided to permit the operator to adjust the light level.

(d) Red-toned lighting should be provided for night vision within the cab.

### 24-1.6.4 Work Areas

(a) Floodlights shall be designed to provide a minimum illumination level of 5 fc (53.8 lx) on the work area below the crane.

(b) The spacing of the floodlights shall provide a uniform lighting pattern of light on the work area.

(c) Bulbs shall be mounted in enclosed fixtures.

(d) Fixtures shall be installed on vibration-dampening mountings.

### 24-1.6.5 Emergency Lighting

An emergency lighting system shall be installed to provide lighting for cab egress in the event of power failure.



### Boom Latch Lighting — Dockside Cranes

Lighting shall be provided and located so as to illuminate the boom latches (when provided). The light switch shall be located at the boom controls.

#### 24-1.6.7 Gantry Travel Warning Lights and Alarms

Flashing or rotating amber lights and audible alarms activated by gantry travel shall be provided.

#### 24-1.6.8 Obstruction Lights — Dockside Cranes

When required by FAA FED AC 150/5345-43F or other applicable regulatory code, obstruction lights shall be provided on the highest point of the crane and on the end of the boom. These lights shall be controlled through a photocell.

### SECTION 24-1.7: COMMUNICATION SYSTEMS

(a) For dockside cranes, two-way communication shall be provided at the following locations: ground level, operator's cab, machinery house, diesel engine/generator compartment (if provided), and boom control station. Additionally, a loudspeaker shall be mounted on the exterior of the operator's cab for communicating to personnel aboard ship and at ground level.

(b) For yard cranes, the operator shall have a means of alerting ground personnel, and two-way communications between the operator and ground and/or vessel personnel shall be provided.

### SECTION 24-1.8: SERVICE PLATFORMS AND FOOTWALKS

#### 24-1.8.1 Construction of Service Platforms

Service platforms and footwalks shall conform to the following requirements:

(a) Service platforms and footwalks shall be provided on the crane for access to all components, including accessory components and assemblies, to which access is required for the crane's lubrication, service, maintenance, and inspection.

(b) The dimension of the working space in the vertical direction from the floor of the platform to the nearest overhead obstruction shall be a minimum of 48 in. (1220 mm) at the location where a person is performing a function while on the platform.

(c) Footwalks shall have a clear passageway of at least 18 in. (457 mm), except at the trolley drive mechanism, where 15 in. (380 mm) of clear passageway shall be allowed.

(d) The dimension of the working space in the direction of access to energized electrical parts, that are likely to require inspection or maintenance while energized shall be in accordance with ANSI/NFPA 70, Article 110.

(e) Service platforms and footwalks shall be designed to sustain a distributed load of at least 100 lb/ft<sup>2</sup> (2400 Pa).

(f) Service platforms and footwalks shall have a slip-resistant walking surface.

(g) Service platforms and footwalks shall be provided with guard railings and toeboards meeting the requirements of ANSI A1264.1, except as modified to meet the requirements of this Volume.

(h) Floor openings shall have toe plates in accordance with applicable safety regulations.

#### 24-1.8.2 Stairs, Ladders, and Stairways

(a) Crane access and egress shall be provided from the ground level to the operator's cab, machinery house, diesel engine/generator compartment (if provided), and boom control station.

(b) Means of access and egress shall meet the requirements of ANSI A1264.1.

(c) Ladders shall meet the requirements of ALI A14.3, except that the ladder at ground level may not be rigidly attached at the lower end.

#### 24-1.8.3 Emergency Egress

There shall be a means of egress from the crane to permit departure under emergency conditions, such as a fire. This shall include egress and emergency lighting from the operator's cab at any trolley position to ground level utilizing the crane walkways.

#### 24-1.8.4 Personnel Platform on Headblock or Spreader — Dockside Cranes

(a) Personnel platforms and attachments on the headblock or spreader, used for installation and removal of container-connecting cones, shall be designed by the manufacturer or a qualified person.

(b) Access to the personnel platform shall be provided with steps and handholds.

(c) The riding location shall be provided with guard rails and a gate or enclosing device.

(d) The access space and riding location shall be equipped with guards where needed to protect personnel from moving machinery.

(e) A stowage space for specialized gear for longshoring operations shall be provided. The stowage space shall be designed to prevent gear from falling from the crane.

(f) Anchorage points designed and constructed in accordance with ASME B30.23 shall be provided.



## 24-1.9: BUMPERS, TROLLEY RUNWAY, AND TROLLEY STOPS

### 24-1.9.1 Gantry Bumpers — Rail-Mounted Cranes

(a) Gantry end trucks shall be provided with bumpers that shall have sufficient energy-absorbing capacity to prevent damage to equipment when one crane contacts another, considering one crane stopped and the other traveling at full rated speed without power and with no live load, or when such a traveling crane is stopped by the crane stops at the end of the crane runway. The deceleration rate shall not exceed  $16 \text{ ft/sec}^2$  ( $4.9 \text{ m/s}^2$ ). Stability considerations may require a lower deceleration rate.

(b) Bumpers shall be located at the ends of the gantry truck assemblies and shall be mounted to engage crane stops or adjacent cranes.

(c) Gantry bumpers, when fully compressed, shall project at least 3 in. beyond any part of the crane.

(d) Bumpers shall be mounted so that there is no direct shear on bolts upon impact.

### 24-1.9.2 Trolley Bumpers

(a) Energy-absorbing bumpers shall be provided. Bumpers may be installed on the trolley or on the end stops.

(b) Bumpers and stops shall be of sufficient capacity to stop a loaded trolley when traveling at full rated speed, with a rated load, at maximum lift, without power, and without causing structural or mechanical damage to the crane structure or trolley.

(c) The deceleration rate shall not exceed  $16 \text{ ft/sec}^2$  ( $4.9 \text{ m/s}^2$ ).

(d) Bumpers shall be designed and installed to minimize parts falling from the crane in case of breakage or loosening of bolted connections.

(e) Bumpers shall be mounted so that there is no direct shear on bolts upon impact.

### 24-1.9.3 Trolley Rails

(a) The trolley runway and supporting structure shall be designed to withstand the loads and forces imposed by the trolley.

(b) Rails shall be straight, joined, and spaced to the trolley span compatible with the design of the trolley.

(c) Special attention shall be given to trolley rail joints at boom hinges to minimize impact and damage from raising and lowering the boom.

### 24-1.9.4 Trolley Stops

(a) End stops shall be fitted at each end of the trolley runway.

(b) For cranes with elevating booms, retracting safety stops on the trolley runway at the landside end of the boom hinge shall be provided to prevent passage of the trolley to the waterside when the boom is elevated.

## SECTION 24-1.10: TRUCK SWEEPS/GUARDS

### 24-1.10.1 Rail-Mounted Cranes

(a) Gantry travel trucks shall be equipped with sweeps that project in front of the leading wheels to remove debris from the rail.

(b) Trolley trucks should be equipped with sweeps that project in front of the leading wheels to remove debris from the rail.

### 24-1.10.2 Rubber-Tired Cranes

(a) Crane wheels shall be guarded with fenders, bumpers, or skirt guards that extend to the lowest practical level above the ground and which shield each wheel to the front and the rear.

(b) Trolley trucks should be equipped with sweeps that project in front of the leading wheels to remove debris from the rail.

## SECTION 24-1.11: BRAKES

### 24-1.11.1 Main Hoist Brakes

(a) For electric hoist drive systems, each motor shall be fitted with a spring-set brake. The brake shall be mounted on the reducer high-speed input shaft.

(b) If two brakes are provided, each brake shall have a torque rating of not less than 100% of the rated load hoisting torque. If a single brake is provided, it shall have a torque rating of not less than 125% of the rated load hoisting torque.

(c) Each brake shall be capable of stopping the motion under all operating conditions unaided by motor regeneration.

(d) Means shall be provided (torque proving) to prevent brake release until motor torque has been established.

(e) Brakes shall have thermal capacity for the frequency of operation required by the service.

(f) Brakes shall be applied automatically when power to the brake is removed.

(g) Brakes shall be provided with means to compensate for lining wear.

(h) For direct lift hoist systems using a hydraulic cylinder with chain or wire rope, the cylinder shall be equipped with a hard-mounted counterbalance or lock valve at the cylinder port. The counterbalance or lock valve shall be set to hold load-induced pressure of the maximum lifted load (payload, spreader, load beam, and vertically moving attachments). Positive seals shall be provided at the cylinder piston and piston rod





etal piston rings or similar seals that permit leakage shall not be used in hydraulic cylinders during operations.

(1) For hoist systems using hydraulic motors, a counter-balance valve shall be provided on the motor, and a spring-applied hydraulic release brake shall be provided between the hydraulic motor and drum drive gearbox.

#### 24-1.11.2 Trolley, Gantry, and Shuttle Brakes

(a) Brakes for stopping the motion of the trolley, gantry, or shuttle travel shall have a torque rating of not less than 125% of the motor full load torque. Brakes shall have the capability to stop the trolley, gantry, or shuttle travel within a distance in feet (meters) equal to 10% of rated load speed in ft/min (m/s) when traveling at full speed with rated load.

(b) Brakes shall be capable of stopping the trolley, gantry, or shuttle under all operating conditions, from full speed to zero, unaided by motor regeneration.

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

(d) Brakes shall be applied automatically when power to the motor is removed.

(e) Brakes shall be provided with means to compensate for lining wear.

#### 24-1.11.3 Boom Brakes — Luffing Boom

(a) The boom hoist system shall be fitted with two brakes: one mounted on the boom hoist drum and one mounted on the reducer high-speed input shaft.

(b) Each brake shall be capable of stopping the motion under all operating conditions unaided by motor regeneration.

(c) Means shall be provided (torque proving) to prevent brake release until motor torque has been established.

(d) Brakes shall have thermal capacity for the frequency of operation required by the service.

(e) Brakes shall be applied automatically when power to the motor is removed.

(f) Brakes shall be provided with means to compensate for lining wear.

### SECTION 24-1.12: DRIVE MOTORS

#### 24-1.12.1 Main Hoist, Boom, Trolley, and Gantry Drive Motors

Motors shall have continuous and peak torque and speed ratings to meet the duty cycle requirements, including acceleration and deceleration requirements at rated load and rated speed.

#### 24-1.12.2 Controlled Lowering

A controlled lowering means capable of maintaining controlled lowering speeds for the main hoist and boom shall be provided.

### SECTION 24-1.13: ELECTRICAL EQUIPMENT

#### 24-1.13.1 General

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

(b) Equipment shall be Underwriters Laboratories (UL) approved or approved by an internationally recognized testing laboratory.

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

(d) Wiring of AC power, AC controls, DC power, and DC controls shall be separated and isolated from each other to avoid induction of currents and feedback circuits.

(e) Intercom wire shall be isolated throughout from other conductors and shall be in twisted pairs and shielded.

(f) Motor fields and brake conductors shall have isolated circuits throughout. Common conductors shall not be used.

(g) Conductors shall be identified with wire numbers at each terminal to which they are connected in accordance with the wiring diagram provided with the crane.

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

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

(j) Guards for live parts, if provided, shall be so constructed or located that they cannot be inadvertently deformed so as to make contact with live parts.

(k) The doors of electrical cabinets shall open 90 deg or shall be removable.

(l) Electrical power distribution equipment and controls shall be mounted in weather-resistant enclosures.

#### 24-1.13.2 Controllers

(a) Cranes shall be equipped with spring return controllers, spring return master switches, or momentary contact push buttons.

(b) Master switch operating handles shall be located within reach of the operator when the operator is in the operating position.

(c) The movement of each master switch handle should be in the same general direction as the resultant movement of the load.

(d) The arrangement of controllers or master switches should be designed for ergonomic consideration and convenience of the operator.



Automatic cranes shall be so designed that operational motions shall be discontinued if the automatic force control becomes ineffective. The completion of the last command is permissible if power is available.

(f) Controllers shall be legibly marked to indicate their function and direction of travel.

### 24-1.13.3 Resistors

(a) Provisions shall be made to prevent broken or molten resistor bank components from falling on the operator or work area below the crane.

(b) If resistor enclosures are provided, the enclosures shall be installed so as to minimize the accumulation of combustible matter.

### 24-1.13.4 Switches

(a) The power supply to the crane shall have an over-current-protected main disconnect switch with provisions for locking in the "off" position.

(b) An emergency stop switch shall be provided in the operator's cab and shall be located within the reach of the operator when the operator is in the operating position. When the operator actuates this switch, the holding brake(s) shall set. Additional emergency stop switches shall be provided at ground level, located as recommended by the manufacturer.

(c) Limit switches shall be provided at the ends of travel for the hoist, trolley, and boom.

(d) Limit switches shall be dust-tight and waterproof.

### 24-1.13.5 Runway Conductors

Conductors of the open type, mounted on the crane runway beams or overhead, shall be so located or guarded that persons cannot inadvertently come into contact with them.

### 24-1.13.6 Electrical Power Receptacles

If service receptacles are provided they shall be a grounded-type receptacle not exceeding 300 V, except for receptacles for portable welding machines, which shall not exceed 480 V.

## SECTION 24-1.14: HOISTING EQUIPMENT

### 24-1.14.1 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 shall be provided with close-fitting guards or other devices to guide a momentarily unloaded rope back into the groove when the load is reapplied.

(c) The pitch diameters of the sheaves shall be not less than 18 times the nominal diameter of the wire rope.

(d) The sheaves in the spreader shall be equipped with guards to prevent the wire ropes from getting fouled in the sheaves when the spreader is lying on the ground and the ropes are loose.

(e) Unless permanently lubricated, sealed, or shielded bearings are utilized, sheaves shall be equipped with means for lubrication.

### 24-1.14.2 Drums

(a) 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.

(b) The pitch diameter of the drum shall be not less than 15 times the nominal diameter of the wire rope.

(c) Rigging hardware shall be in accordance with ASME B30.26.

### 24-1.14.3 Ropes and Reeving Accessories

(a) The hoisting ropes shall be of a construction recommended by the crane or rope manufacturer or a qualified person. The total load (rated load plus weight of lifting system), divided by the number of parts of line shall not exceed 20% of the minimum breaking force of the rope.

NOTE: The minimum breaking force was formerly referred to as nominal breaking strength.

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

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

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

(1) No less than two wraps of rope shall remain on each anchorage of the hoisting drum when the hook is in its extreme low position.

(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.

(e) Wherever exposed to ambient temperatures in excess of 180°F (82°C), rope having an independent wire rope or wire-strand core shall be used.

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



or compressed fittings shall be applied as recommended by the rope, crane, or fitting manufacturer. Socket or swaged socket assemblies shall be proof tested to the crane or fitting manufacturer's recommendation but in no case greater than 50% of the minimum breaking strength of the component wire rope or strand.

(h) Reeving accessories (rigging hardware) shall be in accordance with ASME B30.26.

#### 24-1.14.4 Load Hooks and Headblocks

Load hooks and headblocks shall be of sufficient weight to overhaul the number of parts of line in use. Hooks shall be equipped with latches unless the application makes the use of a latch impractical. When provided, the latch shall bridge the throat opening of the hook for the purpose of retaining slings or other lifting devices under slack conditions (refer to ASME B30.10).

#### 24-1.14.5 Wire Rope Slap Blocks and Guards

(a) If wire ropes can foul or chafe on adjacent parts of the crane under normal operating conditions, slap blocks shall be installed to minimize damage to the wire rope or other parts of the crane.

(b) If hoist ropes could contact electrical conductors, a guard shall be provided to prevent contact.

#### 24-1.14.6 Below-the-Hook Lifting Devices

Below-the-hook lifting devices shall be in accordance with ASME B30.20.

### SECTION 24-1.15: ELEVATORS

Elevators, if provided, shall conform to the design and construction provisions of ASME A17.1, Section 5.7.

### SECTION 24-1.16: TECHNICAL AND SAFETY-RELATED INSTRUCTIONS AND MANUALS

(18)

The manufacturer shall provide instructions and manuals for the operation, inspection, testing, maintenance, assembly, and disassembly of the equipment.

(a) The instructions and manuals shall be provided in a language specified by the purchaser at the time of the initial sale by the manufacturer.

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

(c) Translations of the original language instructions and manuals shall meet professional translation industry standards, which include, but are not limited to, the following:

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

(2) ensuring grammatical accuracy

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

(4) translating the terminology accurately

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

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

(e) If the manufacturer no longer exists, it is acceptable to use the instructions and manuals provided with the machine in place of the original language instructions and manuals for translation. The requirements of (c) and (d) shall apply.

(f) Where existing equipment is rebuilt or remanufactured, the provision of instructions and manuals shall be the responsibility of the party performing the remanufacturing or rebuilding.



## Chapter 24-2 Inspection, Testing, and Maintenance

### SECTION 24-2.1: INSPECTION

#### (18) 24-2.1.1 General

Inspections shall be performed by designated persons. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard and if so, what additional steps need to be taken to address the hazard.

#### 24-2.1.2 Inspection Classification

(a) *Initial Inspection.* Prior to initial use, new, reinstalled, altered, modified, or repaired cranes shall be inspected to ensure compliance with the applicable provisions of this Volume. The inspection shall be in accordance with the requirements of [paras. 24-2.1.3](#) and [24-2.1.4](#).

(b) Inspection procedure for cranes in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The two general classifications are designated as *frequent* and *periodic*, with respective intervals between inspections as defined below.

(1) *Frequent Inspection.* Visual examinations at daily to monthly intervals with records not required.

(2) *Periodic Inspection.* Visual inspection at 1-month to 12-month intervals or as specifically recommended by the manufacturer or qualified person. Records shall be kept of apparent external conditions to provide the basis for a continuing evaluation.

NOTE: If an elevator is fitted, its inspection protocol shall be conducted in accordance with the provisions of ASME A17.1.

#### 24-2.1.3 Frequent Inspection

Frequent inspection shall include observations during operation. The following items shall be inspected:

(a) operating mechanisms for proper operation, proper adjustment, and unusual sounds.

(b) 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.

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

(d) spreader and headblock for proper condition.

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

(f) operational aids for proper function in accordance with the recommendations of the device manufacturer or a qualified person.

#### 24-2.1.4 Periodic Inspection

(a) A qualified person shall determine whether disassembly is required.

(b) The inspection shall include the items listed in [para. 24-2.1.3](#) and items and conditions such as the following:

(1) deformed, cracked, or corroded members

(2) loose or missing 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) excessive wear of brake system parts

(6) excessive wear of chain drive sprockets and excessive chain stretch

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

(8) wind indicators for proper operation

(9) gasoline, diesel, electric, or other power plants for proper operation

(10) function labels for legibility and replacement

(11) damaged trolley rail joints at boom hinges

#### 24-2.1.5 Cranes Not in Regular Service

(a) A crane that is used in infrequent service, that has been idle for a period of 6 months or more but less than 1 yr, shall be inspected before being placed in service in accordance with the requirements of [paras. 24-2.1.3](#) and [24-2.4.2\(a\)](#).

(b) A crane that is used in infrequent service, that has been idle for a period of 1 yr or more, shall be inspected before being placed in service in accordance with the requirements of [paras. 24-2.1.4](#) and [24-2.4.2\(b\)](#).

### SECTION 24-2.2: TESTING

#### 24-2.2.1 Operational Tests

(a) *New or Relocated Container Cranes.* Prior to initial use, new or relocated container cranes shall be tested by or under the direction of a qualified person. Testing shall include, but not be limited to, the following functions:



ing, lifting, and lowering.  
e, full range of travel.

gantry travel.

(4) boom, raise and lower or shuttle.

(5) over-hoist limit switches. The actuating mechanism of the limit device shall be located so it will trip the device under all conditions in sufficient time to prevent damage from two-blocking.

(6) locking, limiting, and indicating devices, if provided.

(b) *Repaired or Modified Container Cranes.* Prior to use, a repaired or modified container crane shall be tested. Testing may be limited to the function(s) affected by the repair or modification.

#### 24-2.2.2 Load Test

(a) *New or Relocated Container Cranes*

(1) Prior to initial use and following operational tests, new or relocated container cranes shall be inspected and load tested by or under the direction of a qualified person. A written test report shall be prepared by the qualified person and be placed on file where readily available. Test loads shall be not less than 120% nor more than 125% of the rated load, unless otherwise recommended by the manufacturer or a qualified person.

(2) The load test shall consist of the following operations as a minimum requirement:

(-a) hoist the test load a short distance, and stop to verify that the load is supported by the crane and held by the hoist brakes(s).

(-b) raise the test load, and transport it by means of the trolley for the full length of trolley travel.

(-c) transport the test load by means of the gantry travel for a short distance of the runway in each direction with the test load centered between the runway rails.

(-d) lower the test load, and stop and hold the load with the brakes(s).

(b) *Repaired or Altered Container Cranes.* The need for load testing a repaired or altered container crane shall be determined by a qualified person. Testing may be limited to the function(s) affected by the repair, alteration, or modification.

### SECTION 24-2.3: MAINTENANCE

#### 24-2.3.1 Preventive Maintenance

(a) A preventive maintenance program shall be established and should be based on the recommendations outlined in the crane manufacturer's manual. Dated records should be kept and placed on file where readily available.

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

#### 24-2.3.2 Maintenance Procedure

(a) Before adjustments and repairs are started on a crane, the following precautions shall be taken as applicable:

(1) The crane to be repaired should be placed in a location where it will be safe from interference with other cranes and operations in the area.

(2) Controllers shall be placed in the "off" position.

(3) Electrical circuits being worked on shall be de-energized and locked and tagged in the de-energized position.

(4) Effective markings and barriers shall be utilized in instances where repair/maintenance work creates a hazardous area beneath the crane.

(5) When cranes are in operation on the same runway, means shall be provided to avoid interference with the idle crane or work area.

(b) Provisions shall be made for trained personnel to work on energized equipment when adjustments and tests are required.

(c) After maintenance work is completed and before restoring the crane to normal operation

(1) guards shall be reinstalled

(2) safety devices shall be reactivated

(3) replaced parts and loose material shall be removed

(4) maintenance equipment shall be removed

#### 24-2.3.3 Adjustments and Repairs

(a) Any hazardous conditions disclosed by the inspection requirements of [Section 24-2.1](#), shall be corrected before normal operation of the crane is resumed. Adjustments and repairs shall be performed by designated personnel.

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

(1) functional operating mechanisms

(2) limit devices

(3) control systems

(4) brakes

(c) If repairs of load-sustaining members are made by welding, identification of materials shall be made, and appropriate welding procedures shall be followed as recommended by the manufacturer or a qualified person.

#### 24-2.3.4 Lubrication

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



chinery should be stationary while lubricants g applied and protection provided as called for .a. 24-2.3.2(a), unless equipped for automatic or remote lubrication.

## (18) SECTION 24-2.4: WIRE ROPE INSPECTION AND REPLACEMENT

### 24-2.4.1 General

Inspections shall be performed by designated persons. Any deficiencies identified shall be examined and a determination made by a qualified person as to whether they constitute a hazard, and if so, what additional steps need to be taken to address the hazard.

### 24-2.4.2 Rope Inspection

#### (a) Frequent Inspection

(1) Ropes should be visually inspected once each working day. A visual inspection shall consist of observations of rope that can reasonably be expected to be in use during the day's operations. These visual observations should be concerned with discovering gross damage that may be a hazard, including the following:

(-a) distortion of the rope, such as kinking, crushing, unstranding, birdcaging, main strand displacement, or core protrusion. Loss of rope diameter in a short rope length or unevenness of outer strands is evidence that the rope or ropes must be replaced.

(-b) general corrosion.

(-c) broken or cut strands.

(-d) number, distribution, and type of visible broken wires [see paras. 24-2.4.3(b)(1) and 24-2.4.3(b)(2) for further guidance].

(2) Care shall be taken when inspecting sections subject to rapid deterioration, such as flange points, cross-over points, and repetitive pickup points on drums.

(3) When damage is discovered, the rope shall either be removed from service or given an inspection as detailed in (b).

(4) Records are not required for frequent inspections.

#### (b) Periodic Inspection

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

(2) Periodic inspections should cover the entire length of rope. Only the surface wires need be inspected. No attempt should be made to open the rope. Any dete-

rioration resulting in appreciable loss of original strength, such as the conditions described below, shall be noted, and determination shall be made by a qualified person as to whether further use of the rope would constitute a hazard.

(-a) points listed in (a)

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

(-c) severely corroded or broken wires at end connections

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

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

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

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

(-c) sections subject to reverse bends

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

(4) To establish data as a basis of judging the proper time for replacement, a dated report of rope condition at each periodic inspection shall be maintained.

### 24-2.4.3 Rope Replacement

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

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

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

(2) one outer wire broken at the point of contact with the core of the rope that has worked its way out of the rope structure and protrudes or loops out from the rope structure. Additional inspection of this section is required.

(3) IWRC or strand core protrusion between the outer strands.

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

(5) apparent damage from any heat source, including, but not limited to, welding, power-line strikes, or lightning.

(6) reductions from nominal diameter of more than 5%.

(7) for standing ropes, more than two broken wires in one lay in sections beyond end connections or more than one broken wire at an end connection.

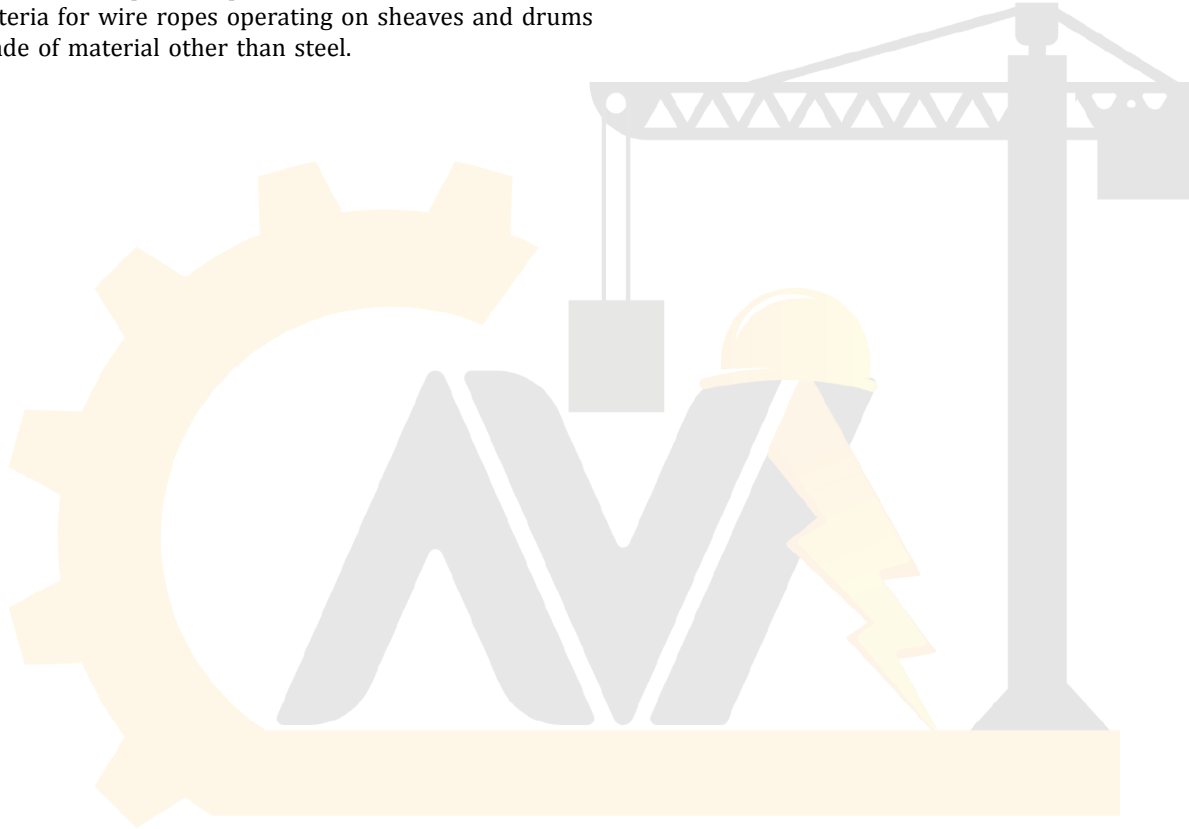


the corrosion as evidenced by pitting. Replacement shall be allowed from the removal listed in (b)(1) through (b)(8) only with the written approval of the manufacturer of the specific wire rope.

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

(d) Replacement rope shall have the same or higher minimum breaking strength as the original rope furnished or recommended by the crane manufacturer. Any deviation from the original size, grade, or construction shall be specified by a rope manufacturer, the crane manufacturer, or a qualified person.

NOTE: If an elevator is fitted, inspection and replacement of wire rope shall be carried out in accordance with ASME A17.1.



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## Chapter 24-3 Operation

### SECTION 24-3.1: QUALIFICATIONS FOR AND CONDUCT OF OPERATORS

#### 24-3.1.1 Operators

Cranes shall be operated only by the following qualified personnel:

- (a) designated persons.
- (b) trainees under the supervision of a designated person. The number of trainees permitted to be supervised by a single designated person, the physical location of the designated person while supervising, and the type of communication required between the designated person and trainee shall be determined by a qualified person.
- (c) maintenance and test personnel, when it is necessary in the performance of their duties.

No other personnel shall enter a crane cab, with the exception of supervisors whose duties require them to do so and then only in the performance of their duties and with the knowledge of the operator or other designated person.

#### 24-3.1.2 Qualifications for Operators

(a) Operators shall be required to pass a written or oral examination and a practical operating examination unless they are able to furnish evidence of qualifications and experience. Qualifications shall be limited to the specific type of equipment for which examined.

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

- (1) have vision of at least 20/30 Snellen in one eye and 20/50 Snellen in the other, with or without corrective lenses.
- (2) be able to distinguish colors, regardless of position of colors, if color differentiation is required for operation.
- (3) hearing, with or without hearing aid, must be adequate for a specific operation.
- (4) have sufficient strength, endurance, agility, coordination, and speed of reaction to meet the demands of crane operation.
- (5) evidence of physical defects or emotional instability that could render a hazard to the operator or others, or that in the opinion of the examiner could interfere with the operator's performance, may be

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

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

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

#### 24-3.1.3 Conduct of Operators

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

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

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

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

(e) Before leaving a crane unattended, the operator shall land any attached load and shut down the crane in accordance with the manufacturer's procedures.

(f) If there is a warning sign or lock on a device, such device shall not be energized until the sign or lock is removed by the person who placed it there or by a designated person.

(g) Before closing the control power, the operator shall ensure that all controllers are in the "off" position.

(h) If power goes off during operation, the operator shall immediately place all controllers in the "off" position. Prior to reuse of the crane, operating motions shall be checked for proper direction.

(i) The operator shall be familiar with the equipment and its proper care. If adjustments or repairs are necessary, or any defects are known, the operator shall report the same promptly to a designated person. The operator shall also notify the next operator of any remaining uncorrected defects upon changing shifts.





with runway stops or other cranes shall be extreme caution. The operator shall do so with care for the safety of persons on or below the crane and only after making certain that any persons on the other cranes are aware of what is being done.

(k) Cranes shall be secured against unauthorized operation and inadvertent motion.

(l) When the wind-indicating device gives the alarm, the manufacturer's or qualified person's recommended procedures for operating in high wind conditions shall be followed.

(m) Persons boarding or leaving cranes should do so only at authorized locations and designated boarding entrances.

## SECTION 24-3.2: HANDLING THE LOAD

### 24-3.2.1 Load Weight

The crane shall not be loaded beyond its rated load except for test purposes as provided in [Chapter 24-2](#).

### 24-3.2.2 Moving the Load

(a) The operator shall ascertain that

(1) the hoist rope is not kinked

(2) the spreader is brought over the load in such a manner as to minimize swinging

(3) the spreader is seated and locked to the container

(b) During lifting, care shall be taken that

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

(2) the load does not contact any obstructions

(c) Cranes shall not be used for side pulls.

(d) The operator shall not cause the crane to lift, lower, or travel while anyone is on the load.

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

(f) The load shall not be lowered below the point where two wraps of rope remain on each anchorage of the hoisting drum.

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

### 24-3.2.3 Hoist Limit Devices (Switches)

(a) Prior to the initial use of any hoist during each shift, the operator shall verify operation of the primary upper limit device under no-load conditions. Care shall be exercised; the block shall be inched into the limit or run in at slow speed. If the device does not operate properly, the operator shall immediately notify a designated person.

(b) The hoist limit device that controls the upper limit of travel of the load block shall not be used as an operating control in normal operation unless additional devices are provided to prevent damage from over travel.

## SECTION 24-3.3: SIGNALS

### 24-3.3.1 Standard Signals

(a) Signals to the operator shall be hand signals as shown in [Figure 24-3.3-1](#), unless voice communication (telephone, radio, or equivalent) is utilized. Radio communication should be used where hand signals are not practical, such as nonroutine operations. If radio communication is used

(1) the radio should be tested prior to commencing crane operations to ensure the transmission is clear and reliable

(2) each crane should use a separate channel if frequencies are available

(3) the operator's radio key should be a hands-free system

(4) radios should not be used for personal communications or discussions not related to the operation at hand

(b) Signals shall be discernible or audible to the operator.

(c) Hand signals shall be posted at the work site.

### 24-3.3.2 Special Signals

(a) Special operations may require additions to or modifications of standard signals.

(b) Special signals shall be agreed upon and understood by the signalperson and operator.

(c) Special signals shall not conflict with standard signals.

## SECTION 24-3.4: MISCELLANEOUS

### 24-3.4.1 Ladders

(a) Hands shall be free from encumbrances while personnel are using ladders.

(b) Articles that are too large to be carried in pockets or tool belts shall be lifted and lowered by hand line or service hoist.

### 24-3.4.2 Cabs

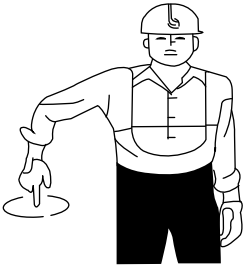
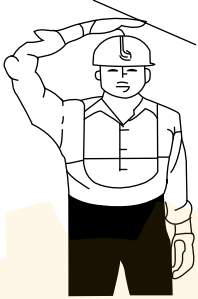
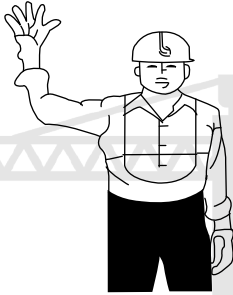
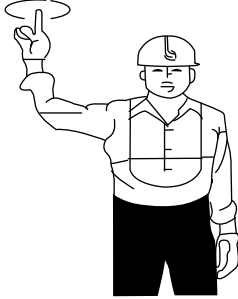
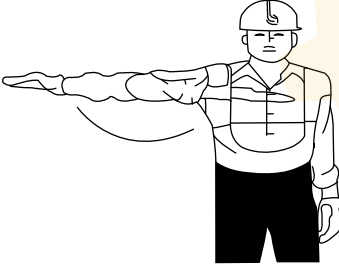
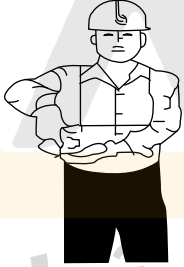
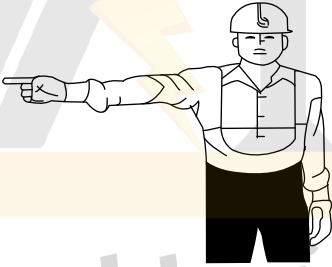

(a) Articles brought into the cab shall be stored in a manner that does not interfere with access or operation.

(b) Tools, oilcans, rags, and other necessary articles shall be stored in a fire-resistant container and shall not be permitted to lay loose in or about the cab.

### 24-3.4.3 Fire Extinguishers

Operators and maintenance personnel shall be familiar with the operation, location, and care of fire extinguishers provided.

Figure 24-3.3-1 Standard Hand Signals for Controlling Container Cranes

 <p><b>LOWER.</b> With arm extended downward, forefinger pointing down, move hand in small horizontal circles.</p>	 <p><b>ALL CLEAR.</b> With arm extended over hard hat, palm down, move hand forward and backward, repeat 2-3 times.</p>	 <p><b>UP EASY.</b> With arm vertical, repeatedly open and close fingers and thumb, touching fingertips and thumb tip when closed.</p>	 <p><b>HOIST.</b> With arm vertical, forefinger pointing up, move hand in small horizontal circles.</p>
 <p><b>STOP.</b> Right arm across chest, then fully extended with palm down.</p>	 <p><b>DOWN EASY.</b> With arm extended downward, forefinger pointing down, move hand in small slow circles. Place opposite hand palm up motionless under hand giving motion signal.</p>	 <p><b>MOVE SPREADER/HOOK IN THE DIRECTION INDICATED.</b> With arm fully extended, point with finger in desired direction of movement.</p>	 <p><b>GANTRY CRANE RIGHT/LEFT.</b> Roll hands over each other in the desired direction of travel.</p>



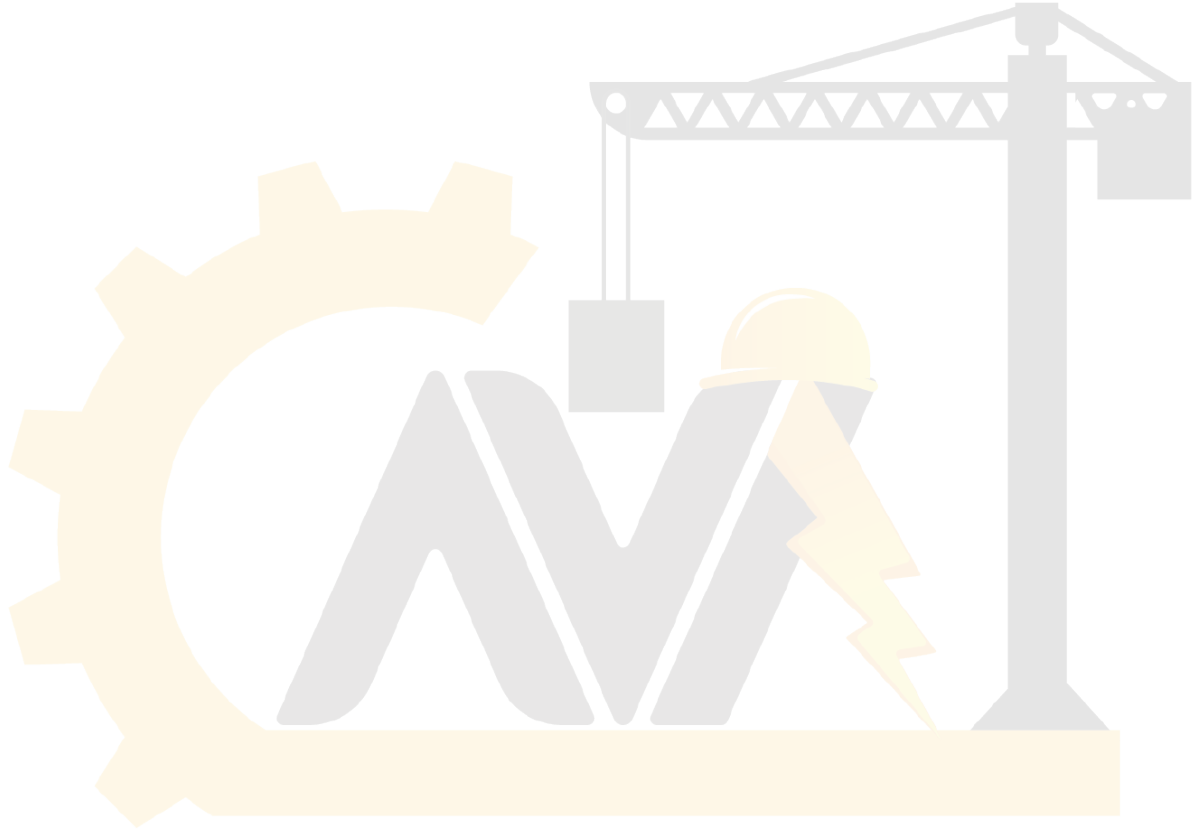
### Lifting Personnel on Headblock or Spreader (Dockside Cranes)

(a) Personnel to be lifted shall be in the personnel platform specified in [para. 24-1.8.4](#).

(b) Personnel to be lifted and crane operators shall be informed of established procedures for lifting personnel.

(c) Personnel shall be lifted on an unloaded crane only.

(d) Personnel shall wear fall protection equipment and shall keep their fall protection device lanyards fastened to the anchorage points at all times while occupying the platform, unless special-circumstance work requirements dictate otherwise.



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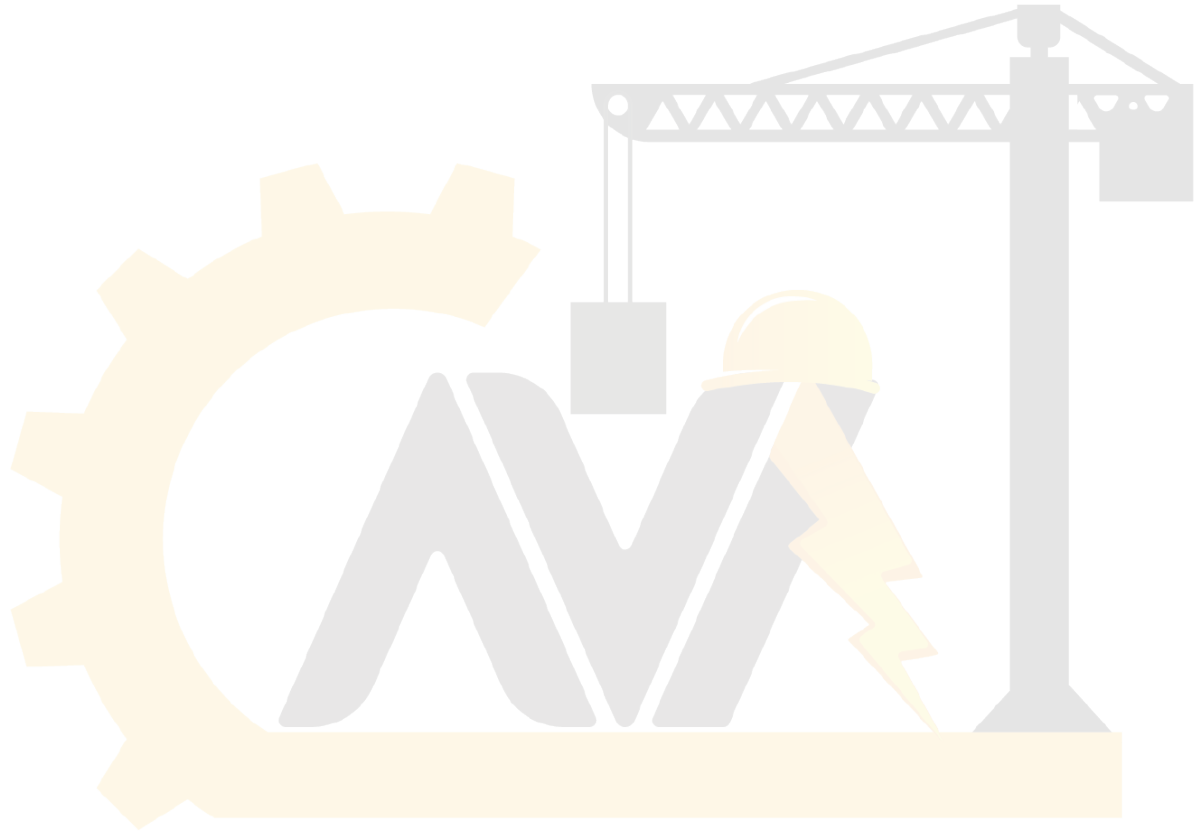
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