

The American Society of Mechanical Engineers

ARTICULATING BOOM CRANES

AN AMERICAN NATIONAL STANDARD

ASME B30.22-2000

(Revision of ASME B30.22-1993)

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

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FOREWORD

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

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

In March 1926, invitations were issued to 50 organizations to appoint representatives to a Sectional Committee. The call for organization of this Sectional Committee was sent out October 2, 1926, and the committee organized November 4, 1926, with 57 members representing 29 national organizations. The Safety Code for Cranes, Derricks, and Hoists, ASA B30.2-1943, was created from the eight-page document referred to in the first paragraph. This document was reaffirmed in 1952 and widely accepted as a safety standard.

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

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

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

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

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

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Committee, in accordance with the format described in Section III, before rendering decisions on disputed points.

This volume of the Standard, which was approved by the B30 Committee and by ASME, was approved by ANSI and designated as an American National Standard on July 14, 2000.

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

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

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CONTENTS

Foreword		iii
Committee Roster		v
Summary of Changes		ix
Introduction		1
General		1
Section I	Scope	2
Section II	Purpose	2
Section III	Interpretations	2
Section IV	New and Existing Installations	3
Section V	Mandatory and Advisory Rules	3
Section VI	Metric Conversions	3
Chapter 22-0	**Scope, Definitions, and References**	5
Section 22-0.1	Scope of B30.22	5
Section 22-0.2	Definitions	5
Section 22-0.3	References	18
Chapter 22-1	**Construction and Characteristics**	19
Section 22-1.1	Load Ratings	19
Section 22-1.2	Boom Lift, Boom Telescoping, and Load Hoist Mechanisms	20
Section 22-1.3	Swing Mechanism	20
Section 22-1.4	Crane Transport	21
Section 22-1.5	Rope and Reeving Accessories	21
Section 22-1.6	Controls	22
Section 22-1.7	Installation	22
Section 22-1.8	Construction	22
Chapter 22-2	**Inspection, Testing, and Maintenance**	23
Section 22-2.1	Inspection	23
Section 22-2.2	Testing	24
Section 22-2.3	Maintenance	25
Section 22-2.4	Rope Inspection, Replacement, and Maintenance	25
Chapter 22-3	**Operation**	29
Section 22-3.1	Qualifications for and Conduct of Operators and Operating Practices	29
Section 22-3.2	Operating Practices	30
Section 22-3.3	Miscellaneous	30

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Figures

1 Commercial Truck-Mounted Standard Ground Control 6
2 Commercial Truck-Mounted Top Seat Control 7
3 Commercial Truck-Mounted Remote Control 8
4 Stationary Installation 9
5 Rail Car Installation 9
6 Trailer-Mounted 9
7 Traveling Rail Base-Mounted on Trailer 9
8 Off-Road Vehicle 10
9 Wheel-Mounted Off-Road Dual Control Station 10
10 Wheel-Mounted Off-Road Single Control Station 10
11 Crawler-Mounted Off-Road Single Control Station 10
12 Definitions of Specifications for Articulating Cranes 12
13 Hook Approach 15
14 Elevation Below Horizontal 15
15 Elevation Above Horizontal 15
16 Nomenclature for Articulating Cranes 16
17 Danger Zone for Cranes and Lifted Loads Operating Near Electrical Transmission Lines 31

Table

1 Required Clearance for Normal Voltage in Operation Near High Voltage Power Lines and Operation in Transit With No Load and Boom or Mast Lowered 32

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ASME B30.22-2000

SUMMARY OF CHANGES

The 2000 edition of ASME B30.22 includes editorial changes, revisions, and corrections introduced in B30.22a-1994, B30.22b-1995, B30.22c-1997, and B30.22d-1998, as well as the following changes identified by (00).

Page	*Location*	*Change*
5–17	22-0.2.2	(1) Definitions of *boom extensions, manual,* or *hydraulic (one or more)*; *crane rating*; *jib (fly jib)*; *load hook*; *outer boom*; *outer boom cylinder*; and *boom pivot* revised (2) *Secondary boom*; *secondary boom cylinder*; and *secondary boom pivot* deleted
	Legend for Figs. 12, 13, 14, and 15	Callout "HA" revised
16	Fig. 16	Revised
20	22-1.2.1	Title and subpara. (a) revised

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

INTRODUCTION

General

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

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

B30.1 Jacks
B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
B30.3 Construction Tower Cranes
B30.4 Portal, Tower, and Pedestal Cranes
B30.5 Mobile and Locomotive Cranes
B30.6 Derricks
B30.7 Base Mounted Drum Hoists
B30.8 Floating Cranes and Floating Derricks
B30.9 Slings
B30.10 Hooks
B30.11 Monorails and Underhung Cranes
B30.12 Handling Loads Suspended From Rotorcraft
B30.13 Storage/Retrieval (S/R) Machines and Associated Equipment
B30.14 Side Boom Tractors
B30.15 Mobile Hydraulic Cranes
Note: B30.15-1973 has been withdrawn. The revision of B30.15 is included in the latest edition of B30.5.
B30.16 Overhead Hoists (Underhung)
B30.17 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
B30.18 Stacker Cranes (Top or Under Running Bridge, Multiple Girder With Top or Under Running Trolley Hoist)
B30.19 Cableways
B30.20 Below-the-Hook Lifting Devices
B30.21 Manually Lever Operated Hoists
B30.22 Articulating Boom Cranes
B30.23 Personnel Lifting Systems
B30.24 Container Cranes[1]
B30.25 Scrap and Material Handlers[1]

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.

The use of cableways, cranes, derricks, hoists, hooks, jacks, and slings is subject to certain hazards that cannot be met by mechanical means but only by the exercise of intelligence, care, and common sense. It is therefore essential to have personnel involved in the use and operation of equipment who are competent, careful, physically and mentally qualified, and trained in the safe operation of the equipment and the handling of the loads. Serious hazards are overloading, dropping or slipping of the load caused by improper hitching or slinging, obstructing the free passage of the load, and using equipment for a purpose for which it was not intended or designed.

The Standards Committee fully realizes the importance of proper design factors, minimum or maximum sizes, and other limiting dimensions of wire rope or chain and their fastenings, sheaves, sprockets, drums, and similar equipment covered by the Standard, all of which are closely connected with safety. Sizes, strengths, and similar criteria are dependent on many different factors, often varying with the installation and uses. These factors depend on the condition of the equipment or material; on the loads; on the acceleration or speed of the ropes, chains, sheaves, sprockets, or drums; on the type of attachments; on the number, size, and arrangement of sheaves or other parts; on environmental conditions causing corrosion or wear; and on many variables that must be considered in each individual case. The rules given in the Standard must be interpreted

[1] B30.24 and B30.25 are in the developmental stage.

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accordingly, and judgment used in determining their application.

Some of the provisions of this Standard require compliance with information found in manuals or other documents with the equipment supplied by the manufacturer. The information includes recommendations, requirements, and instructions (e.g., "the reeving shall be checked for compliance with the recommendations of the manufacturer").

Compliance with the provisions should not preclude the possibility of consulting a qualified person. This is true particularly when: the equipment has been altered, repaired, or modified; the manuals or documents supplied by the manufacturer are no longer available; or the manufacturer or a successor is no longer in business and the manuals are no longer available. However, the purpose of consulting a qualified person shall not be to avoid contacting the manufacturer and using the information supplied by the manufacturer.

The Standards Committee will be glad to receive criticisms of this Standard's requirements and suggestions for its improvement, especially those based on actual experience in application of the rules.

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

(a) cite the specific paragraph designation of the pertinent volume;

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

(c) briefly state the reason and/or evidence for the suggested change;

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

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

Section I: Scope

This Standard applies to the construction, installation, operation, inspection, and maintenance of jacks; power-operated cranes, monorails, and crane runways; power-operated and manually operated derricks and hoists; lifting devices, hooks, and slings; and cableways.

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

Section II: Purpose

This Standard is designed to:

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

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

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

Section III: Interpretations

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

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

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

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

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

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

ASME procedures provide for reconsideration of any interpretation when or if additional information which

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might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Section IV: New and Existing Installations

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

(b) New Installations. Construction, installation, inspection, testing, maintenance, and operation of equipment manufactured and facilities constructed after the effective date of this volume shall conform with the mandatory requirements of this volume.

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

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

Section V: Mandatory and Advisory Rules

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

Section VI: Metric Conversions

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

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ARTICULATING BOOM CRANES

Chapter 22-0
Scope, Definitions, and References

Section 22-0.1: Scope of B30.22

The scope includes only cranes of the types described in para. 22-0.2.1, articulated by hydraulic cylinders, which are powered by internal combustion engines or electric motors and are mounted on a mobile chassis or stationary installation. Frequently, articulating cranes are equipped with a load hoist mechanism to broaden their versatility. Load hoist mechanism equipped machines are covered by this volume.

Some basic machine types within this scope are convertible for excavating work and other uses not considered to be lifting service. The requirements of this volume are applicable only to such machines when used as lifting cranes.

Exemptions from this volume include:

(a) all units with a maximum rated capacity of 1 ton or less;

(b) all units with booms constructed of nonconductive-type materials;

(c) all units equipped with or designed primarily for personnel baskets, platforms, ladders, etc.;

(d) all units when equipped with nonlifting attachments;

(e) all units used in forestry and logging applications;

(f) telescoping boom cranes that do not articulate (covered under B30.5);

(g) scrap and material handlers.

Section 22-0.2: Definitions

22-0.2.1 Types of Articulating Boom Cranes

commercial truck-mounted: a crane, consisting of a rotating mast, mainframe or base, boom, and one or more operator's stations, such as ground controls (Fig. 1), top seat controls (Fig. 2), or remote controls (Fig. 3), mounted on a frame attached to a commercial truck chassis, retaining a payload capability whose power source may power the crane. The function is to lift, lower, and swing loads at various radii.

stationary: a crane, consisting of a rotating mast, mainframe or base, and boom, mounted on a stationary structure. The function is to lift, lower, and swing loads at various radii from a fixed center of rotation. See Fig. 4.

trailer or rail car-mounted: a crane, consisting of a rotating mast, mainframe or base, and boom, mounted on a trailer or rail car. The function is to lift, lower, and swing loads at various radii. See Figs. 5 and 6.

traveling base-mounted: a crane, consisting of a rotating mast, boom, mainframe or base, and one or more operator's stations, mounted on a traveling base. The function is to lift, lower, and swing loads at various radii. See Fig. 7.

wheel- or crawler-mounted (multiple control stations): a crane, consisting of a rotating mast, mainframe or base, operator's station, and boom, mounted on an off-road carrier equipped with axles, rubber-tired wheels, or crawlers for travel, a power source(s), and having separate stations for driving and operating. Its function is to lift, lower, and swing loads at various radii. See Figs. 8 and 9.

wheel- or crawler-mounted (single control station): a crane, consisting of a rotating mast, mainframe or base, and boom, mounted on an off-road carrier equipped with axles, rubber-tired wheels, or crawlers for travel, a power source, and having a single control station for driving and operating. Its function is to lift, lower, and swing loads at various radii. See Figs. 10 and 11.

22-0.2.2 General Definitions (00)

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

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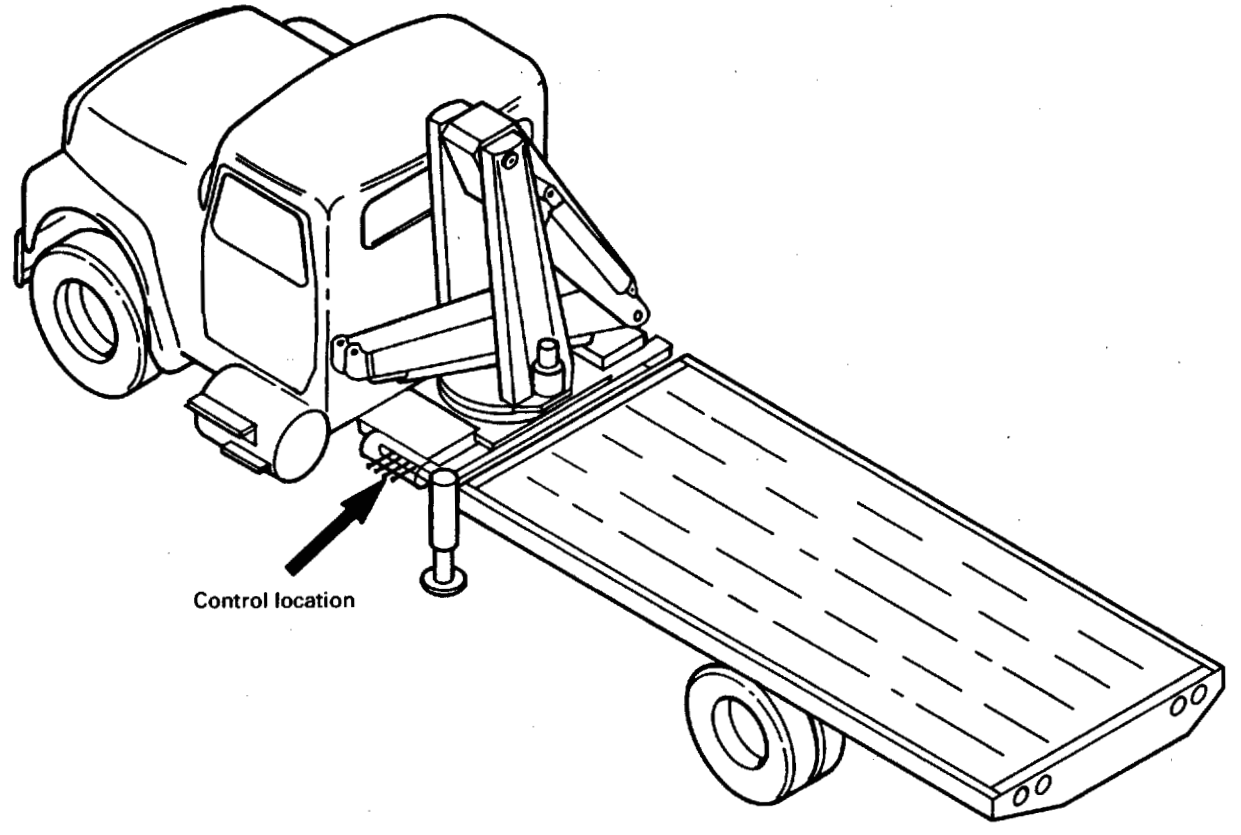


FIG. 1 COMMERCIAL TRUCK-MOUNTED STANDARD GROUND CONTROL

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

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

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

axle: the shaft or spindle with which or about which a wheel rotates. On wheel-mounted cranes, it refers to a type of axle assembly, including housings, gearing, differential, bearings, and mounting appurtenances.

axle (tandem): two or more axles mounted in tandem in a frame so as to divide the load between the axles and permit vertical oscillation of the wheels.

ballast (counterweight): weight used to supplement the weight of the machine in providing stability for lifting working loads.

boom extension cylinder: the hydraulic cylinder(s) which extend the boom's extensions.

boom extensions, manual or hydraulic (one or more): structural members, which extend and are usually located in or on the outer boom or on the jib boom.

brake: a device used for retarding or stopping motion.

cab: a housing which covers machine or operator's or driver's station.

carrier: the undercarriage of a wheel- or crawler-mounted crane specifically designed for transporting the rotating crane structure. It may or may not provide its own travel mechanism. It is distinguished from a commercial truck vehicle in that it is not normally designed to transport personnel, materials or equipment other than crane rotating structure and is normally designed for off-road use.

commercial truck vehicle: a commercial motor vehicle designed primarily for the transportation of property in connection with business and industry.

controls: a means for controlling the movement functions of the crane.

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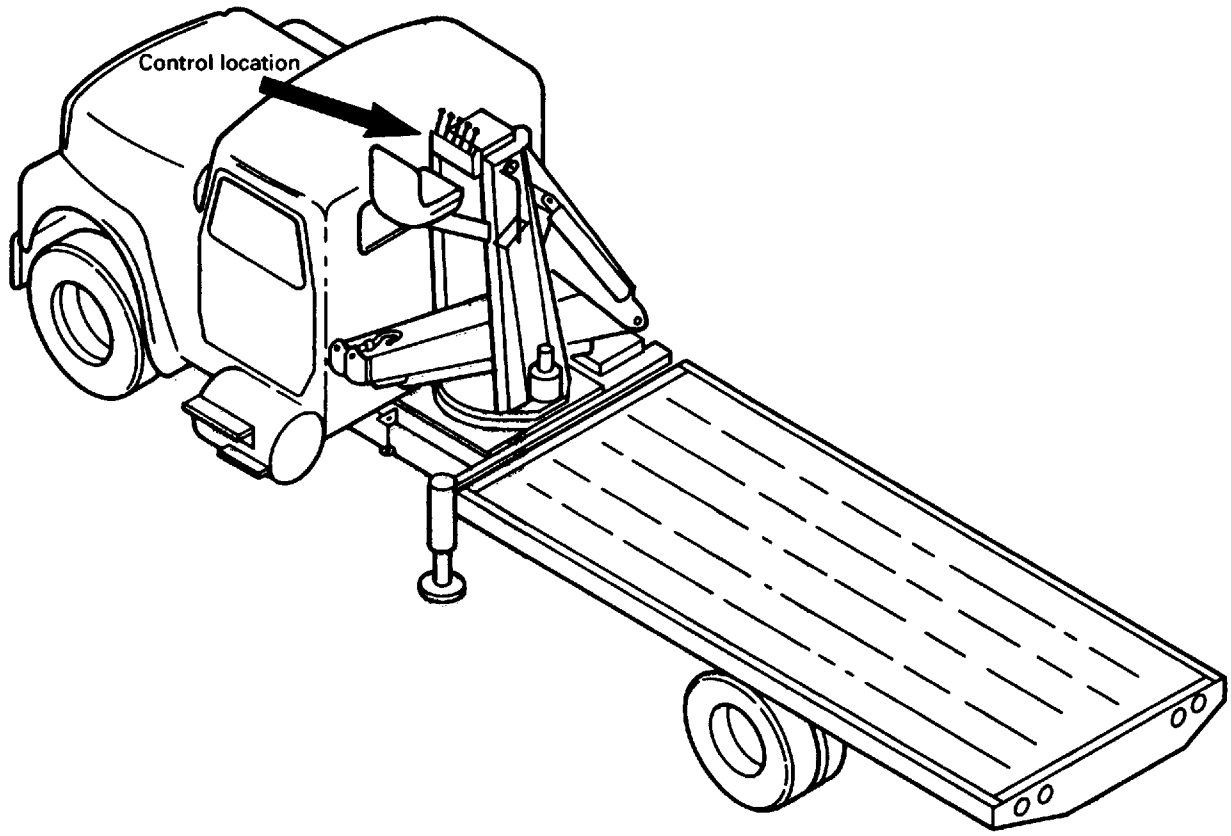


FIG. 2 COMMERCIAL TRUCK-MOUNTED TOP SEAT CONTROL

crane: articulating boom crane.

crane rating: the crane shall be rated in ft-lb (N·m). This rating shall be established by multiplying the manufacturer's rated load by the minimum boom radius with the boom in its horizontal retracted position (all extension booms retracted), outer and jib boom fully extended and hook pin height equal to the inner boom pin height.

crossover points: in multiple layer spooling of rope on drum, those points of rope contact where the rope crosses preceding rope layer.

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

drum: the cylindrical member around which a rope is wound for lifting and lowering the load.

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

electrically insulated: a material property which is related to the material's ability to resist conduction of electricity.

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

inner boom: the structural member, attached to the mast, which supports the outer boom(s).

inner boom lift cylinder: the hydraulic cylinder which lifts the inner boom.

inner boom pivot: the horizontal pin about which the inner boom is raised or lowered relative to the mast.

jib (fly jib): an articulating or fixed boom assembly with or without extendable boom sections that attaches to the outer boom.

load, working: the external load in pounds (kg) applied to the crane, including the weight of load-attaching equipment such as slings, pallet forks, and grapples.

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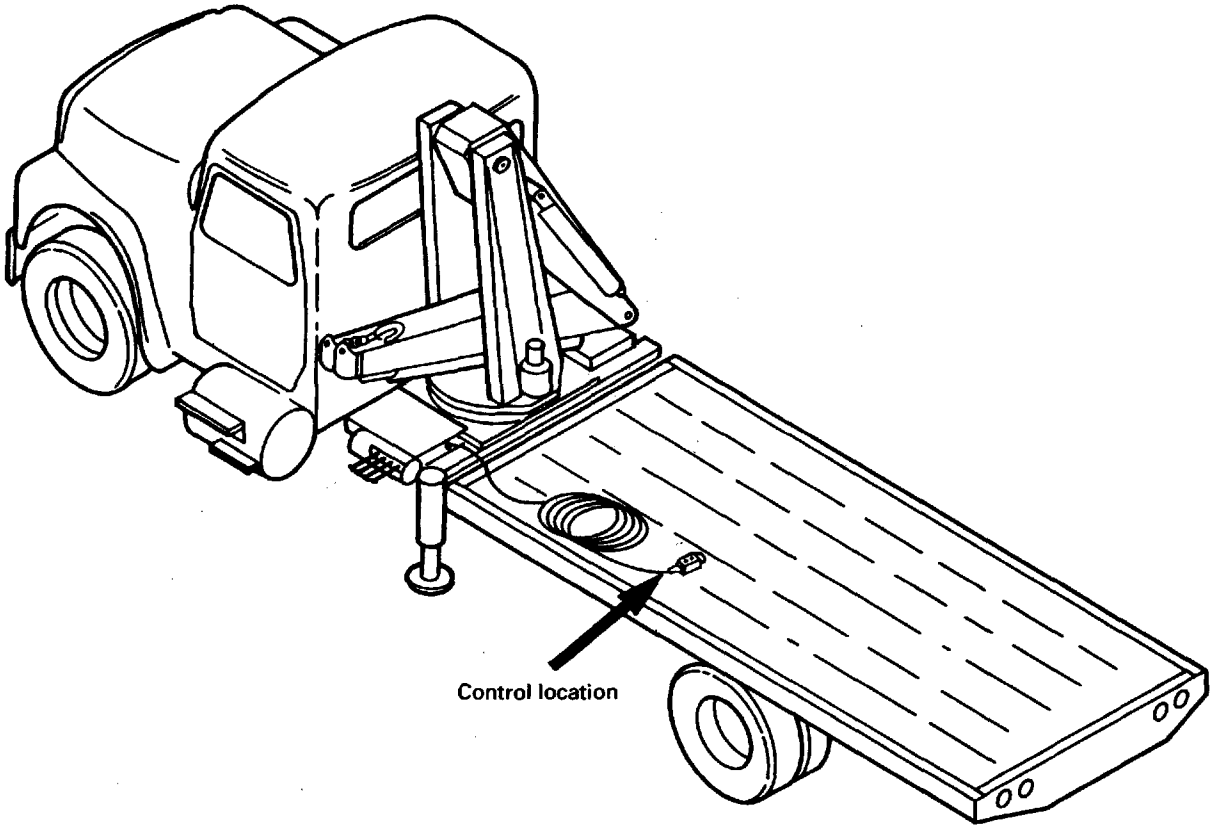


FIG. 3 COMMERCIAL TRUCK-MOUNTED REMOTE CONTROL

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

load block, upper: the assembly of shackle, swivel, sheaves, pins, and frame suspended from the boom point.

load hoist mechanism: a hoist drum or rope reeving system used for lifting and lowering loads.

load hook: a structural component, which pins to the outer boom, jib boom, extensions, or the load line and is used for attaching loads to the crane.

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

load radius: the horizontal distance from the center line of rotation to the center line of the hook pin at any boom position.

load ratings: ratings in pounds (kilograms) established by the manufacturer.

mainframe (base): the stationary base of the crane which supports the mast or turntable.

mast: a frame for use in connection with supporting a boom from mainframe or base.

model designation: manufacturer's model number for articulating boom crane.

mounting or suspension beam: a structural member used in three-point mounting concept, which allows the chassis frame to twist and transfers the crane's loading into chassis rails.

mounting structure: the structure on which the crane is mounted.

nonlifting attachment: devices attached to the crane which perform functions other than lifting a load, such as augers, tampers, and hydraulic hammers.

normal operating conditions

cab-, station-, or top seat-operated crane: conditions during which a crane is performing functions

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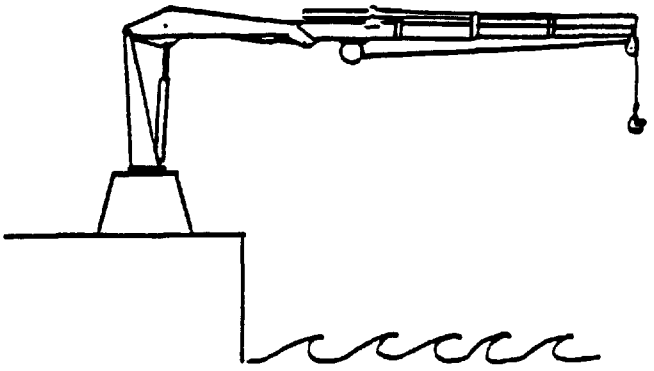


FIG. 4 STATIONARY INSTALLATION

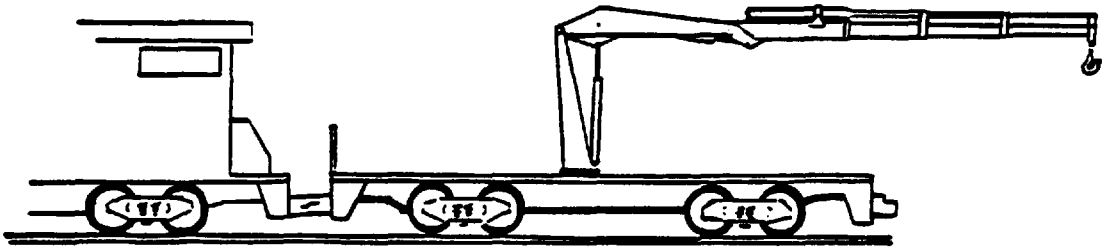


FIG. 5 RAIL CAR INSTALLATION

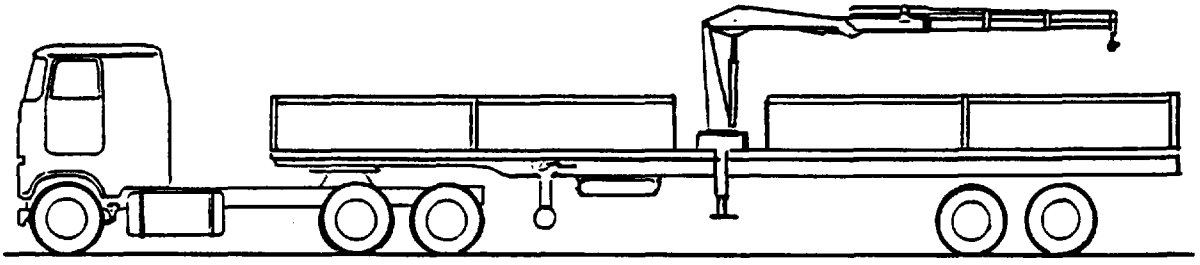


FIG. 6 TRAILER-MOUNTED

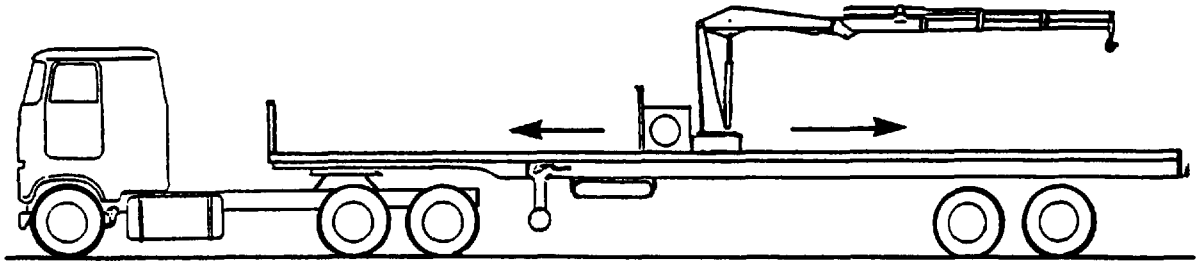


FIG. 7 TRAVELING RAIL BASE-MOUNTED ON TRAILER

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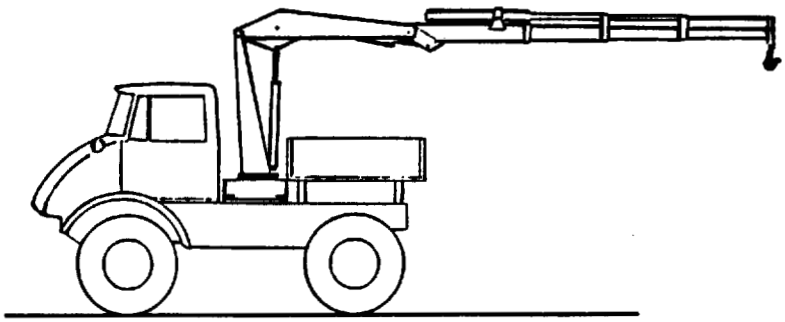


FIG. 8 OFF-ROAD VEHICLE

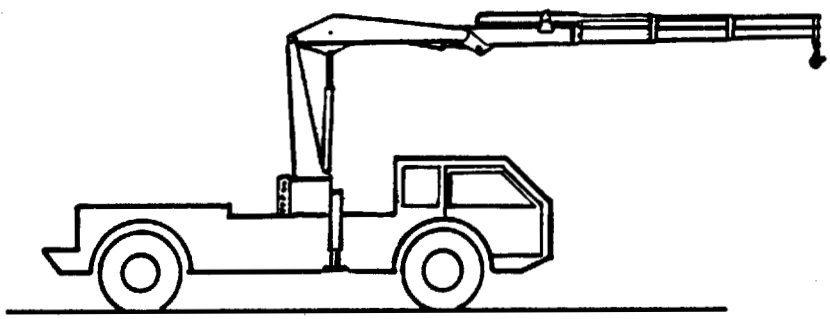


FIG. 9 WHEEL-MOUNTED OFF-ROAD DUAL CONTROL STATION

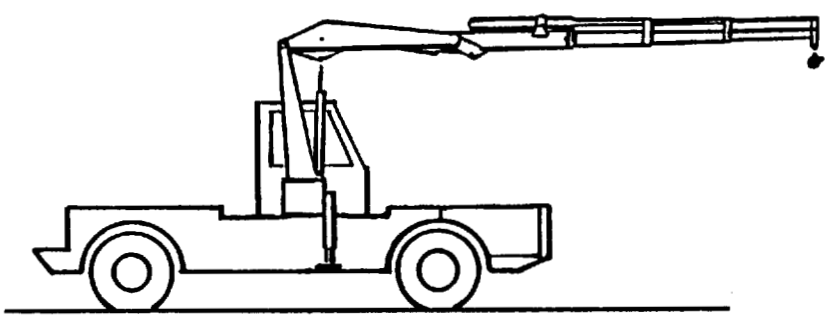


FIG. 10 WHEEL-MOUNTED OFF-ROAD SINGLE CONTROL STATION

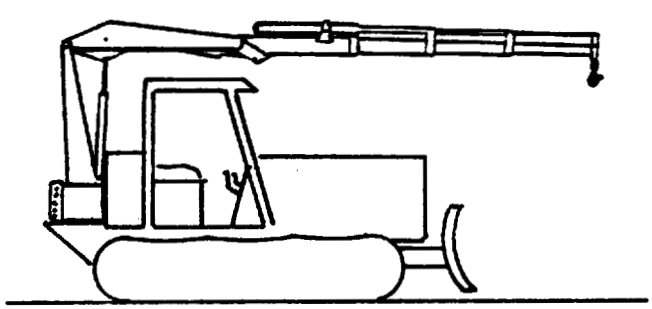


FIG. 11 CRAWLER-MOUNTED OFF-ROAD SINGLE CONTROL STATION

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LEGEND FOR FIGS. 12, 13, 14, AND 15 (00)

A	*articulating angle* — the angle through which the outer boom moves from full retraction to full extension of the outer boom lift cylinder (Fig. 13)
CA	*cab-to-axle dimension* — the distance from the back of the chassis cab to the center line of the rear axle, or tandem axle assembly [Fig. 12, sketch (a)]
CG	*center of gravity of crane* [Fig. 12, sketch (a)]
CGH	*crane center of gravity, horizontal* — the horizontal distance from the center line of rotation to the center of weight of the stowed crane in the travel position [Fig. 12, sketch (a)]
CGL	*crane center of gravity, longitudinal* — longitudinal center of gravity as measured from the center line of rotation to the center of weight of the stowed crane in the travel position [Fig. 12, sketch (a)]
CGV	*crane center of gravity, vertical* — the vertical center of gravity as measured from the mounting surface of the mainframe or base to the center of weight of the stowed crane in the travel position [Fig. 12, sketch (a)]
CH	*crane height* — the overall height measurement from the mounting surface of the crane to the highest point on the crane when stowed for travel [Fig. 12, sketch (a)]
CLL	*center line of rotation location, longitudinal* — the horizontal distance parallel to the longitudinal center line of the chassis from the rear axle of the chassis to the center line of rotation of the mast [Fig. 12, sketch (a)]
CLR	*center line of rotation* — the vertical axis about which the mast rotates [Fig. 12, sketch (a)]
D	*depth of crane* — mounting space for crane less clearances [Fig. 12, sketch (c)]
E1	*elevation below horizontal* — the travel of the hook to maximum depression below horizontal (Fig. 14)
E2	*elevation above horizontal* — the travel of the hook to maximum elevation above horizontal (Fig. 15)
F	*chassis height* — the height of the top of the chassis frame rail above ground level [Fig. 12, sketch (a)]
FO	*front overhang* — the distance from the most forward part of the vehicle or crane ahead of the front axle to the center line of the front axle [Fig. 12, sketch (a)]
GC	*ground clearance* — the distance from the lowest part of the crane to the ground [Fig. 12, sketch (a)]
GL	*ground level* — the surface (assumed to be flat and level) on which the vehicle is supported [Fig. 12, sketch (a)]
HA	*hook approach, horizontal and vertical* — the horizontal distance from the center line of rotation to the center line of the hook pin and the vertical distance from the crane mounting surface to the center line of the hook pin when inner boom is at maximum elevation, outer boom is fully retracted, and all extension booms are fully retracted (Fig. 13)
HR	*hook height, maximum retracted* — the height above the mounting surface of the base of the unit of the center line of the boom tip hook pin with all booms at maximum elevation and all extensions fully retracted [Fig. 12, sketch (b)]
H1	*hook height, maximum 1st extension* — the height above the mounting surface of the base of the unit of the center line of the boom tip hook pin with all booms at maximum elevation and the 1st extension stage boom fully retracted [Fig. 12, sketch (b)]
H2	*hook height, maximum 2nd extension* — the height above the mounting surface of the base of the unit of the center line of the boom tip hook pin with all booms at maximum elevation and the 1st and 2nd extension boom fully retracted [Fig. 12, sketch (b)]
H3	*hook height, maximum 3rd extension* [Fig. 12, sketch (b)]
H4	*hook height, maximum 4th extension* [Fig. 12, sketch (b)]
MO	*mast offset* — the amount of offset from the center line of the longitudinal axis of the vehicle to the center line of rotation of the mast of the crane [Fig. 12, sketch (c)]
P	*stabilizer vertical travel* — the distance measured below mounting surface of crane to which the stabilizers could reach when fully extended [Fig. 12, sketch (b)]
R	*load radius* — the horizontal distance from the center line of rotation to the center line of the hook pin at any boom position [Fig. 12, sketch (b)]
RR	*horizontal reach, retracted* — the distance from the center line of rotation to the center line of the boom tip hook pin with all booms horizontal and all extensions fully retracted [Fig. 12, sketch (b)]
R1	*horizontal reach, 1st extension* — the distance from the center line of rotation to the center line of the boom tip hook pin with all booms horizontal and 1st extension stage fully extended [Fig. 12, sketch (b)]
R2	*horizontal reach, 2nd extension* [Fig. 12, sketch (b)]
R3	*horizontal reach, 3rd extension* [Fig. 12, sketch (b)]
R4	*horizontal reach, 4th extension* [Fig. 12, sketch (b)]
RO	*rear overhang* — the distance from the most rearward part of the vehicle or crane behind the rear axle to the center line of the rear axle in the traveling position [Fig. 12, sketch (a)]
S	*stabilizer spread* — the distance measured between the center lines of pivotal points of stabilizer pads at ground level at maximum spread [Fig. 12, sketch (b)]
W	*width of unit in stowed position* [Fig. 12, sketch (a)]
WB	*wheelbase* [Fig. 12, sketch (a)]

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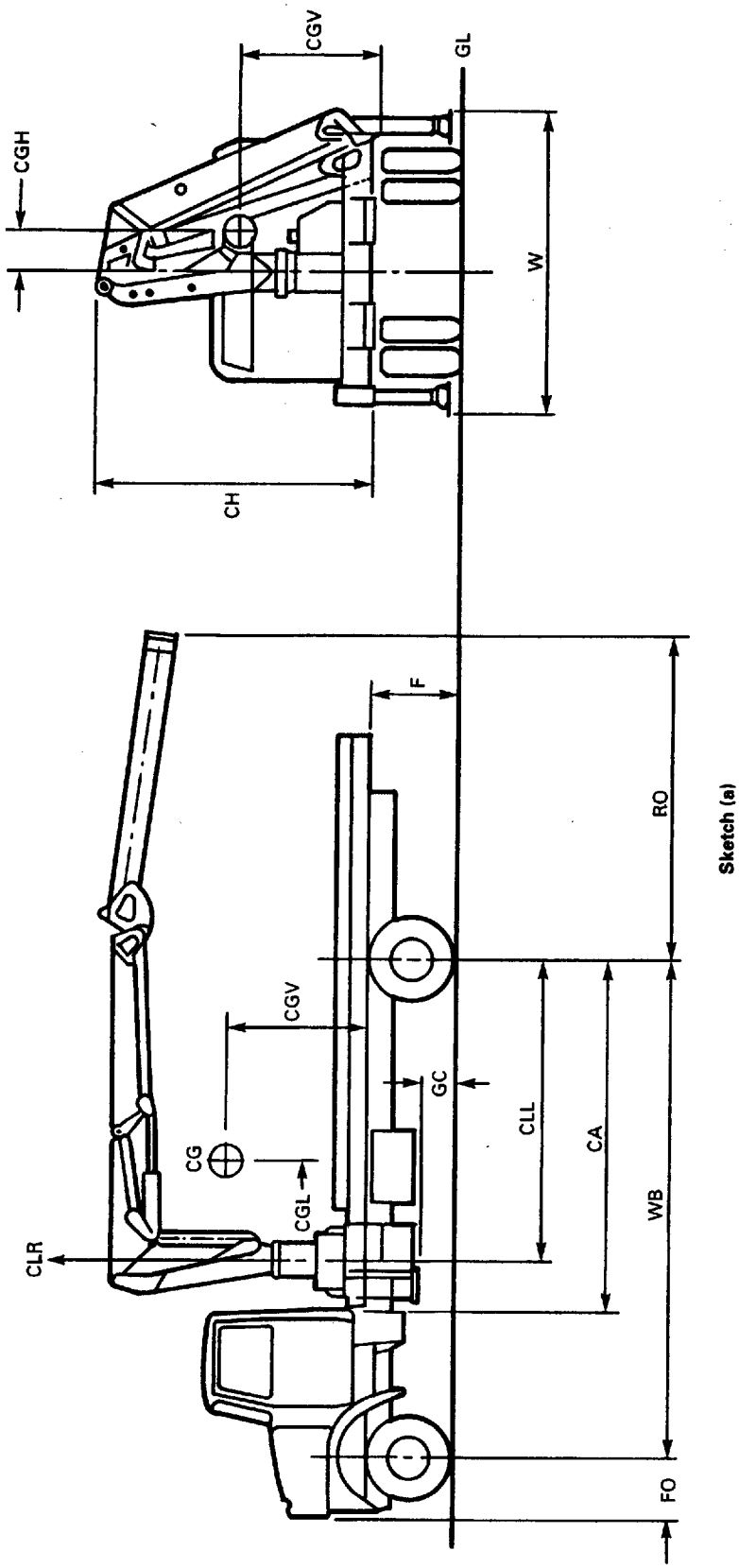


FIG. 12 DEFINITIONS OF SPECIFICATIONS FOR ARTICULATING CRANES

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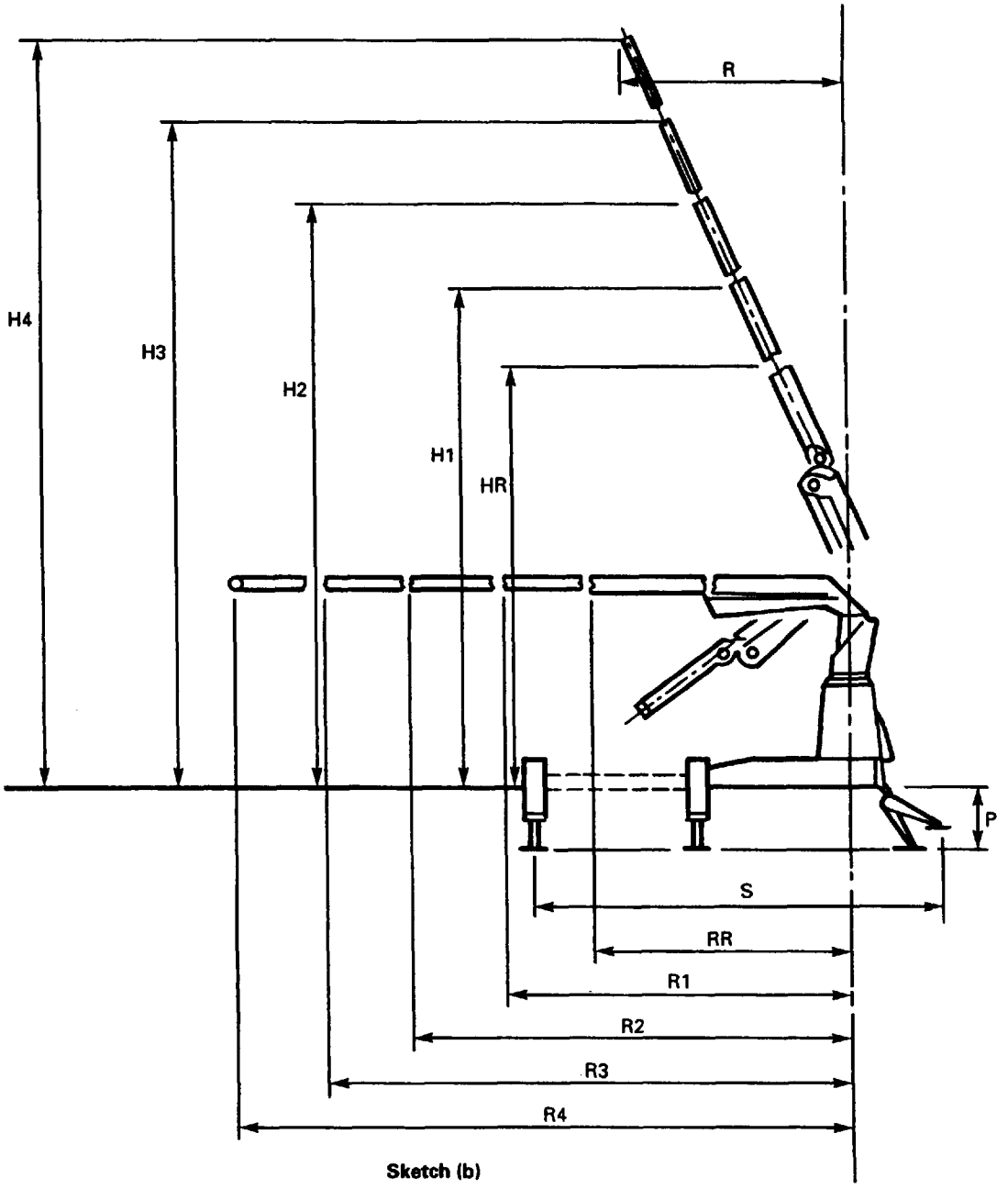
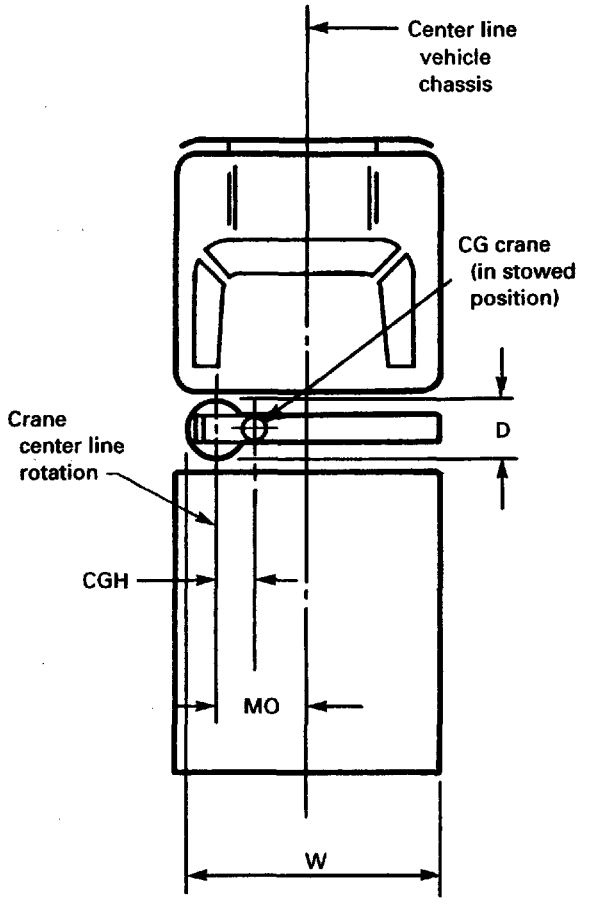


FIG. 12 DEFINITIONS OF SPECIFICATIONS FOR ARTICULATING CRANES (CONT'D)

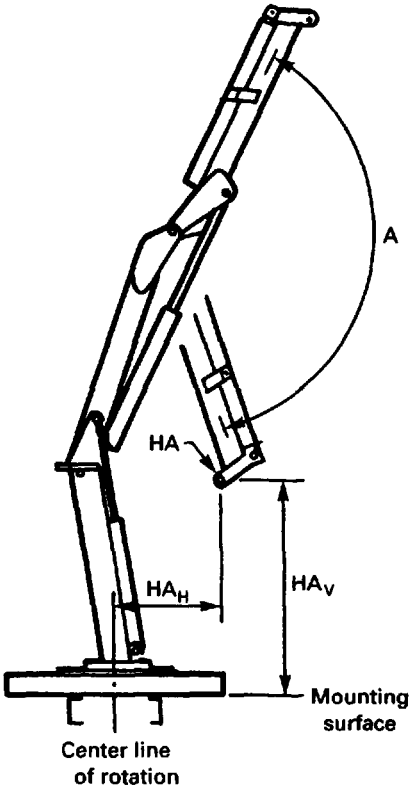
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Sketch (c)

FIG. 12 DEFINITIONS OF SPECIFICATIONS FOR ARTICULATING CRANES (CONT'D)

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A — articulating angle
HA — hook approach
HA_H — hook approach (horizontal)
HA_V — hook approach (vertical)

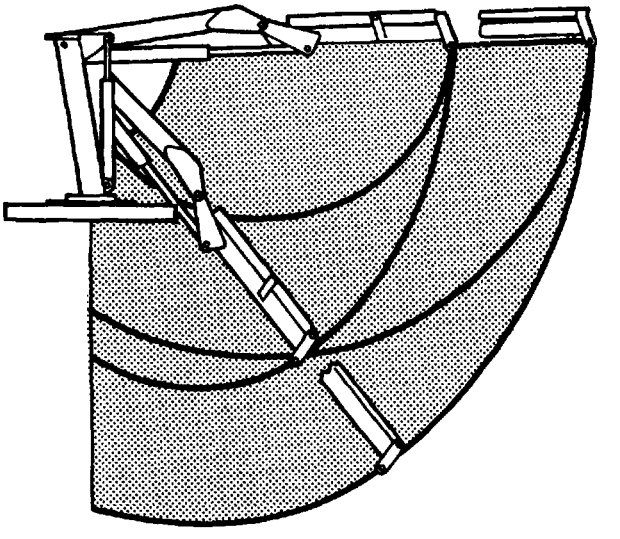
FIG. 13 HOOK APPROACH

within the scope of the original design. Under these conditions, the operator is at the operating controls on the crane, and no other person is on the crane.

ground- or floor-operated crane: conditions during which a crane is performing functions within the scope of the original design. Under these conditions, the operator is at the operating controls that are mounted to the crane but operated with the operator off the crane and with no other person on the crane.

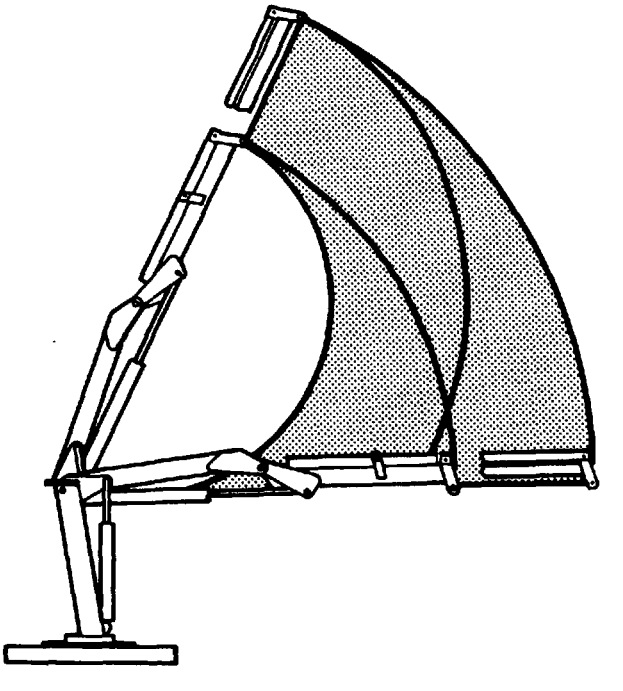
remote-operated crane: conditions during which a crane is performing functions within the scope of the original design. Under these conditions, the operator is at the operating controls that are not directly mounted to any part of the crane, and with no other person on the crane.

outer boom: the structural member, attached to the inner boom, which supports the jib boom.



E1 — elevation below horizontal

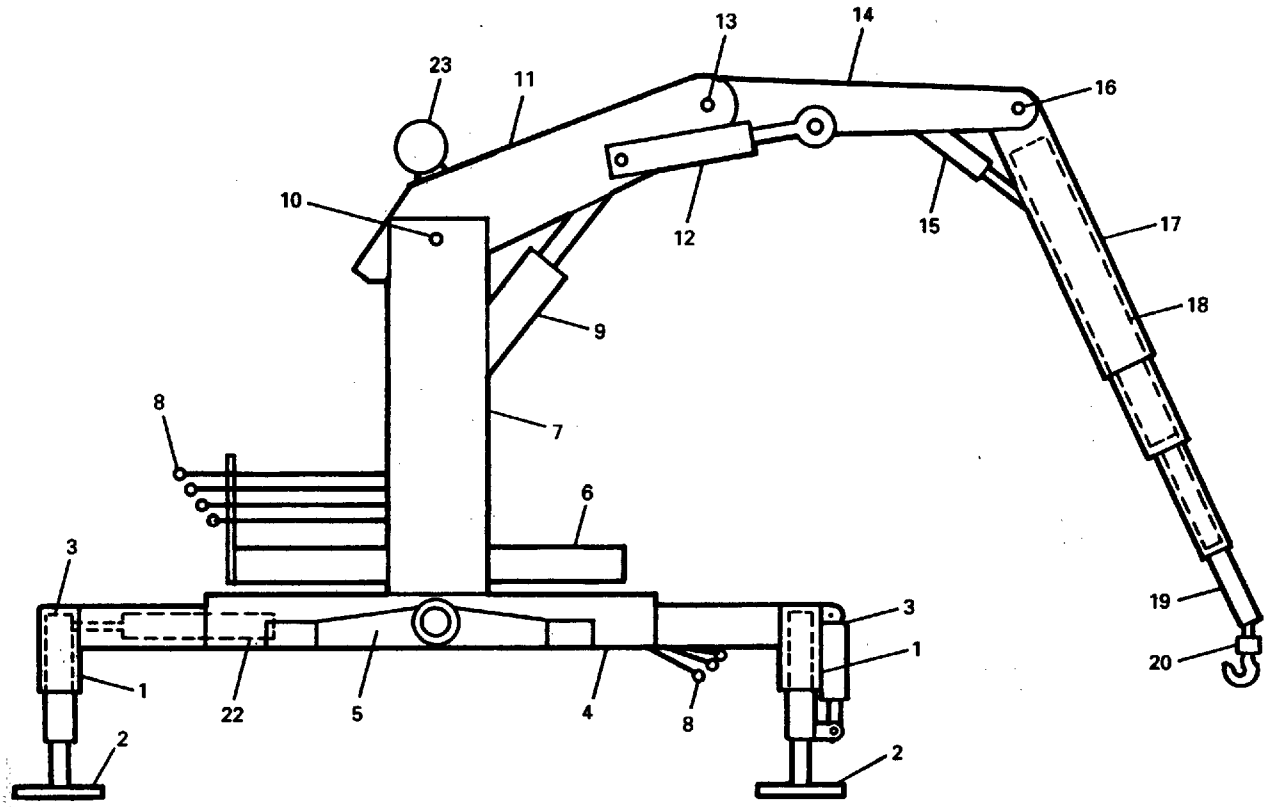
FIG. 14 ELEVATION BELOW HORIZONTAL



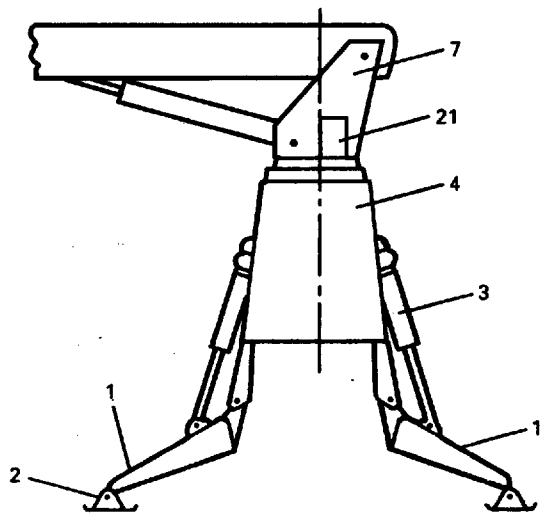
E2 — elevation above horizontal

FIG. 15 ELEVATION ABOVE HORIZONTAL

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1. Stabilizer
2. Stabilizer pad
3. Stabilizer cylinder, vertical
4. Mainframe or base
5. Mounting or suspension beam
6. Rotation (slewing) cylinder type
7. Mast or turntable
8. Controls
9. Inner boom lift cylinder
10. Inner boom pivot
11. Inner boom
12. Outer boom cylinder
13. Outer boom pivot
14. Outer boom
15. Jib (fly jib) boom cylinder
16. Jib (fly jib) boom pivot
17. Jib (fly jib) boom
18. Boom extension cylinder
19. Boom extensions (one or more)
20. Load hook
21. Rotation (slewing) drive, gearbox type
22. Stablilzer cylinder, horizontal
23. Winch



(00) **FIG. 16 NOMENCLATURE FOR ARTICULATING CRANES**

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outer boom cylinder: the hydraulic cylinder which lifts and lowers the outer boom in relation to the inner boom.

outer boom pivot: the horizontal pin about which the outer boom is raised and lowered relative to the inner boom.

payload: that load or loads being transported by the commercial truck chassis from place to place.

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

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

rope: refers to wire rope unless otherwise specified.

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

running rope: a rope which travels around sheaves or drums.

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

sheave: a grooved wheel or pulley over which the rope travels.

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

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

stability: a condition in which the sum of the moments tending to overturn the unit is less than the sum of the moments resisting overturning.

stabilizer: stabilizers are extendable or fixed members attached to the mounting base to increase the stability of the crane, but which may not have the capability of relieving all of the weight from wheels or tracks.

stabilizer cylinder, horizontal: a hydraulic cylinder which extends the stabilizer.

stabilizer cylinder, vertical: a hydraulic cylinder which lowers the stabilizer pad to ground surface.

stabilizer pad: the structural member which distributes unit load over ground surface.

standard crane: as defined by the manufacturer.

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

swing (slewing): rotation of the mast and boom for movement of loads in a horizontal direction about the axis of rotation.

swing (slewing) cylinders: two opposed single-acting cylinders which act on a rack gear which engages the mast pinion.

swing (slewing) drive gearbox: a mechanism which drives the mast or turntable.

swing (slewing) mechanism: the machinery involved in providing rotation of the mast and boom.

swivel: a load carrying member to permit rotation under load in a plane perpendicular to the direction of the load.

swiveling: the rotation of the load attachment portion (hook or shackle) of a lower load block or hook assembly about its axis of suspension in relation to the load line(s).

telescoping boom: consists of a boom from which one or more boom sections are telescoped for additional length.

tipping: see *stability.*

transit: the moving or transporting of a crane from one job site to another.

travel: the function of the machine moving under its own power from one location to another.

two-block damage-prevention feature: a system that will stall when two-blocking occurs without causing damage to the hoist rope or crane machinery components.

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

wheelbase: the distance between centers of front and rear axles. For a multiple axle assembly, the axle center for wheelbase measurement is taken at the midpoint of the assembly.

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STD.ASME B30.22-ENGL 2000 ■ 0759670 0618358 166 ■

weight of crane: weight of manufacturer's standard articulating boom crane. List separately weights of optional items such as hydraulic pump, hydraulic oil, counterweight, ballast, accessories, and equipment added by installer.

winch (hoist): a power driven drum or drums capable of lifting and lowering loads.

Section 22-0.3: References

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

U.S. Department of Transportation Standards

Publisher: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402

ANSI/AWS D14.3-82, Welding Specifications for Earth Moving and Construction Equipment[1]

Publisher: American Welding Society, 550 NW Le Jeune Road, Miami, FL 33135

ANSI/SAE J765-Oct90, Crane Load Stability Test Code[1]

ANSI/SAE J1063-Oct80, Cantilevered Boom Crane Structures — Method of Test[1]

Publisher: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096

ASME B30.9-1996, Slings[1]

ASME B30.10-1993, Hooks[1]

Publisher: The American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016; Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007

[1] May also be obtained from American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

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Chapter 22-1
Construction and Characteristics

Section 22-1.1: Load Ratings

22-1.1.1 Load Ratings Where Stability Governs Lifting Performance

(a) The margin of stability for determination of load ratings, with booms of stipulated lengths at stipulated working radii for the various types of crane mountings, is established by taking a percentage of the loads which will produce a condition of tipping or balance with the boom in the least stable direction, relative to the mounting. The load ratings shall not exceed the following percentages for cranes, when tested in accordance with ANSI/SAE J765 for indicated types of mounting.

Type of Crane Mounting	Maximum Load Ratings, %
Commercial truck vehicle-mounted crane with stabilizers extended and set	85
Rail car, without stabilizer support [Note (1)]	85
Crawler, without stabilizer support	75
Crawler, using stabilizers fully extended and set	85
Wheel-mounted without stabilizer support	75
Wheel-mounted using stabilizers fully extended and set	85

NOTE:
(1) As a precaution, while testing for free ratings, stabilizers should be loosely applied; rail clamps should not be used.

(b) The effectiveness of these preceding stability factors will be influenced by such additional factors as freely suspended loads; rail, wind, or ground conditions; condition and inflation to tire manufacturer's highway-rated pressure of rubber tires; boom lengths; proper operating speeds for existing conditions; and, in general, careful and competent operation.

22-1.1.2 Load Ratings Where Structural Competence Governs Lifting Performance

(a) Load ratings for some radii are limited by the stability of the crane. However, in some of the operating ranges, the ratings may be limited by factors other than stability, such as the conditions described below.

(1) Load ratings at some radii may be based on structural competence of the crane rather than stability.

(2) A nonsymmetrical mounting requires a higher loading to produce a condition of tipping in a direction other than that of least stability on which the load ratings are established. Therefore, if the crane specification includes additional ratings for directions other than the least stable, such ratings also may be governed by structural competence rather than stability. For such specified additional ratings, the work area shall be indicated, and for those ratings which might be governed by tipping loads, the applicable percentage factors in para. 22-1.1.1(a) shall not be exceeded.

(b) For all operational applications, the crane load ratings established by the manufacturer shall not be exceeded.

22-1.1.3 Load Rating Chart

(a) A durable rating chart or charts with legible letters and figures shall be provided with each crane and attached in a location available to the operator while at the controls. The data and information to be provided on these charts shall include, but not be limited to, the following:

(1) a range of manufacturer's crane load ratings at stated operating radii, work areas, boom lengths, configurations, and jib lengths;

(2) in areas where no load or reduced load is to be handled, a work area figure or load rating chart shall so state;

(3) recommended reeving for the hoist lines shall be shown if the crane is equipped with a winch.

(b) In addition to the data required on the load rating chart, the following information shall be shown either on the load rating chart or in the operating manual:

(1) recommended tire pressure chart, where applicable;

(2) cautionary or warning notes relative to limitations on equipment and operating procedures;

(3) the maximum telescopic travel length of each boom telescopic section;

(4) whether sections are telescoped with power or manually;

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(5) sequence and procedure for extending and retracting telescopic boom section;

(6) maximum loads permitted during actual boom extending operation, and any limiting conditions or cautions;

(7) hydraulic relief valve settings specified by the manufacturer;

(8) if the crane is equipped with a load hoist mechanism, recommended parts of hoist reeving, size, length and type of rope for various crane loads, and recommended hoist reeving diagram.

Section 22-1.2: Boom Lift, Boom Telescoping, and Load Hoist Mechanisms

(00) **22-1.2.1 Inner, Outer, and Jib Boom Lift Mechanism**

(a) The inner, outer, and jib boom cylinder(s) shall be capable of elevating, lowering, and controlling the booms with rated load and shall be capable of supporting the boom and rated load without action by the operator.

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

22-1.2.2 Telescoping Boom(s)

(a) Extension and retraction of boom sections may be accomplished through hydraulic, mechanical, or manual means.

(b) The powered retract and extend functions shall be capable of controlling the rated load.

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

22-1.2.3 Load Hoist Mechanism (Load Hoist Equipped Machines Only)

(a) The hoist mechanism may consist of a winch or hydraulic cylinder(s) with necessary rope reeving.

(b) Winch Assembly. The winch drum assemblies shall have power and operational characteristics to perform all load lifting and lowering functions required in crane service when operated under recommended conditions.

(1) When brakes are used with winch drums, they shall be of the size and thermal capacity to control all rated crane loads with minimum recommended reeving. Brakes shall be provided with adjustments, when necessary, to compensate for lining wear and to maintain force in springs, where used.

(2) Winch drums shall have rope capacity with the recommended rope size and reeving to perform crane service within the range of boom lengths, operating radii, and vertical lifts specified by the manufacturer.

(a) No less than two full wraps of rope shall remain on the drum when the hook is in the extreme low position and the booms are at maximum elevation and extension.

(b) The drum end of the rope shall be anchored to the drum by an arrangement specified by crane or winch manufacturer.

(c) The drum flange shall extend a minimum $\frac{1}{2}$ in. (13 mm) over the top layer of rope at all times.

(3) The winch drums shall provide a first layer rope pitch diameter of not less than 18 times the nominal diameter of the rope used.

(4) A means controllable from the operator's station shall be provided to hold the drum from rotating in the lowering direction and be capable of holding the rated load without further action by the operator.

(c) Two-Blocking Damage-Prevention Feature. On an articulating crane equipped with a winch, a two-blocking damage-prevention feature shall be provided. Stalling of the hydraulic system may be acceptable.

(d) Cylinders With Rope Reeving

(1) Cranes using a load hoist mechanism with hydraulic cylinder(s) and rope reeving shall have power and operational characteristics to perform all load lifting and controlled lowering functions required in crane service when operated under recommended conditions.

(2) Cylinders shall be equipped with a load holding device to prevent uncontrolled lowering of the load in case of hydraulic line failure.

(3) The load hoist cylinder shall be capable of holding rated load without action of the operator.

Section 22-1.3: Swing Mechanism

22-1.3.1 Swing Control. The swing mechanism shall start and stop with controlled acceleration and deceleration.

22-1.3.2 Swing Braking Means and Locking Devices

(a) A stopping means with holding power in both directions shall be provided to restrict movement of the rotating mast, when desired under normal operation. The braking means shall be capable of being set in the holding position and remaining so without further action by the operator.

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(b) A positive locking device or boom support shall be provided to prevent the boom from rotating when in stowed position for transit.

Section 22-1.4: Crane Transport

Commercial truck vehicle-mounted cranes shall meet applicable requirements of U.S. Department of Transportation Standards.

Section 22-1.5: Rope and Reeving Accessories

22-1.5.1 Rope Design Factors

(a) For supporting rated loads and for supporting the boom and working attachments at recommended travel or transit positions and boom lengths:

(1) the design factor for live or running ropes that wind on drums or travel over sheaves shall be not less than 3.5;

(2) the design factor for boom pendants or standing ropes shall not be less than 3.0.

(b) For supporting rated loads, rotation resistant ropes shall have a design factor of 5 or greater.

(c) The design factor specified in the paragraphs 22-1.5.1(a)(1), (2), and (b) shall be the total "nominal" breaking strength of all ropes in the system divided by the load imposed on the rope system when supporting the static weights of structure and crane rated load.

22-1.5.2 Ropes

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

(b) Socketing shall be done as recommended by the manufacturer of the assembly or a qualified person.

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

(d) 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.

(e) Rotation-resistant ropes and fiber core ropes shall not be used for boom extension systems or boom support reeving.

22-1.5.3 Reeving Accessories

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

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

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

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

22-1.5.4 Sheaves

(a) Sheave grooves shall be free from surface conditions which would 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 rope used, and the sides of the groove should be tapered outwardly to facilitate entrance of the rope into the groove. Flange corners should be rounded and the rims should 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 lower load block shall be equipped with close-fitting guards that will prevent ropes from becoming fouled when the block is lying on the ground with ropes slack.

(d) All sheave bearings, except permanently lubricated bearings, shall be provided with means for lubrication.

22-1.5.5 Sheave Sizes

(a) Load hoisting sheaves shall have pitch diameters not less than 18 times the nominal diameter of the rope used.

(b) Lower load block sheaves shall have pitch diameters of not less than 16 times the nominal diameter of the rope used.

(c) Boom extension system sheaves shall have a pitch diameter of not less than 15 times the nominal diameter of the rope.

22-1.5.6 Load Hooks, Ball Assemblies, and Load Blocks. Load hooks, ball assemblies, and load blocks shall be of sufficient weight to overhaul the

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line from the highest hook position for boom or boom and jib lengths, and the number of parts of line in use. All hook and ball assemblies and load blocks shall be labeled with their rated capacity and weight. 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*).

Section 22-1.6: Controls

22-1.6.1 General

(a) Basic controls used during the crane operating cycle shall be located within reach of the operator while at the operator's station and labeled as to their designated function.

(b) Controls for "swing," "inner boom," "outer boom," "jib boom," "boom extension," and "optional hydraulic equipment" shall be provided with means for holding in neutral position without the use of positive latches.

(c) Remote-operated cranes shall be equipped with an "emergency stop" system, located at the operator's remote control station to provide the means to remove power from the crane in the event of a malfunction.

(d) Means shall be provided to hold vehicle stationary while operating crane.

22-1.6.2 Control Forces and Movements

(a) Forces shall not be greater than 35 lb (156 N) on hand levers and not greater than 50 lb (222 N) on foot pedals.

(b) Travel distance on hand levers shall not be greater than 14 in. (356 mm) from neutral position on two-way levers, and not greater than 24 in. (610 mm) on one-way levers. Travel distance on foot pedals shall not be greater than 10 in. (254 mm).

Section 22-1.7: Installation

22-1.7.1 Mechanical Testing. The installer shall perform loading tests (on a vehicle or test stand) on each crane installed. Tests shall be conducted to the extent necessary to assure compliance with the crane's maximum load ratings, including systems such as the following:

(a) boom(s) — elevating and lowering
(b) boom(s) — extending
(c) swing (slewing)
(d) safety devices
(e) optional attachments

22-1.7.2 Stability Testing. A stability test shall be conducted on each new or remounted mobile unit. The test shall be conducted with the completed, unloaded vehicle on a firm, level surface. The stability shall be such that the load ratings do not exceed the requirements of para. 22-1.1.1. Tests shall be conducted in accordance with ANSI/SAE J765.

22-1.7.3 Exhaust Gases. Engine exhaust gases shall be piped and discharged in a direction away from the operator. All exhaust pipes shall be guarded or insulated to prevent contact by personnel when performing normal duties.

Section 22-1.8: Construction

22-1.8.1 Welding. All welding and welding operator qualifications for load sustaining members shall be in accordance with ANSI/AWS D14.3. Where special steels or other materials are used, the manufacturer shall provide welding procedures.

22-1.8.2 Hydraulic and Pneumatic Line Protection. Exposed lines subject to damage shall be protected insofar as it is practical.

22-1.8.3 Lubricating Points. Lubricating points should be accessible without the necessity of removing guards or other parts.

22-1.8.4 Stabilizers

(a) Means shall be provided to hold all stabilizers in the retracted position while in transit, and in the extended position when blocked for crane operation.

(b) Each power operated stabilizer shall be visible from an actuating location, unless the operator is assisted by a signalperson.

(c) Cylinders for vertical stabilization of the machine shall be equipped with an integrally mounted holding device (such as a pilot-operated check valve) to prevent loss of support under load in the event of a hydraulic system failure (e.g., supply hose rupture).

22-1.8.5 Design Requirements. Prototype models of production articulating boom cranes shall meet applicable requirements of ANSI/SAE J1063. On special design booms (not production models) or other special lift conditions, calculations to a standard, by a qualified person, or by the crane manufacturer, are acceptable.

22-1.8.6 Miscellaneous Equipment. Means shall be provided for checking the manufacturer's specified pressure settings in each hydraulic circuit.

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Chapter 22-2
Inspection, Testing, and Maintenance

Section 22-2.1: Inspection

22-2.1.1 General. The manufacturer shall furnish operation and maintenance information.

22-2.1.2 Inspection Classification

(a) Initial Inspection. Prior to initial use, all new, altered, or modified cranes shall be inspected by a designated person to ensure compliance with provisions of this Standard.

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

(1) Frequent inspection — daily to monthly intervals.

(2) Periodic inspection — one to twelve-month intervals, or as specifically recommended by the manufacturer.

(c) Inspections shall be performed by designated personnel.

22-2.1.3 Frequent Inspection. Items such as the following shall be inspected for defects at intervals as defined in para. 22-2.1.2(b)(1) or as specifically indicated, including observation during operation for wear or damage which might appear between regular inspections. Conditions such as those listed, shall be carefully examined and determination made as to whether they constitute a hazard:

(a) control mechanisms for maladjustment interfering with proper operation — daily, when used;

(b) control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter;

(c) safety devices for malfunction;

(d) all hydraulic hoses, particularly those which flex in normal operation of crane functions, should be visually inspected once every working day, when used;

(e) hooks and latches for deformation, chemical damage, cracks, and wear. Refer to ASME B30.10;

(f) rope reeving for compliance with crane manufacturer's specifications;

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

(h) hydraulic system for proper oil level and leaks — daily;

(i) tires for recommended inflation pressure, cuts, and loose wheel nuts;

(j) connecting pins and locking device for wear and damage.

22-2.1.4 Periodic Inspection. Complete inspections of the crane shall be performed at intervals as generally defined in para. 22-2.1.2(b) depending upon its activity, severity of service, and environment. These inspections shall include the requirements of para. 22-2.1.2 and in addition, items such as the following. Conditions such as those listed, shall be examined and determination made as to whether they constitute a hazard:

(a) deformed, cracked, or corroded members in the crane structure and carrier;

(b) loose bolts, particularly mounting bolts;

(c) cracked or worn sheaves and drums;

(d) worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers, and locking devices;

(e) excessive wear on brake and clutch system parts and linings;

(f) crane hooks inspected for cracks;

(g) travel steering, braking, and locking devices, for malfunction;

(h) excessively worn or damaged tires.

(i) Hydraulic and Pneumatic Hose, Fittings, and Tubing Inspection

(1) evidence of leakage at the surface of the flexible hose or its junction with metal end couplings;

(2) blistering or abnormal deformation to the outer covering of the hydraulic or pneumatic hose;

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(3) leakage at threaded or clamped joints that cannot be eliminated by normal tightening or recommended procedures;

(4) evidence of excessive abrasion or scrubbing on the outer surface of a hose, rigid tube, or fitting. Means shall be taken to eliminate the interference of elements in contact or otherwise protect the components.

(j) *Hydraulic and Pneumatic Pumps and Motors Inspection*

(1) loose bolts or fasteners;

(2) leaks at joints between sections;

(3) shaft seal leaks;

(4) unusual noises or vibration;

(5) loss of operating speed;

(6) excessive heating of the fluid;

(7) loss of pressure.

(k) *Hydraulic and Pneumatic Valves Inspection*

(1) cracks in valve housing;

(2) improper return of spool to neutral position;

(3) leaks at spools or joints;

(4) sticking spools;

(5) failure of relief valves to attain or maintain correct pressure setting;

(6) relief valve pressures shall be checked as specified by the manufacturer.

(l) *Hydraulic and Pneumatic Cylinders Inspection*

(1) drifting caused by fluid leaking across piston;

(2) rod seals leaking;

(3) leaks at welded joints;

(4) scored, nicked, or dented cylinder rods;

(5) damaged case (barrel);

(6) loose or deformed rod eyes or connecting joints.

(m) *Hydraulic Filters.* Evidence of rubber particles on the filter element may indicate hose, "O" ring, or other rubber component deterioration. Metal chips or pieces on the filter may denote failure in pumps, motors, or cylinders. Further checking will be necessary to determine origin of the problem before corrective action can be taken.

(n) Labels are to be in place and legible.

22-2.1.5 Cranes Not in Regular Use

(a) A crane which has been idle for a period of one month or more, but less than six months, shall be given an inspection conforming with the requirements of paras. 22-2.1.2 and 22-2.4.2(b).

(b) A crane which has been idle for a period of over six months shall be given a complete inspection conforming with the requirements of paras. 22-2.1.2, 22-2.1.3, and 22-2.4.2 before being placed in service.

22-2.1.6 Inspection Records. Dated records for periodic inspection should be made on critical items such as brakes, crane hooks, ropes, hydraulic and pneumatic cylinders, and hydraulic and pneumatic relief pressure valves. Records should be kept available to an appointed person.

Section 22-2.2: Testing

22-2.2.1 Operational Tests

(a) Each new crane shall be tested by the manufacturer to verify compliance with the operational requirements of this section, including functions such as the following:

(1) load lifting and lowering mechanisms;

(2) boom lifting and lowering mechanisms;

(3) boom extension and retraction mechanism;

(4) swinging mechanism;

(5) travel mechanism;

(6) safety devices.

(b) When the complete crane is not supplied by one manufacturer, such tests shall be conducted at final assembly.

(c) Operational test results shall be made available.

22-2.2.2 Load Test

(a) Prior to initial use:

(1) All new and reinstalled cranes shall be inspected and load tested by or under the direction of a designated person. A written test report shall be prepared by a designated person and placed on file. Test loads shall not be less than 100% or more than 110% of the rated load, unless otherwise recommended by the manufacturer or a qualified person.

(2) The need for testing of repaired, altered, or modified cranes shall be determined by a qualified person. When load test is required, testing shall be in accordance with para. 22-2.2.2(a)(1).

(b) The load test, if made, shall consist of the following operations as a minimum requirement.

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

(2) Swing the crane, if applicable, the full range of its swing.

(3) Boom the crane up and down within the allowable working radius for the test load.

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

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Section 22-2.3: Maintenance

22-2.3.1 Preventive Maintenance

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

(b) It is recommended that replacement parts be obtained from the original equipment manufacturer or be of at least equal quality.

22-2.3.2 Maintenance Procedure

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

(1) crane placed where it will cause the least interference with other equipment or operations;

(2) all controls at the "OFF" position;

(3) starting means rendered inoperative;

(4) boom lowered to the ground, if possible, or otherwise secured against dropping;

(5) relieve hydraulic oil pressure from all hydraulic circuits before loosening or removing hydraulic components.

(b) Warning or "out of order" signs shall be placed on the crane controls.

(c) After adjustments and repairs have been made, the crane shall not be returned to service until all guards have been reinstalled, trapped air removed from hydraulic system (if required), safety devices reactivated, and maintenance equipment removed.

22-2.3.3 Adjustments and Repairs

(a) Any hazardous conditions disclosed by the inspection requirements of Section 22-2.1 shall be corrected before operation of the crane is resumed. Adjustments and repairs shall be done only by designated personnel.

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

(1) functional operating mechanism;

(2) safety devices;

(3) control systems.

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

(1) critical parts of functional operating mechanisms which are cracked, broken, corroded, bent, or excessively worn;

(2) critical parts of the crane structure, which are cracked, bent, broken, or excessively corroded;

(3) crane hooks showing conditions described in para. 22-2.1.3(a)(5) shall be taken out of service.

(d) Instructions shall be provided by the manufacturer for the removal of air from hydraulic circuits.

22-2.3.4 Lubrication. All moving parts of the crane, for which lubrication is specified, should be regularly lubricated per the manufacturer's recommendations and procedures.

Section 22-2.4: Rope Inspection, Replacement, and Maintenance

22-2.4.1 General. Due to crane design configuration, to maintain mobility, sheave diameters, drum diameters, and rope design factors are limited. Due to these design parameters, inspection in accordance with para. 22-2.4.2 to detect any deterioration and timely replacement in accordance with para. 22-2.4.3 is essential.

22-2.4.2 Inspection

(a) Frequent Inspection

(1) All running ropes in service should be visually inspected once each working day. A visual inspection shall consist of observation of all rope which can be in use during the day's operations. These visual observations should be concerned with discovering gross damage such as listed below, which may be an immediate hazard:

(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 uneveness of outer strands should provide evidence that the rope or ropes need to be replaced;

(b) general corrosion;

(c) broken or cut strands;

(d) number, distribution, and type of visible broken wires. When such damage is discovered, the rope shall either be removed from service or given an inspection as detailed in para. 22-2.4.3(b).

(2) Care shall be taken when inspecting sections of rapid deterioration such as flange points, crossover points, and repetitive pickup points on drums.

(b) Periodic Inspection

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

(a) expected rope life as determined by experience on the particular installation or similar installations;

(b) severity of environment;

(c) percentage of capacity lifts;

(d) frequency rates of operation;

(e) exposure to shock loads.

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Inspections need not be at equal calendar intervals and should be more frequent as the rope approaches the end of its life. This inspection shall be made at least annually.

(2) Periodic inspection shall be performed by a designated person. This inspection shall cover the entire length of rope. Only the surface wires need be inspected. No attempt should be made to open the rope. Any deterioration, resulting in appreciable loss of original strength, such as described below, shall be noted and determination made as to whether use of the rope would constitute a hazard:

(a) points listed in para. 22-2.4.2(a)(1)(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.

22-2.4.3 Rope Replacement

(a) No precise rules can be given for determination of the exact time for rope replacement, since many variable factors are involved. Once 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 that 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 lay or three broken wires in one strand in one lay;

(2) one outer wire broken at the contact point with the core of the rope which 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) wear of one-third the original diameter of outside individual wires;

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

(5) evidence of any heat damage from any cause;

(6) reductions from nominal diameter greater than those shown below.

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

(7) In 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.

(8) Replacement rope shall have a strength rating at least as great 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.

(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) Ropes Not in Regular Use. All rope which has been idle for a period of a month or more due to shutdown or storage of a crane on which it is installed, shall be given an inspection in accordance with para. 22-2.4.3(b) before it is placed in service. This inspection shall be for all types of deterioration and shall be performed by a designated person.

(e) Inspection Records

(1) Frequent inspection — no records required.

(2) Periodic inspection — in order to establish data as a basis for judging the proper time for replacement, a dated report of rope condition at each periodic inspection should be kept on file. This report shall cover points of deterioration listed in para. 22-2.4.3(b).

22-2.4.4 Rope Maintenance

(a) Rope should be stored to prevent damage or deterioration.

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

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

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nonpreformed ropes of $^{7}/_{8}$ in. (22 mm) diameter or smaller, two seizings on each side of the cut are required, and for nonpreformed rope 1 in. (25 mm) diameter or larger, three seizings on each side of the cut are required.

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

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

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

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Chapter 22-3
Operation

Section 22-3.1: Qualifications for and Conduct of Operators and Operating Practices

22-3.1.1 Operators

(a) Crane operation shall be limited to personnel with the following minimum qualifications:

(1) designated persons;

(2) trainees under the direct supervision of a designated person;

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

(4) inspectors (crane).

(b) No one other than the personnel specified in para. 22-3.1.1(a) shall enter the operating area of a crane with the exception of persons such as oilers, supervisors, and those specified persons authorized by supervisors whose duties require them to do so and then only in the performance of their duties and with the knowledge of the operator or other appointed person.

22-3.1.2 Qualifications for Operators

(a) Operators shall be required by the employer to pass a practical operating examination. 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) vision of at least 20/30 Snellen in one eye and 20/50 in the other, with or without corrective lenses;

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

(3) adequate hearing, with or without hearing aid, for the specific operation.

(c) Evidence of physical limitations or emotional instability which could render a hazard to the operator or others, or which in the opinion of the examiner could interfere with the operator's performance, may be sufficient cause for disqualification. In such cases, specialized clinical or medical judgments and tests may be required.

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

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

(f) In addition to the above listed requirements, the operator shall:

(1) demonstrate the ability to comprehend and interpret all labels, operator's manuals, safety codes, and other information pertinent to correct crane operation;

(2) possess knowledge of emergency procedures and implementation of same;

(3) demonstrate to the employer the ability to operate the specific type of equipment;

(4) be familiar with applicable safety regulations;

(5) understand responsibility for maintenance requirements of the crane;

(6) be thoroughly familiar with the crane and its control functions;

(7) understand the operating procedures as outlined by the manufacturer.

22-3.1.3 Conduct of Operators

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

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

(c) The operator should not leave a suspended load unattended unless specific precautions have been instituted and are in place.

(d) If there is a warning sign on the switch or engine starting controls, the operator shall not close the switch or start the engine until the warning sign has been removed by the appointed person.

(e) Before closing the switch or starting the engine, the operator shall see that all controls are in the "OFF" or neutral position and all personnel are in the clear.

(f) If power fails during operation, the operator shall:

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(1) move power controls to "OFF" or neutral position;

(2) land the suspended load and boom, if practical.

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

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

(i) Stabilizers shall be visible to the operator while extending or setting unless the operator is assisted by a signalperson.

Section 22-3.2: Operating Practices

22-3.2.1 Handling the Load

(a) Size of Load

(1) No crane shall be loaded beyond the rated load except for test purposes.

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

(3) When loads that are not accurately known are to be lifted, the person responsible for the job shall ascertain that the weight of the load does not exceed the crane rated load at the radius at which the load is to be lifted.

(b) Attaching the Load

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

(2) Hoist rope shall not be wrapped around the load.

(c) Moving the Load

(1) The operator shall determine that:

(a) the crane is level and, where necessary, the vehicle/carrier is blocked properly;

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

(c) means are provided to hold the vehicle stationary while operating the crane.

(2) Before starting to lift, the hook shall be brought over the load in such a manner as to minimize swinging.

(3) During lifting, care shall be taken that:

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

(b) load, boom, or other parts of the crane do not contact any obstruction.

(4) Cranes shall not be used for dragging loads sideways.

(5) This Standard recognizes that articulating boom cranes are designed and intended for handling materials. They do not meet personnel lift or elevator requirements. Therefore, no lifting, lowering, swinging, or traveling shall be done while a person is on the hook or load. Hook-attached suspended work platforms (baskets) shall not be used with cranes covered by this Standard. Work platforms (baskets) attached to the boom shall be approved by the crane manufacturer.

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

(7) When the crane is so equipped, the stabilizers shall be fully extended and set. Blocking under stabilizers shall meet the requirements as follows:

(a) strong enough to prevent crushing;

(b) of such thickness, width, and length as to completely support the stabilizer pad.

(8) Firm footing under all tires, or individual stabilizer pads should be level. Where such a footing is not otherwise supplied, it should be provided by timbers, cribbing, or other structural members to distribute the load so as not to exceed allowable bearing capacity of the underlying material.

(9) In transit, the boom shall be carried in stowed position.

(10) When rotating the crane, sudden starts and stops shall be avoided. Rotational speed shall be such that the load does not swing out beyond the radius at which it can be controlled.

(11) The crane shall not be traveled with a load on the hook unless recommended by the manufacturer.

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

(d) Stowing Procedure. Follow manufacturer's procedure and sequence when stowing and unstowing the crane.

Section 22-3.3: Miscellaneous

22-3.3.1 Operating Near Electric Power Lines

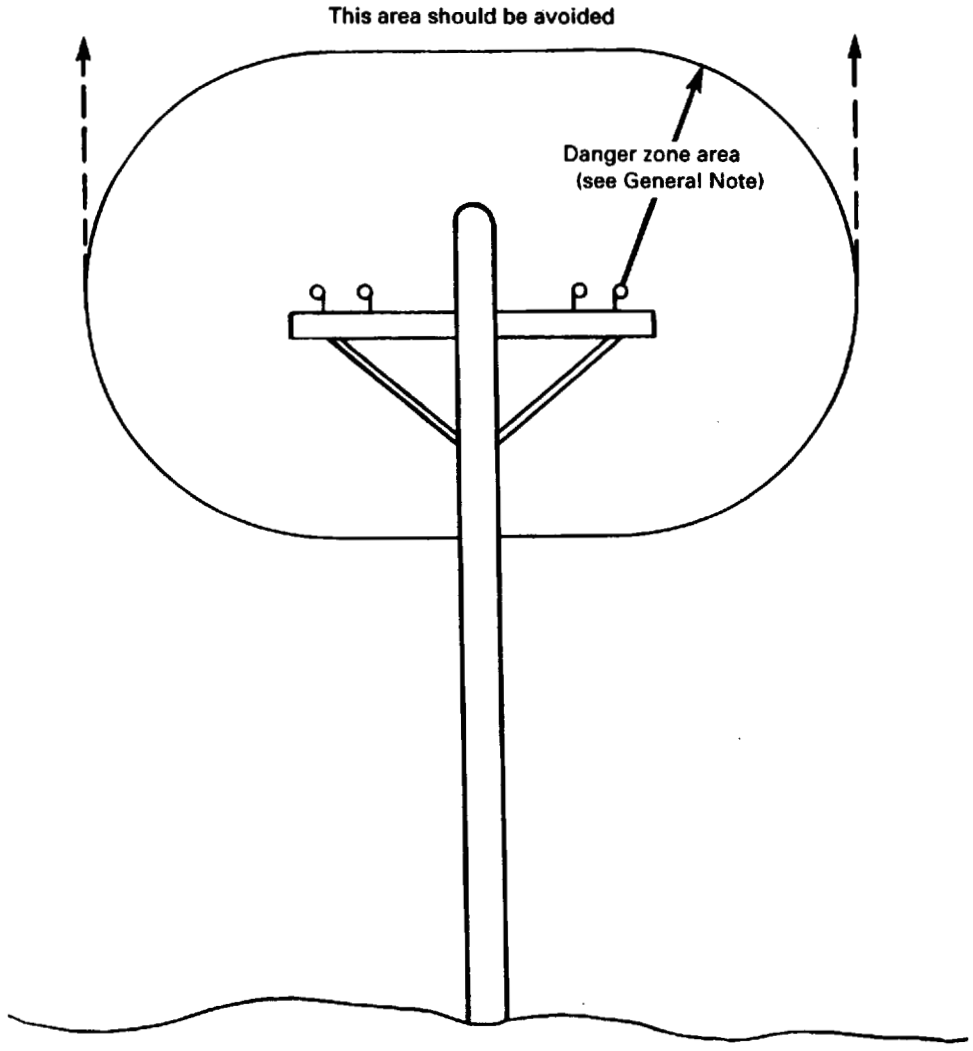
(a) Cranes shall be operated so that no part of the crane or load enters into the danger zone shown in Fig. 17.

EXCEPTIONS:

(1) The danger zone may be entered after confirmation by an appointed person that the electrical distribution and transmission lines have been de-energized and visibly grounded at the point of work; or

(2) The danger zone may be entered if insulating barriers (not a part of nor an attachment to the crane) have been erected to prevent physical contact with the lines.

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GENERAL NOTE: For minimum radial distance of danger zone, see Table 1.

FIG. 17 DANGER ZONE FOR CRANES AND LIFTED LOADS OPERATING NEAR ELECTRICAL TRANSMISSION LINES

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TABLE 1 REQUIRED CLEARANCE FOR NORMAL VOLTAGE IN OPERATION NEAR HIGH VOLTAGE POWER LINES AND OPERATION IN TRANSIT WITH NO LOAD AND BOOM OR MAST LOWERED

Normal Voltage, kV (Phase to Phase)	Minimum Required Clearance	
	ft	m
When operating near high voltage power lines		
to 50	10	3.05
Over 50 to 200	15	4.6
Over 200 to 350	20	6.1
Over 350 to 500	25	7.62
Over 500 to 750	35	10.67
Over 750 to 1,000	45	13.72
While in transit with no load and boom or mast lowered		
to 0.75	4	1.22
Over 0.75 to 50	6	1.83
Over 50 to 345	10	3.83
Over 345 to 750	16	4.87
Over 750 to 1,000	20	6.1

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

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

(3) In transit with no load and boom lowered, the clearance shall be as specified in Table 1.

(4) A qualified signalperson shall be assigned to observe the clearance and give warning before approaching the above limits.

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

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

(d) Durable signs shall be installed at the operator's station and on the outside of the crane, warning that electrocution or serious bodily injury may occur unless a minimum clearance of 10 ft (3 m) is maintained between the crane or the load being handled and energized power lines. Greater clearances are required because of higher voltage as stated in para. 22-3.3.1(a). These signs shall be revised but not removed when local jurisdiction requires greater clearances.

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