

**ASME B30.6-2015**  
**(Revision of ASME B30.6-2010)**

# Derricks

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

**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**

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**The American Society of  
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**Two Park Avenue • New York, NY • 10016 USA**

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# CONTENTS

Foreword .....	iv
Committee Roster .....	vi
Introduction .....	viii
Summary of Changes .....	xi
<b>Chapter 6-0 Scope, Definitions, Translations, Personnel Competence, and References .....</b>	<b>1</b>
Section 6-0.1 Scope of B30.6 .....	1
Section 6-0.2 Definitions .....	1
Section 6-0.3 Translations of Safety-Related Information and Control Designations .....	6
Section 6-0.4 Personnel Competence .....	7
Section 6-0.5 References .....	7
<b>Chapter 6-1 Construction and Installation .....</b>	<b>8</b>
Section 6-1.1 Load Ratings .....	8
Section 6-1.2 Construction .....	8
Section 6-1.3 Ropes and Reeving Accessories .....	9
Section 6-1.4 Anchoring and Guying .....	10
Section 6-1.5 Winches and Swingers .....	10
Section 6-1.6 General Requirements .....	10
<b>Chapter 6-2 Inspection, Testing, and Maintenance .....</b>	<b>11</b>
Section 6-2.1 Inspection .....	11
Section 6-2.2 Testing .....	12
Section 6-2.3 Maintenance .....	12
Section 6-2.4 Rope Inspection, Replacement, and Maintenance .....	13
<b>Chapter 6-3 Operation .....</b>	<b>15</b>
Section 6-3.1 Qualifications, Responsibilities, and Operating Practices .....	15
Section 6-3.2 Responsibilities .....	16
Section 6-3.3 Handling the Load .....	18
Section 6-3.4 Signals .....	19
Section 6-3.5 Miscellaneous .....	22
<b>Figures</b>	
6-0.2.1-1 A-Frame Derrick .....	1
6-0.2.1-2 Basket Derrick .....	2
6-0.2.1-3 Breast Derrick .....	2
6-0.2.1-4 Chicago Boom Derrick .....	3
6-0.2.1-5 Gin Pole Derrick .....	3
6-0.2.1-6 Guy Derrick .....	4
6-0.2.1-7 Shearleg Derrick .....	5
6-0.2.1-8 Stiffleg Derrick .....	5
6-3.4.2-1 Standard Hand Signals for Controlling Derricks .....	20
6-3.5.3-1 Danger Zone for Derricks and Lifted Loads Operating Near Electrical Transmission Lines .....	23
<b>Table</b>	
6-3.5.3-1 Required Clearance for Normal Voltage in Operation Near High-Voltage Power Lines .....	24

# FOREWORD

This American National Standard, Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings, has been developed under the procedures accredited by the American National Standards Institute (ANSI). This Standard had its beginning in December 1916 when an eight-page Code of Safety Standards for Cranes, prepared by an 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, AESC approved the ASME Safety Code Correlating Committee's recommendation and authorized the project with the U.S. Department of the Navy, Bureau of Yards and Docks, and ASME as sponsors.

In March 1926, invitations were issued to 50 organizations to appoint representatives to a Sectional Committee. The call for organization of this Sectional Committee was sent out October 2, 1926, and the committee organized November 4, 1926, with 57 members representing 29 national organizations. Commencing June 1, 1927, and using the eight-page code published by ASME in 1916 as a basis, the Sectional Committee developed the Safety Code for Cranes, Derricks, and Hoists. The early drafts of this safety code included requirements for jacks, but, due to inputs and comments on those drafts, the Sectional Committee decided in 1938 to make the requirements for jacks a separate code. In January 1943, ASA B30.2-1943 was published addressing a multitude of equipment types and in August 1943, ASA B30.1-1943 was published just addressing 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 the initial publication of B30.3, B30.5, B30.6, B30.11, and B30.16 being designated as revisions of B30.2, with the remainder of the B30 volumes being published as totally new volumes. ASA changed its name to USASI in 1966 and to ANSI in 1969, which resulted in B30 volumes from 1943 to 1968 being designated as either ASA B30, USAS B30, or ANSI B30, depending on their date of publication.

In 1982, the Committee was reorganized as an Accredited Organization Committee, operating under procedures developed by ASME and accredited by ANSI. This Standard presents a coordinated set of rules that may serve as a guide to government and other regulatory bodies and municipal authorities responsible for the guarding and inspection of the equipment falling within its scope. The suggestions leading to accident prevention are given both as mandatory and advisory provisions; compliance with both types may be required by employers of their employees.

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

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

B30.6 was first published in 1969; new editions were published in 1977, 1984, 1990, 1995, 2003, and 2010. This 2015 Edition incorporates many global B30 changes, including the addition of sections on personnel competence, translation, and responsibilities, along with several other revisions.

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 June 18, 2015.

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

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

(15)

## B30 STANDARD INTRODUCTION

### SECTION I: SCOPE

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

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

- B30.1 Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries
- B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
- B30.3 Tower Cranes
- B30.4 Portal and Pedestal Cranes
- B30.5 Mobile and Locomotive Cranes
- B30.6 Derricks
- B30.7 Winches
- B30.8 Floating Cranes and Floating Derricks
- B30.9 Slings
- B30.10 Hooks
- B30.11 Monorails and Underhung Cranes
- B30.12 Handling Loads Suspended From Rotorcraft
- B30.13 Storage/Retrieval (S/R) Machines and Associated Equipment
- B30.14 Side Boom Tractors
- B30.15 Mobile Hydraulic Cranes  
(withdrawn 1982 — requirements found in latest revision of B30.5)
- B30.16 Overhead Hoists (Underhung)
- B30.17 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
- B30.18 Stacker Cranes (Top or Under Running Bridge, Multiple Girder With Top or Under Running Trolley Hoist)
- B30.19 Cableways
- B30.20 Below-the-Hook Lifting Devices
- B30.21 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<sup>1</sup>

### SECTION II: SCOPE EXCLUSIONS

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

### SECTION III: PURPOSE

The B30 Standard is intended to

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

### SECTION IV: USE BY REGULATORY AGENCIES

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

### SECTION V: EFFECTIVE DATE

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

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

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

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

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

## SECTION VI: REQUIREMENTS AND RECOMMENDATIONS

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

## SECTION VII: USE OF MEASUREMENT UNITS

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

## SECTION VIII: REQUESTS FOR REVISION

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

Secretary, B30 Standard Committee  
ASME Codes and Standards  
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 Standard Committee.

## SECTION IX: REQUESTS FOR INTERPRETATION

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

Secretary, B30 Standard Committee  
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Requests should be in the following format:

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

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

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

## SECTION X: ADDITIONAL GUIDANCE

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

The B30 Standard Committee fully realizes the importance of proper design factors, minimum or maximum

dimensions, and other limiting criteria of wire rope or chain and their fastenings, sheaves, sprockets, drums, and similar equipment covered by the standard, all of which are closely connected with safety. Sizes, strengths, and similar criteria are dependent on many different factors, often varying with the installation and uses.

These factors depend on

- (a) the condition of the equipment or material
- (b) the loads
- (c) the acceleration or speed of the ropes, chains, sheaves, sprockets, or drums

- (d) the type of attachments
- (e) the number, size, and arrangement of sheaves or other parts
- (f) environmental conditions causing corrosion or wear
- (g) many variables that must be considered in each individual case

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

# ASME B30.6-2015 SUMMARY OF CHANGES

Following approval by the ASME B30 Committee and ASME, and after public review, ASME B30.6-2015 was approved by the American National Standards Institute on June 18, 2015.

ASME B30.6-2015 includes editorial changes, revisions, and corrections introduced in ASME B30.6-2010, as well as the following changes identified by (15).

<i>Page</i>	<i>Location</i>	<i>Change</i>
viii–x	B30 Standard Introduction	Updated
1	Chapter 6-0	Title revised
	Section 6-0.1	Revised
	6-0.2.1	Definition of <i>derrick</i> revised
4, 6, 7	6-0.2.2	(1) Definitions of <i>appointed, authorized, designated person, and director</i> deleted (2) Definitions of <i>minimum breaking force</i> and <i>operational aid</i> added
	Section 6-0.3	Added
	Section 6-0.4	Added
	Section 6-0.5	Updated
8	6-1.1.1	Revised
	6-1.1.2	Subparagraph (a)(3) revised
9	6-1.3.2	Subparagraph (b) revised
	6-1.3.3	Subparagraphs (b) and (c) revised
	6-1.3.4	Subparagraphs (b) and (c) and Note in subpara. (e) revised
	6-1.3.5	(1) Subparagraphs (a) and (f) revised (2) Figure 6-1.3.5-1 deleted
10	Section 6-1.5	Revised in its entirety
	6-1.6.5	Added
11, 12	Section 6-2.1	Revised in its entirety
	6-2.2.1	Subparagraph (a)(4) revised
	6-2.2.2	Subparagraph (a)(2)(-a) revised
	6-2.3.1	Subparagraph (a) revised
	6-2.3.2	Subparagraphs (a)(2) through (a)(4), (a)(6), and (a)(7) revised
13, 14	6-2.3.4	Subparagraph (a) revised
	6-2.4.1	(1) First paragraph added (2) Subparagraphs (b)(2), (b)(2)(-b), (f), and (d) revised

<i>Page</i>	<i>Location</i>	<i>Change</i>
15	Section 6-3.1	(1) Former Section 6-3.1 deleted, and remaining sections redesignated (2) Revised in its entirety
16–19, 22	Section 6-3.2	(1) Added (2) Former para. 6-3.2.3 deleted
	Section 6-3.3	Revised in its entirety
	6-3.4.4	Revised

# DERRICKS

## Chapter 6-0

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

(15)

#### (15) SECTION 6-0.1: SCOPE OF B30.6

Volume B30.6 includes provisions that apply to the construction, installation, operation, inspection, testing, and maintenance of guy, stiffleg, basket, breast, gin pole, Chicago boom, shearleg, and A-frame derricks. These derricks, powered by winches through systems of wire rope reeving, are used for lifting, lowering, and horizontal movement of freely suspended unguided loads. Derricks are usually stationary mounted and may be temporarily or permanently installed. The provisions included in this Volume also apply to any variations of these types of derricks with the same fundamental characteristics, except those specified for floating derricks in ASME B30.8, Floating Cranes and Floating Derricks.

#### SECTION 6-0.2: DEFINITIONS

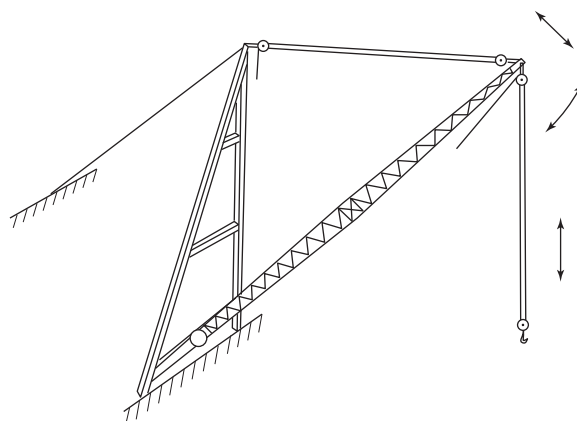
##### (15) 6-0.2.1 Types of Equipment

*derrick*: an apparatus consisting of a mast or equivalent member held at the end by guys or braces, with or without a boom, for use with a winching mechanism and operating ropes.

*derrick, A-frame*: a derrick in which the boom is hinged from a cross member or pedestal between the bottom ends of two upright members spread apart at the lower ends and joined at the top, the boom point is secured to the junction of the side members, and the side members are braced or guyed from this junction point (see Fig. 6-0.2.1-1).

*derrick, basket*: a derrick without a boom, similar to a gin pole, with its base supported by ropes attached to corner posts or other parts of the structure. The base is at a lower elevation than its supports. The location of the base of a basket derrick can be changed by varying the length of the rope supports. The top of the pole is secured with multiple reeved guys to position the top of the pole to the desired location by varying the length of the upper guy lines. The load is lifted and lowered by ropes

Fig. 6-0.2.1-1 A-Frame Derrick



through a sheave or block secured to the top of the pole (see Fig. 6-0.2.1-2).

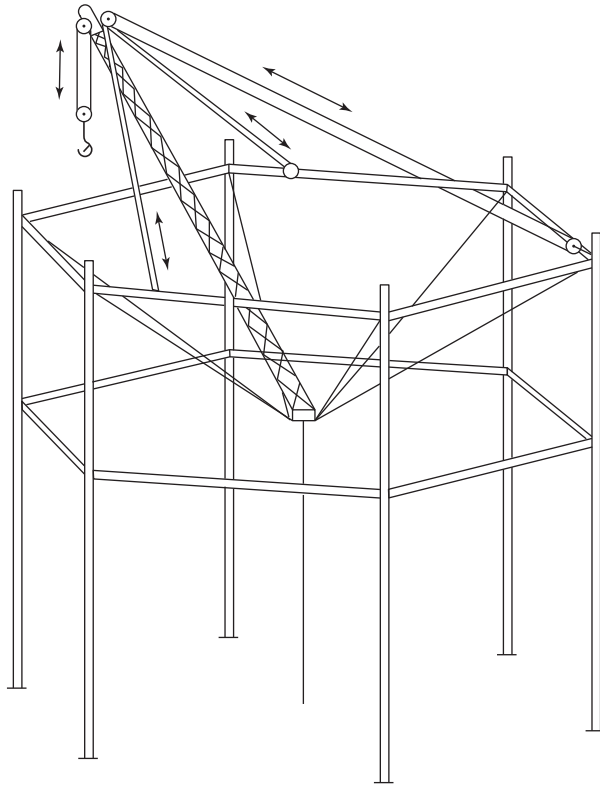
*derrick, breast*: a derrick without a boom. The mast consists of two side members spread farther apart at the base than at the top, and tied together at the top and bottom by rigid members. The mast is prevented from tipping forward by guys connected to its top. The load is lifted and lowered by ropes through a sheave or block secured to the top of the crosspiece (see Fig. 6-0.2.1-3).

*derrick, Chicago boom*: a boom that is attached to a structure, an outside upright member of the host structure serving as the mast, and the boom being mounted in a pivoting seat secured to the upright. The derrick is complete with load, boom, and boom point swing line falls (see Fig. 6-0.2.1-4).

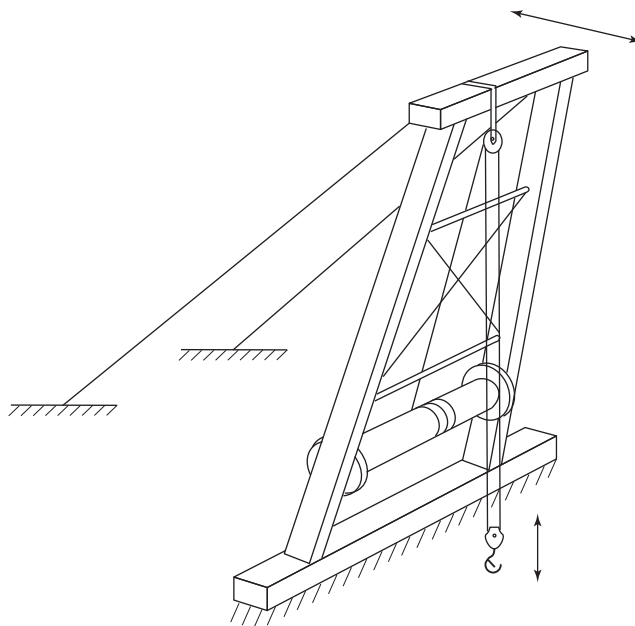
*derrick, gin pole*: a boom without a mast that has guys arranged from its top to permit leaning the mast in one or more directions. The load is lifted and lowered by ropes reeved through sheaves or blocks at the top of the mast and the lower block (see Fig. 6-0.2.1-5).

*derrick, guy*: a fixed derrick consisting of a mast capable of being rotated 360 deg, but not continuous rotation, supported in a vertical position by guys and a boom,

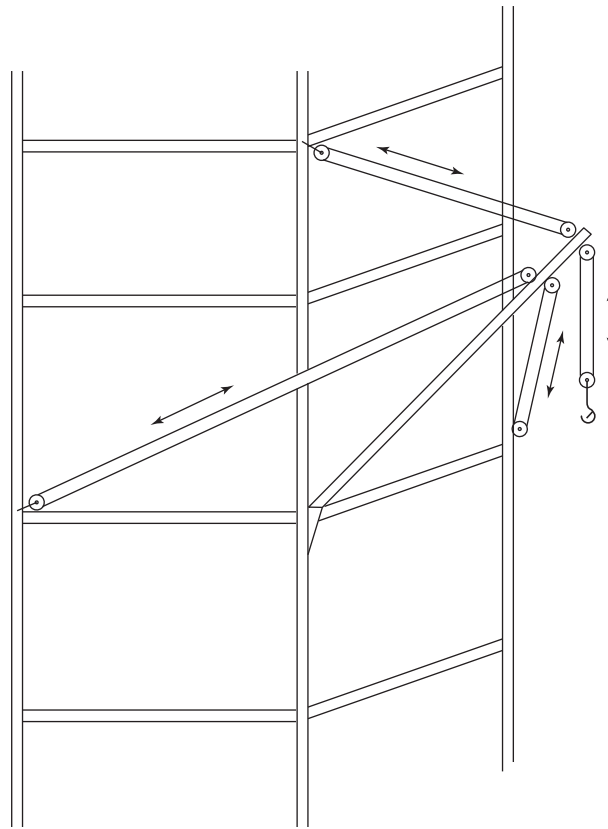
**Fig. 6-0.2.1-2 Basket Derrick**



**Fig. 6-0.2.1-3 Breast Derrick**



**Fig. 6-0.2.1-4 Chicago Boom Derrick**



**Fig. 6-0.2.1-5 Gin Pole Derrick**

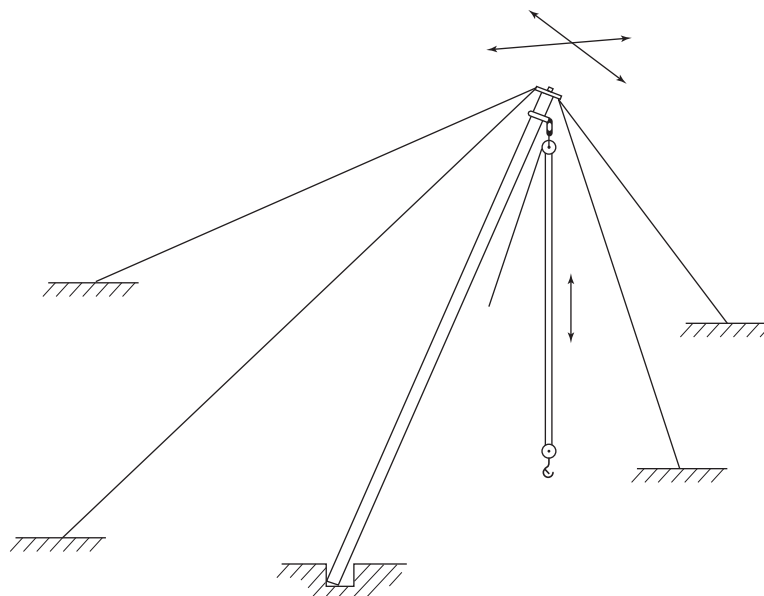
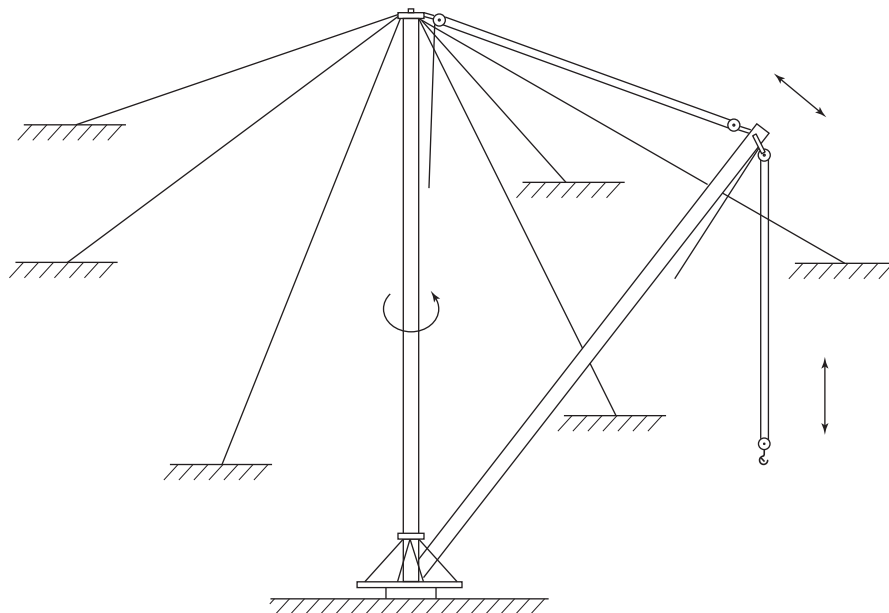




Fig. 6-0.2.1-6 Guy Derrick



the bottom end of which is hinged or pivoted to move in a vertical plane with a reeved rope between the head of the mast and the boom harness for lifting and lowering the boom, and a reeved rope from the boom point for lifting and lowering the load (see Fig. 6-0.2.1-6).

*derrick, shearleg:* a boom with or without a mast, not capable of swinging, hinged at the bottom and raised and lowered by a boom hoist mechanism or a hydraulic cylinder (see Fig. 6-0.2.1-7).

*derrick, stiffleg:* a derrick similar to a guy derrick, except that the mast is supported or held in place by two or more stiff members, called stifflegs, which are capable of resisting either tensile or compressive forces. Sills are generally provided to connect the lower ends of the stifflegs to the foot of the mast (see Fig. 6-0.2.1-8).

### (15) 6-0.2.2 General

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

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

*boom:* a timber or metal section or strut, pivoted or hinged at the heel (lower end) at a location fixed in height on a frame, mast, or vertical member, with its point (upper end) supported by chains, ropes, or rods to the upper end of the frame, mast, or vertical member. A rope for lifting and lowering the load is reeved

through the sheaves or a block at the boom point and the load block. The length of the boom shall be taken as the straight line distance between the axis of the foot pin and the axis of the boom point sheave pin, or where used, the axis of the upper load block attachment pin.

*boom angle:* the angle above or below horizontal of the longitudinal axis of the boom base section.

*boom angle indicator:* an accessory device that measures the angle of the boom base section center line to the horizontal.

*boom harness:* the block and sheave arrangement on the boom point to which the topping lift cable is reeved for changing the boom angle.

*boom point:* the outward end of the top section of the boom.

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

*derrick bullwheel:* a horizontal ring or wheel fastened to the mast base of a derrick for the purpose of swinging the derrick by means of ropes leading from this wheel to a powered drum.

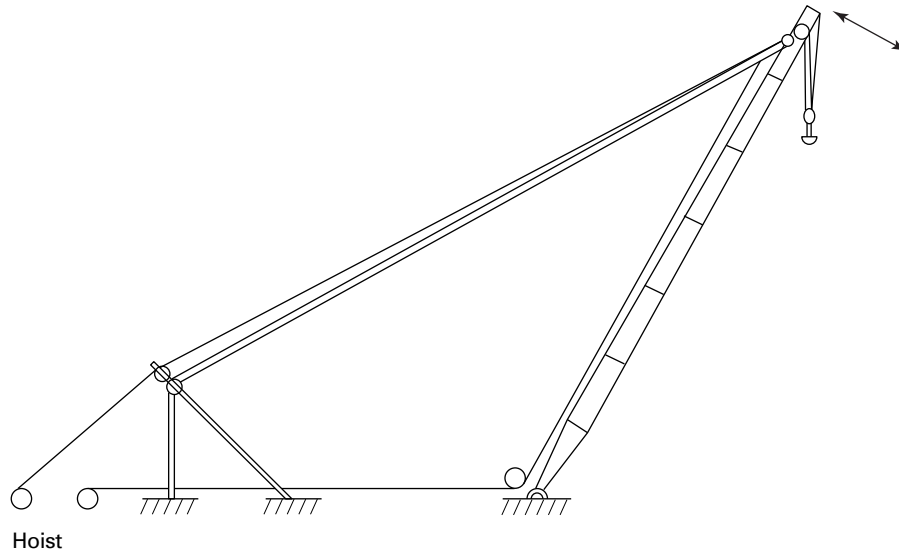
*derrick service:*

(a) *normal:* that service which involves operating at less than 85% rated capacity and not more than 10 lift cycles per hour except for isolated instances.

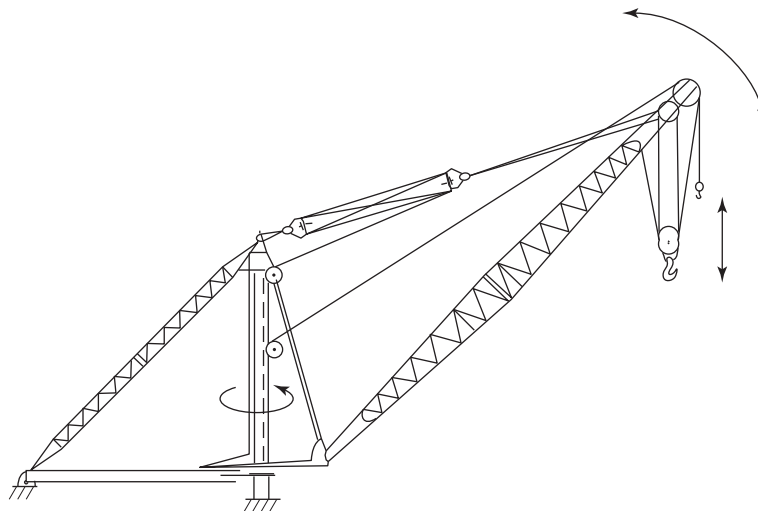
(b) *heavy:* that service which involves operating at 85% to 100% of rated capacity, or in excess of 10 lift cycles per hour as a regular specified procedure.

(c) *severe:* that service which involves normal or heavy service with abnormal operating conditions.

**Fig. 6-0.2.1-7 Shearleg Derrick**



**Fig. 6-0.2.1-8 Stiffleg Derrick**



*eye*: a loop formed at the end of a rope by securing the dead end to the live end at the base of the loop.

*fiddle block*: a block consisting of sheaves held in place by the same cheek plates; at least two sheaves are not on the same shaft.

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

*foot bearing or block (still block)*: the lower support on which the mast rotates.

*gudgeon pin*: a pin connecting the mast cap to the mast, allowing rotation of the mast.

*guy*: a rope used to steady or secure the mast, boom, or other member in the desired position.

*hairpin anchor*: a hairpin-shaped, guy-supporting anchor that is placed in footings or walls before concrete is poured and is held in place by the cured concrete.

*latch, hook*: a device used to bridge the throat opening of a hook.

*load, rated*: the maximum allowable working load in pounds (kilograms) established by the manufacturer in accordance with Section 6-1.1.

*load, working*: the external load in pounds (kilograms) applied to the derrick, including the weight of load-attaching equipment such as hoisting ropes, lower load block, shackles, and slings.

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

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

*mast*: the upright member of the derrick.

*mast cap (spider)*: the fitting at the top of the mast to which the guys are connected.

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

*operational aid*: an accessory that provides information to facilitate operation of a derrick or that takes control of particular functions without action of the operator when a limiting condition is sensed. Examples of such devices include, but are not limited to, the following: anti-two block device, rated capacity indicator, rated capacity load limiter, boom angle or radius indicator, drum rotation indicator, load indicator, and wind speed indicator.

*qualified person*: a person who, by possession of a recognized degree in an applicable field, 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.

*repetitive pickup point*: when operating on a repetitive cycle operation, that part of the rope which is leaving the drum when the load is first applied to the rope.

*rock anchor*: an anchoring device inserted in a hole drilled into rock or concrete. The device is secured in the hole to withstand a predetermined load.

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

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

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

*sill*: a member connecting the foot block and stiffleg, or a member connecting the lower ends of a double-member mast.

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

*stiffleg*: a rigid member supporting the mast at the head.

*swing*: rotation of the mast or boom for movements of loads in a horizontal direction about the axis of rotation.

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

### SECTION 6-0.3: TRANSLATIONS OF SAFETY-RELATED INFORMATION AND CONTROL DESIGNATIONS

(15)

This Section specifies translations of safety-related information and control designations.

(a) Translation of non-English documentation into English

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

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

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

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

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

#### (15) SECTION 6-0.4: PERSONNEL COMPETENCE

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

#### SECTION 6-0.5: REFERENCES

(15)

The following is a list of standards and specifications referenced in this Volume, showing the year of approval:

ANSI/AWS D1.1/D1.1M:2010, Structural Welding Code  
ANSI/AWS D14.3/D14.3M:2010, Specification for  
Welding Earth-moving, Construction and Agricultural  
Equipment

Publisher: American Welding Society (AWS), 8669 NW  
36 Street, No. 130, Miami, FL 33166 (www.aws.org)

ASME B30.7-2011, Winches

ASME B30.8-2010, Floating Cranes and Floating Derricks

ASME B30.10-2009, Hooks

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)

# Chapter 6-1

## Construction and Installation

### SECTION 6-1.1: LOAD RATINGS

#### (15) 6-1.1.1 Basis

Load ratings are dependent on such factors as anchorage, structural competence, rope strength, winch rating, supports, and guy lengths.

#### (15) 6-1.1.2 Rated Load (Working Load) Marking

(a) For permanently installed derricks with fixed lengths of boom, guy, and mast, a substantial, durable, and clearly legible rating chart shall be provided with each derrick and affixed where it is visible to personnel responsible for the operation of the equipment. The chart shall include, but not necessarily be limited to, the following data:

(1) manufacturer's approved load ratings at corresponding ranges of boom angle or operating radii.

(2) specific lengths of components on which the load ratings are based.

(3) required parts for reeving. Size and construction of rope may be shown either on the rating chart or in the operating manual.

(b) For nonpermanent installations, the manufacturer shall provide information from which rated load charts can be prepared by a qualified person for the particular installation. The rated load charts shall be located either at the derrick or at the job site office.

### SECTION 6-1.2: CONSTRUCTION

#### 6-1.2.1 General

(a) Derricks shall be constructed to meet all stresses imposed on members and components under normal operating conditions when properly installed and handling loads not exceeding manufacturer's load ratings with recommended reeving.

(b) Welding of load-sustaining members shall conform to recommended practices of the American Welding Society as outlined in ANSI/AWS D14.3 or ANSI/AWS D1.1.

#### 6-1.2.2 Guy Derricks

(a) The recommended minimum number of guys is six. Preferably, guy length and spacing should be equal. Variations from these requirements are acceptable provided original rated load or rerated load is calculated by a qualified person or derrick manufacturer to compensate for these variations.

(b) For published ratings, the manufacturer shall furnish complete guy information recommending

(1) the number

(2) the spacing around the mast

(3) the maximum vertical slope

(4) the size, grade, and construction of rope to be used in each

(5) initial sag or tension

(6) tension in guy line rope at anchor

(c) The mast base shall permit free rotation of the mast with allowance for slight tilting of the mast caused by guy slack.

(d) The mast cap shall

(1) permit free rotation of the mast

(2) withstand tilting and cramping action imposed by the guy loads

(3) be secured to the mast to prevent disengagement during erection

(4) be provided with means for attachment of guy ropes

#### 6-1.2.3 Stiffleg Derricks

(a) The mast shall be supported in the vertical position by at least two stifflegs, one end of each being connected to the top of the mast and the other end securely anchored. The stifflegs shall be capable of withstanding the loads imposed at any point of operation within the rated load chart range.

(b) The mast base shall

(1) permit free rotation of the mast, when required

(2) permit deflection of the mast without binding

(3) provide means to prevent the mast from lifting out of its socket when the mast is in tension

(c) The stiffleg connecting member at the top of the mast shall

(1) permit free rotation of the mast, when required

(2) withstand the loads imposed by the action of the stifflegs

(3) be so secured as to oppose separating forces at all times

#### 6-1.2.4 Gin Pole Derricks

(a) Guy lines should be sized and spaced so as to make the gin pole stable in both boomed and vertical positions.

(b) The base of the gin pole shall

(1) permit movement of the pole, when required

(2) provide means to anchor the pole against horizontal forces, when required

### 6-1.2.5 Chicago Boom Derricks

The fittings for stepping the boom and for attachment of the topping lift shall be arranged to

- (a) permit the derrick to swing at all permitted operating radii and mounting heights between fittings
- (b) accommodate attachment to the upright member of the host structure
- (c) withstand the forces applied during normal operation with rated loads at permitted operating configurations
- (d) prevent the boom or topping lift from lifting out under tensile forces

## SECTION 6-1.3: ROPES AND REEVING ACCESSORIES

### 6-1.3.1 General

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

#### (15) 6-1.3.2 Guy Ropes

- (a) Guy ropes shall be of a size, grade, and construction to withstand the maximum load imposed.
- (b) The minimum breaking force of each rope shall not be less than 3 times the static load applied to the rope.
- (c) Guy attachments such as turnbuckles shall have provision to prevent loosening during usage.

#### (15) 6-1.3.3 Boom Hoist Ropes

- (a) Boom hoist ropes shall be of a size, grade, and construction to withstand the maximum load imposed.
- (b) The live rope-reeving system in a boom suspension shall withstand the maximum load imposed and be of a length to permit lowering the boom point to horizontal position with at least two full wraps of rope remaining on the drum.
- (c) The minimum breaking force of the most heavily loaded rope in a system shall not be less than  $3\frac{1}{2}$  times the load applied to that rope.
- (d) Rotation resistant ropes shall not be used for boom hoist reeving.

#### (15) 6-1.3.4 Load Hoist Ropes

- (a) Load hoist ropes shall be of a size, grade, and construction to withstand the maximum load imposed.
- (b) Ropes in the load-hoisting systems shall be of a length for the entire range of movement specified for the application with at least two full wraps of rope remaining on the drum.
- (c) The minimum breaking force of the most heavily loaded rope in a system shall not be less than  $3\frac{1}{2}$  times the load applied to that rope, except as specified in (d) below.

(d) Rotation-resistant ropes shall have a design factor of 5 or greater. [The design factor of 5 or greater for rotation-resistant ropes may be modified by the derrick user by complying with the provisions of para. 6-3.3.1(c)].

(e) Rotation-resistant ropes shall be given special care in installation as they are more susceptible to damage than other types of rope.

NOTE: The rope design factors, as given in paras. 6-1.3.2 through 6-1.3.4 above, shall be determined on the basis of rope loads resulting from rated loads, specified reeving, and published minimum breaking force of new rope. Consideration shall be given to frictional losses where appropriate.

Ropes of material other than steel may be used only in accordance with the manufacturer's, or a qualified person's, recommendation.

### 6-1.3.5 Reeving Accessories

(15)

(a) Poured, swaged, compressed, or wedge socket fittings shall be applied as recommended by the rope, derrick, or fitting manufacturer. Any new poured socket or swaged socket assembly used as a boom pendant shall be proof tested to the derrick or fitting manufacturer's recommendation but in no case greater than 50% of the minimum breaking force of the component wire ropes, structural strands, or fittings.

(b) Rope end shall be anchored to the drum.

(c) Eyes shall be made in a recommended manner, and rope thimbles should be used in the eye.

(d) Rope clips attached with U-bolts shall have the U-bolt on the dead or short end of the rope. Spacing and number of all types of clips shall be in accordance with the clip manufacturer's recommendations. Nuts on clip bolts shall be tightened evenly to the manufacturer's recommended torque. After the initial load is applied to newly installed rope and the rope is under tension, the nuts on the clip bolts should be tightened again to the required torque in order to compensate for any decrease in rope diameter caused by the load.

(e) Where a half-wedge socket is used, it shall be of a positive-locking type.

(f) Wire rope clips used in conjunction with wedge sockets shall be attached to the unloaded dead end of the rope only. Refer to ASME B30.26, Chapter 3, Section 26-3.1.4, and Fig. 26-3.1.1-2 for a more complete instruction in the use of wedge sockets.

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

### 6-1.3.6 Sheaves

(a) Sheave grooves shall be smooth and free from surface conditions that could cause rope damage or accelerated rope wear. 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 outward 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 that 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 applied again.

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

(d) Means should be provided, if necessary, to prevent chafing of the ropes.

(e) All running sheaves shall be equipped with means for lubrication or with permanently lubricated, sealed, or shielded bearings.

(f) Hoisting sheaves shall have pitch diameters not less than 18 times the nominal diameter of the rope used.

(g) Boom point sheaves should be provided with guides to limit the offlead angle of the rope when entering the grooves from either side.

(h) Boom hoist sheaves shall have pitch diameters not less than 15 times the nominal diameter of the rope used.

## SECTION 6-1.4: ANCHORING AND GUYING

### 6-1.4.1 Guy Derricks

(a) The mast base shall be anchored. Maximum horizontal and vertical forces encountered when handling rated loads with the particular guy slope and spacing stipulated for the application are among the design factors for which provision shall be made.

(b) The guys shall be secured to the ground or other firm anchorage. Maximum horizontal and vertical forces encountered while handling rated loads with the particular guy slope and spacing stipulated for the application are among the factors for which provision shall be made.

### 6-1.4.2 Stiffleg Derricks

(a) The mast base shall be anchored. Maximum horizontal and vertical forces encountered while handling rated loads stipulated for the application with the particular stiffleg spacing and slope are among the design factors for which provision shall be made.

(b) The stifflegs shall be anchored. Maximum horizontal and vertical forces encountered while handling rated loads with the particular stiffleg arrangement stipulated for the application are among the factors for which provision shall be made.

### 6-1.4.3 Load-Anchoring Data

For permanent fixed installations, the owner shall provide load-anchoring data referred to in paras. 6-1.4.1 and 6-1.4.2 for the conditions stipulated for the application. For nonpermanent installations, such data shall be determined by a qualified person.

## SECTION 6-1.5: WINCHES AND SWINGERS

(15)

(a) The boom, load winch, and swinger mechanisms shall be suitable for the derrick work intended and shall be anchored to prevent displacement from the imposed loads. Caution should be exercised in the use of winches having excessive line pull or braking capacity for the application.

(b) Winch requirements of ASME B30.7 shall apply.

## SECTION 6-1.6: GENERAL REQUIREMENTS

### 6-1.6.1 Guards

(a) Exposed moving parts, such as gears, ropes, set screws, projecting keys, chains, chain sprockets, and reciprocating components, that constitute a hazard under normal operating conditions shall be guarded.

(b) Guards shall be fastened in place.

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

### 6-1.6.2 Lubrication

Lubricating points should be accessible without removing guards or other parts.

### 6-1.6.3 Hooks

(a) Hooks shall meet the manufacturer's recommendations and shall not be overloaded. If hooks are of the swiveling type, they should rotate freely. Refer to ASME B30.10.

(b) Hooks with latches should be used wherever possible.

### 6-1.6.4 Boom Angle Indicator

Boom angle indicator should be provided and be readable by the operator or the signal person, unless the derrick has one rating for all boom angles.

### 6-1.6.5 Controls Marking

(15)

Refer to ASME B30.7 for the requirements for the marking of controls.

## Chapter 6-2

# Inspection, Testing, and Maintenance

### (15) SECTION 6-2.1: INSPECTION

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

#### 6-2.1.1 Inspection Classification

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

(b) *Inspection Procedure.* Inspection procedure for derricks in regular service is divided into two general classifications based upon the intervals at which the inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the derrick 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.* Visual examinations with records not required.

(-a) normal service — monthly

(-b) heavy service — weekly to monthly

(-c) severe service — daily to weekly

(-d) special or infrequent service — as recommended by a qualified person before and after each occurrence

(2) *Periodic Inspection.* Visual inspection with records of apparent external conditions to provide the basis for a continuing evaluation.

(-a) normal service — equipment in place: yearly

(-b) heavy service — equipment in place: yearly

(-c) severe service — as in (b): quarterly

(-d) special or infrequent service — as recommended by a qualified person

#### 6-2.1.2 Frequent Inspection

Items such as the following shall be inspected for deficiencies and damage at intervals as defined in para. 6-2.1.1(b)(1), or as specifically indicated, including observation during operation for any deficiencies and damage that might appear between regular inspections.

(a) all control mechanisms — inspect daily for adjustment, wear, and lubrication

(b) all chords and lacing — inspect daily, visually

(c) tension in guys — inspect daily, by observation

(d) plumb of the mast — inspect visually

(e) external indication of deterioration or leakage in air or hydraulic systems — inspect daily, visually

(f) derrick hooks for deformation or cracks — for hooks with cracks or having more than 15% in excess of normal throat opening or more than 10-deg twist from the plane of the unbent hook, refer to para. 6-2.3.3(c)(1)

(g) rope reeving — visual inspection for noncompliance with derrick manufacturer's recommendations

(h) brakes, clutches, and operating levers — check daily for proper functioning before beginning operations

(i) electrical apparatus — for malfunctioning, signs of excessive deterioration, and dirt and moisture accumulation

#### 6-2.1.3 Periodic Inspection

(a) Complete inspections of the derrick shall be performed at intervals, as defined in para. 6-2.1.1(b)(2). These inspections shall include the requirements of para. 6-2.1.2 and, in addition, items such as the following:

(1) structural members for deformation, cracks, and corrosion

(2) bolts and rivets for tightness

(3) parts such as pins, bearings, shafts, gears, sheaves, drums, rollers, and locking and clamping devices for wear, cracks, and distortion

(4) gudgeon pin for cracks, wear, and distortion

(5) power plants for performance and compliance with applicable safety requirements

(b) Foundation or supports shall be inspected for continued ability to sustain the imposed loads.

#### 6-2.1.4 Derricks Not in Regular Use

(a) A derrick that has been idle for 1 month or more, but less than 6 months, shall be given an inspection conforming with the requirements of paras. 6-2.1.2 and 6-2.4.1(a) before being placed in service.

(b) A derrick that has been idle for more than 6 months shall be given a complete inspection conforming with the requirements of paras. 6-2.1.2, 6-2.1.3, and 6-2.4.1(d).

(c) Standby derricks, before being used, shall be inspected in accordance with (a) or (b) above, depending upon the interval since they were last used.



**6-2.1.5 Inspection Records (for Periodic Inspections)**

Dated inspection reports or comparable records shall be made on critical items, such as hoisting machinery, sheaves, hooks, chains, ropes, and other lifting devices. Dated records should be maintained.

**SECTION 6-2.2: TESTING****(15) 6-2.2.1 Operational Tests**

(a) *New or Reinstalled Derricks.* Prior to initial use, all new or reinstalled derricks shall be tested with no hook load, under the direction of a designated person to verify compliance with this Volume, including, but not limited to, the following:

(1) Lift and lower the hook(s) through full range of hook travel.

(2) Raise and lower the boom through full range of boom travel.

(3) Swing each direction full range of swing.

(4) Operate clutches and brakes.

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

(6) Operate locking, limiting, and indicating devices, when provided.

(b) *Anchorage.* All anchorages shall be approved by a qualified person. Rock and hairpin anchorages may require special testing.

(c) *Repaired, Altered, or Modified Derricks.* Prior to use, a repaired, altered, or modified derrick shall be tested. Testing may be limited to the function(s) affected by the repair.

**(15) 6-2.2.2 Load Test**

(a) *New or Reinstalled Derricks*

(1) Prior to initial use, all new or reinstalled derricks shall be inspected and load tested by or under the direction of a designated person. A written test report shall be prepared by the 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 load test shall consist of the following operations as a minimum requirement:

(-a) Hoist the test load a few inches and hold to verify that the load is supported by the derrick and held by the brake(s).

(-b) Swing the derrick, if applicable, the full range of its swing, at the maximum allowable working radius for the test load.

(-c) Boom the derrick up and down within the allowable working radius for the test load.

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

(b) *Repaired, Altered, or Modified Derricks.* The need for load testing a repaired, altered, or modified derrick shall be determined by a qualified person. When a load test is required, testing shall be in accordance with (a)(1) above.

**SECTION 6-2.3: MAINTENANCE****6-2.3.1 Preventive Maintenance****(15)**

(a) A preventive maintenance program shall be established and should be based on the recommendations of the derrick manufacturer or a qualified person. Dated records should be maintained.

(b) Replacement parts shall be at least equal to the original parts.

**6-2.3.2 Maintenance Procedure****(15)**

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

(1) The derrick to be repaired shall be arranged to cause the least interference with other equipment and operations in the area.

(2) All drum dogs shall be engaged.

(3) If an electric winch is used, the main or emergency switch shall be locked in the open position.

(4) Warning or out-of-order signs shall be placed on the derrick and winch.

(5) The repairs of booms of derricks shall be made when the booms are either lowered and supported or tied off.

(6) A communication system shall be set up between the derrick operator and the user before any work on the equipment is started.

(7) Welding repairs shall be approved by the manufacturer or a qualified person.

(b) After adjustments and repairs have been made, the derrick shall not be returned to service until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.

**6-2.3.3 Adjustments and Repairs**

(a) Any hazardous conditions disclosed by the inspection and requirements of Section 6-2.1 shall be corrected before operation of the derrick is resumed. Adjustments and repairs shall be done only by designated personnel.

(b) Adjustments shall be maintained to assure correct functioning of components such as the following:

(1) all functioning operating mechanisms

(2) tie-downs or anchorages

(3) signal system

(4) brakes and clutches

(5) power plants

(6) guys

(7) limit devices, if provided

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

(1) Hooks showing defects described in para. 6-2.1.2(f) shall be discarded. Repairs by welding or reshaping are not recommended.

(2) All critical parts that are cracked, broken, bent, or excessively worn should be replaced.

(3) Pitted or burned electrical contacts should be corrected only by replacement and in sets. Controller parts should be lubricated only as recommended by the manufacturer.

(d) All replacement and repaired parts shall have at least the original design factor.

#### (15) 6-2.3.4 Lubrication

(a) All moving parts of the derrick and winch for which lubrication is specified, including rope and chain, should be regularly lubricated. Lubricating systems should be checked for proper 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.

(b) Machinery shall be stationary while lubricants are being applied and protection provided as called for in paras. 6-2.3.2(a)(1) through (a)(3), unless equipped for automatic or remote lubrication.

### SECTION 6-2.4: ROPE INSPECTION, REPLACEMENT, AND MAINTENANCE

#### (15) 6-2.4.1 Inspection

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

##### (a) Frequent Inspection

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

(-a) distortion of the rope such as kinking, crushing, unstranding, birdcaging, main strand displacement, or core protrusion.

(-b) general corrosion.

(-c) broken or cut strands.

(-d) number, distribution, and type of visible broken wires [see (c) below for further guidance]. When such damage is discovered, the rope shall be either removed from service or given an inspection as detailed in (b) below.

(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 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 made at least annually.

(2) This inspection shall cover the entire length of rope. The individual wires in the strands of the rope shall be visible to this person during the inspection. Any deterioration resulting in appreciable loss of original strength, such as described below, shall be noted, and a determination shall be made as to whether further use of the rope would constitute a hazard:

(-a) points listed in (a) above

(-b) reduction of rope diameter due to loss of core support or internal or external corrosion

(-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 of 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) Rope Replacement

(1) 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.

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

(-a) in running ropes other than rotation-resistant ropes, six randomly distributed broken wires in one lay or three broken wires in one strand in one lay — consult rope manufacturer for broken wire criteria for rotation-resistant rope

(-b) 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

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

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

(-e) evidence of heat damage from any cause

(-f) reductions from nominal diameter of more than 5%

(-g) 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

(3) 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 derrick manufacturer, or a qualified person, for broken wire removal criteria for wire ropes operating on sheaves and drums made of material other than steel.

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

(d) *Ropes Not in Regular Use.* All ropes that have been idle for a period of 1 month or more due to shutdown or storage of the derrick on which it is installed shall be inspected in accordance with (b) above before being placed in service.

(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 shall be kept on file. This report shall cover points of deterioration listed in (b)(2) above.

(f) A long-range inspection program should be established and include records on examination of ropes

removed from service so that a relationship can be established between visual observation and actual condition of the internal structure.

#### 6-2.4.2 Rope Maintenance

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

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

(c) Before cutting a rope, seizings shall be placed on each side of the location 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 nonpreformed ropes of  $\frac{7}{8}$  in. (22 mm) diameter or smaller, two seizings on each side of the cut are required; for nonpreformed rope of 1 in. (25 mm) diameter and larger, three seizings on each side of the cut are required.

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

(e) Rope should be maintained in a well-lubricated condition. 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 that 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. Periodic field lubrication is particularly important for rotation-resistant rope.

(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 one end, thus shifting the wear to different areas of the rope.

## Chapter 6-3

### Operation

#### (15) SECTION 6-3.1: QUALIFICATIONS, RESPONSIBILITIES, AND OPERATING PRACTICES

##### 6-3.1.1 Operators

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

- (1) designated persons.
- (2) 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 the trainee shall be determined by a qualified person.

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

(4) inspectors (derrick).

(b) No one, other than personnel specified in (a) above, shall enter the cab or operate the derrick with the exception of persons such as oilers, supervisors, and those specific persons authorized by supervisors and then only in the performance of their duties and with the knowledge of the operator.

##### 6-3.1.2 Qualifications for Operators

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

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

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

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

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

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

(5) a negative result on a substance abuse test. The level of testing will be determined by the current standard of practice for the industry in which the derrick is employed, and the test results shall be confirmed by a recognized laboratory service.

(c) Evidence of physical limitations or emotional instability that could be a hazard to the operator or others, or that in the opinion of the examiner could interfere with the operator's safe performance, may be 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 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) Operator requirements shall include, but not be limited to, the following:

(1) evidence of successfully passing a physical examination as defined in (b) above

(2) satisfactory completion of a written examination covering operational characteristics, controls, emergency control skills such as response to fire, control malfunction, as well as characteristics and performance questions appropriate to the derrick type for which qualification is being sought

(3) demonstrated ability to read, write, comprehend, and use arithmetic and a load/capacity chart in the English language

(4) satisfactory completion of a combination written and verbal test on load/capacity chart usage that covers a selection of the configurations the derrick may be equipped to handle, for the derrick type for which qualification is being sought

(5) satisfactory completion of testing by appropriate written, oral, or practical methods demonstrating proficiency in operating the specific derrick type, including prestart and poststart inspections, shutdown, and securing procedures

(6) demonstrated understanding of the applicable sections of the B30 Standard and federal, state, and local requirements

(g) Operators who have successfully qualified to operate a specific derrick type shall be required to be

requalified if supervision deems it necessary. Requalification shall include, but not be limited to, requirements listed in (f)(1) through (f)(6) above.

## (15) 6-3.2: RESPONSIBILITIES

The organizational structure of various projects may differ. The listed roles are described for the purpose of defining responsibilities. All listed responsibilities shall be assigned in the work site organization. A single person may perform one or more of these roles.

(a) *derrick operator*: directly controls the derrick functions.

(b) *derrick owner*: has custodial control of the derrick by virtue of lease or ownership.

(c) *derrick user*: arranges for the derrick's presence on the work site and controls its use while there.

(d) *lift director*: directly oversees the work performed by the derrick and the assigned rigging crew.

(e) *site supervisor* exercises supervisory control over the work site on which the derrick is being used and over the work being performed on that site.

### 6-3.2.1 Responsibilities of the Derrick Owner and Derrick User

In some situations, the derrick owner and user may be the same entity and is therefore accountable for all of the following responsibilities. In other cases, the user may lease or rent a derrick from the owner without supervisory, operational, maintenance, support personnel, or services from the owner. In these situations, paras. 6-3.2.1.1 and 6-3.2.1.2 shall apply.

**6-3.2.1.1** The derrick owner's responsibilities shall include the following:

(a) providing a derrick that meets the requirements of Chapters 6-1 and 6-2, as well as specific job requirements defined by the user

(b) providing a derrick and all necessary components as specified by the manufacturer, necessary to meet the user's requested configuration and capacity

(c) providing all applicable load/capacity chart(s) and diagrams

(d) providing additional technical information pertaining to the derrick, necessary for the derrick operation, when requested by the derrick user

(e) providing field assembly, disassembly, operation, and maintenance information, plus warning decals and placards installed as prescribed by the derrick manufacturer

(f) establishing an inspection, testing, and maintenance program in accordance with Chapter 6-2 and informing the derrick user of the requirements of the program

(g) designating personnel for the purpose of inspection, maintenance, repair, transport, assembly, and disassembly

(h) ensuring that the designated personnel are competent to perform their assigned duties as required by Section 6-0.4

**6-3.2.1.2** The derrick user's responsibilities shall include the following:

(a) complying with the requirements of this Volume, the derrick manufacturer's requirements, and those regulations applicable at the work site

(b) designating personnel to supervise derrick activities

(c) ensuring that the derrick is in proper operating condition prior to initial use at the work site by

(1) verifying that the derrick owner has provided documentation that the derrick meets the inspection requirements of paras. 6-2.1.3, 6-2.2.1, and 6-2.4.1

(2) verifying that a frequent inspection has been performed as defined in para. 6-2.1.2

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

(e) using derrick operators that meet the requirements of para. 6-3.1.2 and are qualified to perform the tasks that will be required with the derrick they are assigned to operate

(f) ensuring the designated operator(s) has been notified of adjustments or repairs that have not yet been completed, prior to commencing derrick operations

(g) designating personnel for inspections as required in Sections 6-2.1 and 6-2.4

(h) designating personnel for the purpose of maintenance, repair, transport, assembly, and disassembly, as applicable

(i) ensuring that all personnel involved in maintenance, repair, transport, assembly, disassembly, and inspection, as applicable, are aware of their responsibilities, assigned duties, and the associated hazards

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

### 6-3.2.2 Responsibilities of the Site Supervisor and Lift Director

In some situations, the Site Supervisor and Lift Director may be the same person.

**6-3.2.2.1** The Site Supervisor's responsibilities shall include the following:

(a) ensuring that the derrick meets the requirements of Chapter 6-2 prior to initial site usage.

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

(c) ensuring that a qualified person is designated as the Lift Director.

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

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

(1) sufficient room to assemble and disassemble the derrick, as applicable

(2) an operating area that is suitable for the derrick with respect to water conditions, support capability, proximity to power lines, and obstructions to derrick operation

(3) traffic control as necessary to restrict unauthorized access to the derrick working area

(f) ensuring that work involving the assembly and disassembly, as applicable, of the derrick is supervised by a qualified person.

(g) ensuring that derrick operators meet the requirements of para. 6-3.1.2.

(h) ensuring that conditions that may adversely affect derrick operations are addressed. Such conditions include, but are not limited to, the following:

(1) wind velocity or gusting winds

(2) heavy rain

(3) fog

(4) extreme cold

(5) artificial lighting

(i) allowing derrick operation near electric power lines only when the requirements of para. 6-3.5.3 are met.

(j) permitting special lifting operations only when equipment and procedures required by this Volume, the derrick manufacturer, or a qualified person are employed. Such operations include, but are not limited to, the following:

(1) multiple derrick lifts

(2) personnel lifting

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

(l) ensuring that derrick maintenance is performed by a designated person.

**6-3.2.2.2** The Lift Director's responsibilities shall include the following:

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

(b) stopping derrick operations if alerted to an unsafe condition affecting these operations.

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

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

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

(f) addressing safety concerns raised by the operator or other personnel and being responsible if it is decided to overrule those concerns and derrick operations are directed to continue. (In all cases, the manufacturer's

criteria for safe operation and the requirements of this Volume shall be adhered to.)

(g) designating a signal person(s) and conveying that information to the derrick operator.

(h) allowing derrick operation near electric power lines only when the requirements of para. 6-3.5.3 and any additional requirements determined by the site supervisor have been met.

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

(1) multiple derrick lifts

(2) personnel lifting

(3) operating on barges

(j) ensuring that the applicable requirements of para. 6-3.3.4 are met when lifting personnel.

(k) informing the derrick operator of the weight of loads to be lifted, as well as the lifting, moving, and placing locations for the loads.

(l) obtaining the derrick operator's verification that the load weight does not exceed the derrick's rated capacity.

(m) ensuring that a derrick's load rigging is performed by designated personnel.

(n) ensuring that the load is properly rigged and balanced.

### 6-3.2.3 Responsibilities of Derrick Operators

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

The operator shall be responsible for the following listed items:

(a) reviewing the requirements for the derrick with the Lift Director before commencing operations.

(b) knowing what types of site conditions could adversely affect the operation of the derrick and consulting with the Lift Director concerning the possible presence of these conditions.

(c) understanding and applying the information contained in the derrick manufacturer's operating manual.

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

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

(f) refusing to operate the derrick when any portion of the load or derrick would enter the danger zone of energized power lines shown in Fig. 6-3.5.3-1.

(g) performing a frequent inspection of the derrick as specified in para. 6-2.1.2.

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

(i) following applicable lock-out/tag-out procedures.

(j) not operating the derrick when physically or mentally unfit.

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

(l) not engaging in any practice that will divert his/her attention while operating the derrick controls.

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

(n) operating the derrick functions, under normal operating conditions, in a smooth and controlled manner.

(o) knowing and following the procedures specified by the manufacturer or approved by a qualified person, for assembly, disassembly, setting up, and reeving the derrick, as applicable.

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

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

(r) considering all factors known that might affect the derrick capacity and informing the Lift Director of the need to make appropriate adjustments.

(s) knowing the standard and special signals as specified in Fig. 6-3.4.2-1 and responding to such signals from the designated signal person. (When a signal person is not required as part of the lift operation, the operator is then responsible for the movement of the derrick. However, the operator shall obey a stop signal at all times, no matter who gives it.)

(t) understanding basic load-rigging procedures.

(u) if power fails during operations

(1) setting all brakes and locking devices

(2) moving all clutch and/or other power controls to the off or neutral position

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

(v) before leaving the derrick unattended

(1) landing any suspended load.

(2) disengaging the master clutch.

(3) setting winch brakes, swing brakes, boom brakes, and other locking devices.

(4) placing all controls in the off or neutral position.

(5) stopping the engine. An exception to this may exist when derrick operation is frequently interrupted during a shift and the operator must leave the derrick controls. Under these circumstances, the engine may remain running, and (v)(1) through (v)(4) above shall

apply. The operator shall be situated where any entry to the derrick controls position can be observed.

(6) considering the recommendations of the manufacturer for securing the derrick, when a local weather storm warning exists.

## SECTION 6-3.3: HANDLING THE LOAD (15)

### 6-3.3.1 Size of Load

(a) No derrick shall be loaded beyond the rated load for the particular derrick configuration, except for test purposes as provided in para. 6-2.2.2.

(b) When loads approach the maximum rating of the derrick, the Lift Director shall ascertain that the weight of the load has been determined within  $\pm 10\%$  before it is lifted.

(c) When rotation-resistant ropes are used with an operating design factor less than 5, but in no case less than 3.5, the special provisions that follow shall apply:

(1) For each such lifting assignment

(-a) a qualified person shall ascertain that the rope is in satisfactory condition [see paras. 6-2.4.1(a)(1)(-a) through (a)(1)(-d)] both before and after each lift, but if more than one broken wire in any one lay is found, the lift shall not be made

(-b) operations shall be conducted in such a manner and at such speeds as to reduce dynamic effects

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

### 6-3.3.2 Attaching the Load

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

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

### 6-3.3.3 Moving the Load

(a) The person directing the lift shall see that the load is well secured and properly balanced in the sling or lifting device when it is initially lifted.

(b) Before starting the lift, note the following conditions:

(1) Hoist rope shall not be kinked.

(2) Multiple part lines shall not be twisted around each other.

(3) The hook shall be brought over the load in such a manner as to prevent swinging.

(4) If there is a slack rope condition, it should be determined that the rope is properly seated on the drum and in the sheaves.

(c) 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

(d) A derrick shall not be used for side loading except when specifically authorized by a qualified person who has determined that the various structural components will not be overstressed.

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

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

(g) Neither the load nor boom shall be lowered below the point where less than two full wraps of rope remain on their respective drums.

(h) When rotating a derrick, 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. A tag or restraint line should also be used.

(i) Boom and hoisting rope systems shall not be twisted.

(j) The operator shall not hoist, lower, or swing while anyone is on the load or hook.

#### 6-3.3.4 Personnel Lifting

This Volume recognizes that derricks are designed and intended for handling materials and not personnel. Personnel are only permitted to be lifted in a personnel platform under the following conditions:

(a) The Site Supervisor shall determine that there is no practical alternative way to perform the needed work or to gain access to the area and shall authorize its usage in writing.

(b) Communication between the derrick operator, signal person, and person(s) being lifted shall be maintained.

(c) In all aspects, personnel lifting operations shall be done in accordance with the applicable provisions of ASME B30.23, except as listed below.

(1) Derricks are not required to have a boom angle indicator. If a boom angle indicator is not installed, alternate means to verify lift radius shall be provided.

(d) The derrick shall not be used for other purposes while handling personnel.

#### 6-3.3.5 Holding the Load

(a) The operator shall not leave the controls while the load is suspended unless the precautions in the exceptions as listed in (b) through (d) below have been taken.

(b) People should not be permitted to stand or pass under a load on the hook.

(c) If the load must remain suspended for any considerable length of time, a dog, a pawl and ratchet, or other equivalent means, rather than the brake alone, shall be used to hold the load.

(d) As an exception to (a) above, under such circumstances where a load is to be held suspended for a period of time exceeding normal lifting operations, the operator

may leave his position at the controls, provided, prior to that time, the Lift Director and operator have established the requirements for dogging the winch and providing notices, barricades, or whatever other precautions may be necessary.

#### 6-3.3.6 Use of Winch Heads

(a) Ropes shall not be handled on a winch head without the knowledge of the operator.

(b) While a winch head is being used, the operator shall be within reach of the power unit control lever.

#### 6-3.3.7 Securing Boom

Dogs, pawls, or other positive holding mechanisms on the winch shall be engaged. When not in use, the derrick boom shall be either

(a) laid down

(b) secured to a stationary member, as nearly under the head as possible, by attachment of a sling to the load block

(c) lifted to a vertical position and secured to the mast for guy derricks

(d) secured against stiffleg for stiffleg derrick

### SECTION 6-3.4: SIGNALS

#### 6-3.4.1 Standard Signals

Standard signals to the operator shall be in accordance with the standard prescribed in paras. 6-3.4.2 and 6-3.4.3, unless voice communication equipment (telephone, radio, or equivalent) is utilized. Signals shall be discernible or audible at all times. No response shall be made unless signals are clearly understood.

#### 6-3.4.2 Hand Signals

Hand signals shall be in accordance with Fig. 6-3.4.2-1 and shall be posted conspicuously.

#### 6-3.4.3 Bell or Light Signals

Bells of different tones shall be used for boom, load, runner (whip), and swinger. Where electrically activated, both bell and light signal systems shall have safety lights of a different color lit to indicate that the signal system is effective. The signals shall be as follows:

(a) *When operating*, one bell or light means *stop*.

(b) *When stopped*, one bell or light means *lift*; two bells or lights means *lower*.

(c) *When temporarily stopped*, three or four bells or lights alternately on the boom and load mean *dog it off* or *stopping for some time*.

(d) *When dogged off*, before starting, ring three or four bells or light three or four lights alternately on the boom and load, meaning *get ready to start work again*.

#### 6-3.4.4 Special Signals

Some special operations may require additions to, or modifications of, the basic signals standardized herein.

(15)



**Fig. 6-3.4.2-1 Standard Hand Signals for Controlling Derricks**

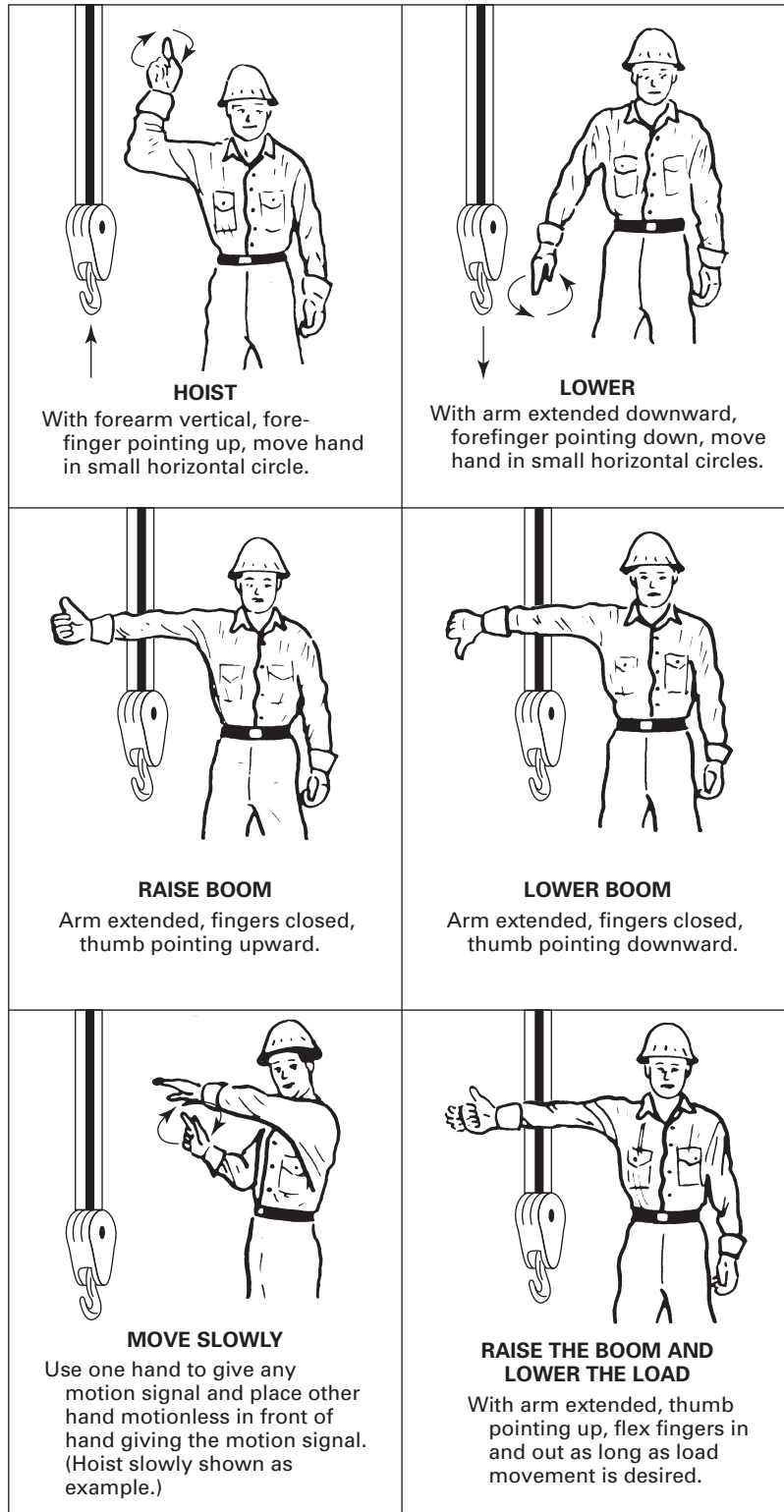

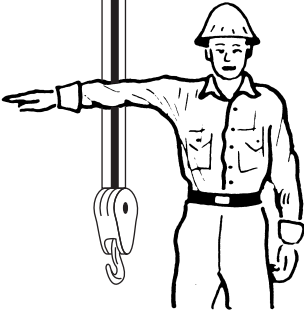
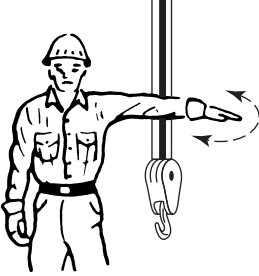
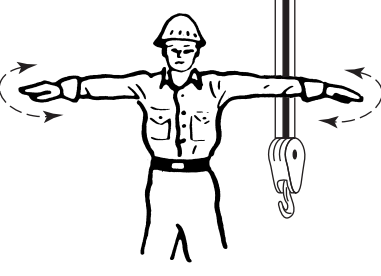
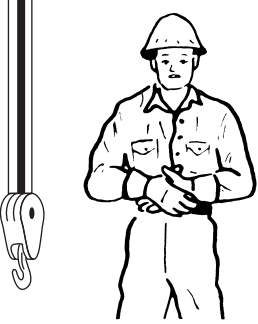


Fig. 6-3.4.2-1 Standard Hand Signals for Controlling Derricks (Cont'd)

 <p><b>LOWER THE BOOM AND RAISE THE LOAD</b> With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.</p>	 <p><b>SWING</b> Arm extended, point with finger in direction of swing of boom.</p>
 <p><b>STOP</b> Arm extended, palm down, move arm back and forth.</p>	 <p><b>EMERGENCY STOP</b> Both arms extended, palms down, move arms back and forth.</p>
 <p><b>DOG EVERYTHING</b> Clasp hands in front of body.</p>	

In all such cases, these special signals should be agreed upon; thoroughly understood by the Lift Director, signal person, and the operator; and should not be in conflict with the standard signals.

#### 6-3.4.5 Instructions

If it is desired to give instructions to the operator other than those provided for in the standard signal system, the derrick motions shall be stopped.

### SECTION 6-3.5: MISCELLANEOUS

#### 6-3.5.1 Fire Extinguishers

(a) A portable fire extinguisher, with a basic minimum extinguisher rating of 10 BC, shall be installed in the cab or at the machinery housing.

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

#### 6-3.5.2 Refueling

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

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

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

#### 6-3.5.3 Operating Near Electric Power Lines

(a) Derricks shall be operated so that no part of the derrick or load enters into the danger zone shown in Fig. 6-3.5.3-1.

##### EXCEPTIONS:

- (1) The danger zone may be entered if the electrical distribution and transmission lines have been de-energized and visibly grounded at the point of work.
- (2) The danger zone may be entered if insulating barriers (not a part of or an attachment to the derrick) have been erected to prevent physical contact with the lines.

(1) For lines rated 50 kV or below, minimum clearance between the lines and any part of the derrick or load shall be 10 ft (3.0 m).

(2) For lines rated over 50 kV, minimum clearance between the lines and any part of the derrick or load shall be 10 ft (3.0 m) plus 0.4 in. (10.2 mm) for each 1 kV over 50 kV, or use twice the length of the line insulator, but never less than 10 ft (3.0 m) (see Table 6-3.5.3-1).

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

(4) In transit with no load and boom lowered, the clearance shall be a minimum of 4 ft (1.2 m) (see Table 6-3.5.3-1).

(5) A qualified signal person shall be assigned to observe the clearance and give warning before approaching the above limits.

(b) If cage-type boom guards, insulating links, or proximity warning devices are used on derricks, such devices shall not be considered a substitute for the requirements of (a) above, even if such devices are required by law or regulation. Limitations of such devices shall be understood by the operating personnel and tested in the manner prescribed by the manufacturer of the device.

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

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

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

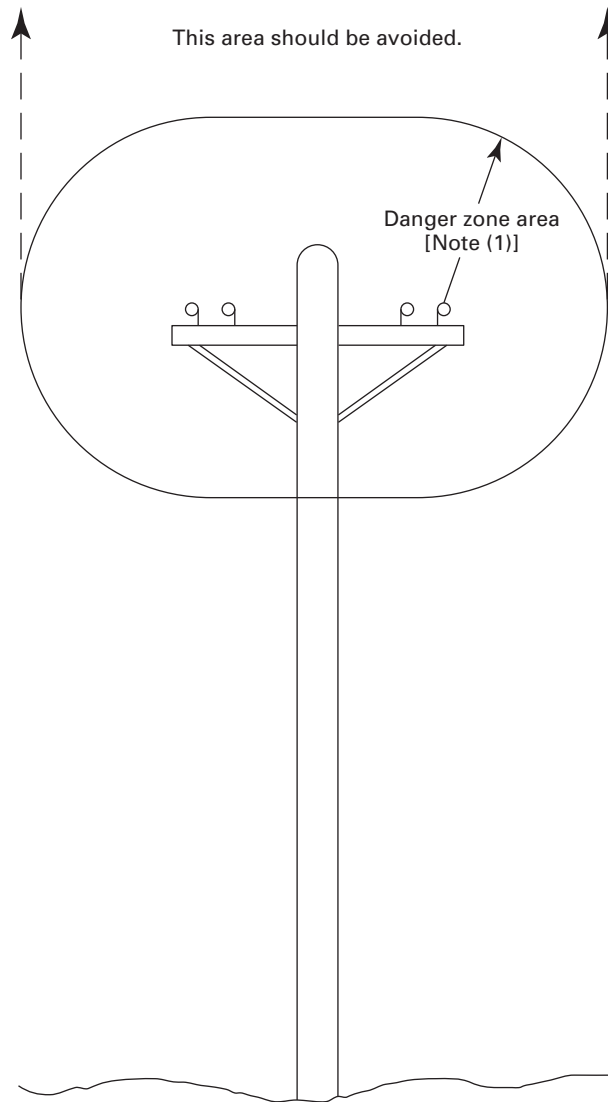
(f) Durable signs shall be installed at the operator's station and on the outside of the derrick, warning that electrocution or serious bodily injury may occur unless a minimum clearance of 10 ft (3.0 m) is maintained between the derrick or the load being handled and energized power lines. Greater clearances are required because of higher voltage as stated in (a)(2) above. These signs shall be revised but not removed when local jurisdiction requires greater clearances.

#### 6-3.5.4 Cab or Operating Enclosure

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

(b) Tools, oil cans, waste, extra fuses, and other necessary articles shall be stored in the toolbox and shall not be permitted to lie loose in or about the cab operating enclosure.

**Fig. 6-3.5.3-1 Danger Zone for Derricks and Lifted Loads Operating Near Electrical Transmission Lines**



**NOTE:**

(1) For minimum radial distance of danger zone, see para. 6-3.5.3.

**Table 6-3.5.3-1 Required Clearance for Normal Voltage in Operation Near High-Voltage Power Lines**

Normal Voltage, kV (Phase to Phase)	Minimum Required Clearance	
	ft	m
<b>When Operating Near High Voltage Power Lines</b>		
Up to 50	10	3.05
Over 50 to 200	15	4.57
Over 200 to 350	20	6.10
Over 350 to 500	25	7.62
Over 500 to 750	35	10.67
Over 750 to 1 000	45	13.72
<b>While in Transit With No Lead and Boom or Mast Lowered</b>		
Up to 0.75	4	1.22
Over 0.75 to 50	6	1.83
Over 50 to 345	10	3.05
Over 345 to 750	16	4.88
Over 750 to 1 000	20	6.10

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