ASME B30.19-2016
(Revision of ASME B30.19-2011)

Cableways

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

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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

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The next edition of this Standard is scheduled for publication in 2021. This Standard will become effective 1 year after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the Committee Web page and under go.asme.org/InterpsDatabase.

Errata to codes and standards may be posted on the ASME Web site under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The Committee Pages can be found at http://cstools.asme.org/. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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FOREWORD

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

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

In March 1926, invitations were issued to 50 organizations to appoint representatives to a Sectional Committee. The call for organization of this Sectional Committee was sent out October 2, 1926, and the committee organized November 4, 1926, with 57 members representing 29 national organizations. Commencing June 1, 1927, and using the eight-page code published by ASME in 1916 as a basis, the Sectional Committee developed the Safety Code for Cranes, Derricks, and Hoists. The early drafts of this safety code included requirements for jacks, but, due to inputs and comments on those drafts, the Sectional Committee decided in 1938 to make the requirements for jacks a separate code. In January 1943, ASA B30.2-1943 was published addressing a multitude of equipment types, and in August 1943, ASA B30.1-1943 was published addressing just 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, USASI 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.

The first edition of B30.19 was issued in 1986; new editions were published in 1993, 2000, 2005, and 2011. This 2016 Edition includes revisions to add personnel competence requirements, revised references, updated inspection, and testing requirements.

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 April 18, 2016.

ASME B30 COMMITTEE
Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

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

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

(16)

B30 STANDARD INTRODUCTION

SECTION I: SCOPE

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

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

B30.1 Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries
B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
B30.3 Tower Cranes
B30.4 Portal and Pedestal Cranes
B30.5 Mobile and Locomotive Cranes
B30.6 Derricks
B30.7 Winches
B30.8 Floating Cranes and Floating Derricks
B30.9 Slings
B30.10 Hooks
B30.11 Monorails and Underhung Cranes
B30.12 Handling Loads Suspended From Rotorcraft
B30.13 Storage/Retrieval (S/R) Machines and Associated Equipment
B30.14 Side Boom Tractors
B30.15 Mobile Hydraulic Cranes (withdrawn 1982 — requirements found in latest revision of B30.5)
B30.16 Overhead Hoists (Underhung)
B30.17 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
B30.18 Stacker Cranes (Top or Under Running Bridge, Multiple Girder With Top or Under Running Trolley Hoist)
B30.19 Cableways
B30.20 Below-the-Hook Lifting Devices
B30.21 Manually Lever-Operated Hoists
B30.22 Articulating Boom Cranes
B30.23 Personnel Lifting Systems
B30.24 Container Cranes
B30.25 Scrap and Material Handlers
B30.26 Rigging Hardware
B30.27 Material Placement Systems
B30.28 Balance Lifting Units
B30.29 Self-Erecting Tower Cranes
B30.30 Ropes[1]

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.

[1] 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. An Interpretation Submittal Form is available on ASME's website at http://cstools.asme.org/Interpretation/InterpretationForm.cfm.

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

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

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

SECTION X: ADDITIONAL GUIDANCE

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

The B30 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 B30.19-2016
SUMMARY OF CHANGES

Following approval by the ASME B30 Committee and ASME, and after public review, ASME B30.19-2016 was approved by the American National Standards Institute on April 18, 2016.

ASME B30.19-2016 includes editorial changes, revisions, and corrections, as well as the following changes identified by a margin note, **(16)**.

Page	*Location*	*Change*
viii–x	B30 Standard Introduction	Updated
1–3	Chapter 19-0	Title revised
	19-0.2.2	(1) Definitions of *appointed*, *authorized*, and *designated* deleted (2) Definition of *lazy guy* revised
	Section 19-0.3	Added
	Section 19-0.4	Updated
13	19-1.3.11	Subparagraph (a)(1) revised
16	Section 19-2.1	Revised in its entirety
17	Section 19-2.2	Revised in its entirety
	19-2.3.1	Subparagraph (a) revised
	19-2.3.2	Subparagraph (g) revised
18, 19	Section 19-2.4	First paragraph added
	19-2.4.2	Subparagraphs (a)(1), (b)(2), and (b)(2)(-b) revised
	19-2.4.3	Former subpara. (b)(4) deleted, and remaining subparagraphs redesignated
20	19-3.1.1	Revised in its entirety

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CABLEWAYS

Chapter 19-0
Scope, Definitions, Personnel Competence, and References

(16)

SECTION 19-0.1: SCOPE OF B30.19

Within the general scope defined in Section I of the Introduction, the scope of B30.19 applies to all load transporting, hoisting, and lowering cable-supported systems operating on and supported from track cable(s). This Standard does not apply to skyline systems, as used in the logging industry, or slackline systems used for excavating.

SECTION 19-0.2: DEFINITIONS

19-0.2.1 Types of Cableways

fixed cableway: a cableway consisting of fixed (nonluffing) towers (masts) that support the track cable(s). The lower and upper load blocks are supported by a carriage powered by inhaul and outhaul ropes to travel on the track cable(s). The function is to lift, lower, and transport loads a distance between the towers (see Fig. 19-0.2.1-1).

luffing cableway: a cableway similar to a fixed cableway except the towers (masts) are not fixed. By the use of powered luffing guys, the towers (masts) can be leaned in either direction transverse to the track cable(s) span, providing a lateral movement of the load block (see Fig. 19-0.2.1-2).

parallel cableway: a cableway similar to a fixed cableway except the towers are supported by wheels that are powered for lateral movement on parallel tracks (see Fig. 19-0.2.1-3).

radial cableway: a cableway that has a fixed (nonluffing) tower and a tower supported by wheels powered for travel on a track that follows an arc at a radius about the fixed tower (see Fig. 19-0.2.1-4).

(16) 19-0.2.2 General

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

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

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

button line: a rope suspended between the top of the cableway towers to position the slack carriers at predetermined locations as the trolley moves longitudinally along the track cable. The button line is normally above and clear of the track cables. The buttons attached to the button line are of varying sizes to permit some of the slack carriers to pass by while stopping the carrier designated for that location.

cab: a housing provided for the operator in which the cableway controls are contained.

cableway: a device used for hoisting, lowering, and transporting loads within a prescribed path, longitudinally and laterally. The load block (upper) travels on a rope catenary system having span ends that are supported on fixed or movable towers (masts) or other elevated supports.

carriage (trolley): a framework that travels by its sheaves (wheels) on the track cable(s). It is pulled along the track cable by the inhaul-outhaul rope and includes the upper load block (see Fig. 19-0.2.1-1).

designer (original): the qualified person or persons designated to design the components of a cableway for a given set of circumstances relating to, but not limited to, capacity, span, height, and terrain (also, see *manufacturer*).

designer (other than original): the qualified person or persons designated to modify the design or arrangement of an existing cableway to a new set of circumstances.

design factor, rope: the ratio of minimum breaking force to working load.

drift: the act of pulling or pushing the lower load block or load horizontally by means of an external force.

drum: the cylindrical member around which a rope is wound and through which power is transmitted to the ropes.

gypsy spool (winch head): a rotating cylindrical drum with curved end flanges used for load handling by means

of fiber rope coiled about its barrel with hand tension applied to the nonloaded end.

head tower (mast): a vertical support structure, guyed or counterweighted for stability, whose purpose is to support the track cable and operating ropes. The head tower is the tower located closest to the load hoist and inhaul-outhaul hoist.

inhaul-outhaul (rope): the rope system that pulls the trolley and load toward the head tower (inhaul), or pulls the trolley and load away from the head tower (outhaul).

inhaul-outhaul hoist (trolley hoist): a hoist having two drums, one of which winds on rope while the other drum simultaneously unwinds rope; or a single drum hoist from which the rope winds on one end while the rope unwinds from the other drum end (see Figs. 19-0.2.2-1, 19-0.2.2-2, and 19-0.2.2-3). The hoist is powered by a prime mover.

lazy guy: fixed length member(s) of rope that prevents luffing the tower(s) (mast) beyond the distance established by the luffing hoist.

load, maximum design: the forces in a particular component of the cableway resulting from the loading condition that causes the highest stress in that component.

load, working: the external load applied to the cableway lower load block, including the weight of load-attaching equipment such as shackles, slings, etc.

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

load block, upper: the assembly of sheaves, pins, and frame from which the hoisting rope suspends the lower load block. The block may be an integral part of the trolley or suspended from the trolley.

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

load ratings: working load rating in pounds (kilograms) or tons established by the designer.

luffing: the tilting of the cableway towers to achieve movement of the load block transverse to the center line of the cableway.

luffing hoist: the hoist drum and rope reeving system used for luffing a cableway tower (mast) (see Fig. 19-0.2.2-4).

manufacturer: a firm that produces fabricated or assembled segments of the cableway. The segments include, but are not limited to, towers, ropes, track cable, trolley, hoists, and load blocks.

messenger line: an auxiliary rope suspended between the towers of the cableway to intermittently support electric power cables or other cables. The messenger line is normally at the very top of the towers, above and clear of the button line.

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

operating ropes: wire ropes attached to a hoist for the purpose of pulling or lifting.

overhaul: the action of pulling on a rope or set of falls to remove slack and unwind the rope from the hoist drum.

pitch diameter: the diameter of a sheave or rope drum measured at the center line of the rope.

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

rope: refers to wire rope unless otherwise specified.

rotation-resistant rope: a wire rope consisting of a 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 and reducing the tendency of the finished rope to rotate.

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

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

slack carrier: a device that travels on the track cable to support the operating ropes when they are slack.

tail tower (mast): a vertical support structure, guyed or counterweighted for stability, the purpose of which is to support the track cable and operating ropes. The tail tower is the tower located furthest from the load hoist and inhaul-outhaul hoist.

thrust track: as support for a traveling tower, a rail(s) designed and constructed to withstand the horizontal and vertical resultant cableway forces perpendicular to the direction of tower travel.

ton, long: 2,240 lb.

ton, short: 2,000 lb.

track cable: the rope(s), spanning between the towers, that supports the trolley, load blocks, slack carriers, and load.

trolley: see *carriage*.

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

SECTION 19-0.3: PERSONNEL COMPETENCE (16)

Persons performing the functions identified in this Volume shall meet the applicable qualifying criteria

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

(16) SECTION 19-0.4: REFERENCES

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

ANSI A10.28-2011, Safety Requirements for Work Platforms Suspended From Cranes or Derricks

ANSI A14.3-2008, Safety Requirements for Fixed Ladders

ANSI Z26.1-1990, Safety Code for Safety Glazing Material for Glazing Motor Vehicles Operating on Land Highways

ANSI Z244.1-2003 (R2014), Lockout/Tagout

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

ANSI/AWS D1.1/D1.1M:2015, Structural Welding Code — Steel

ANSI/AWS D14.3-10, Specification for Welding Earthmoving, Construction, and Agricultural Equipment

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

ANSI/NEMA ICS 3-2005 (R2010), Industrial Systems

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

ASME B30.7-2011, Winches

ASME B30.10-2014, Hooks

ASME B30.23-2011, Personnel Lifting Systems

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

Wire Rope Users Manual, 2008, 4th Edition

Publisher: Wire Rope Technical Board (WRTB), 801 North Fairfax Street, Alexandria, VA 22314-1757 (www.domesticwirerope.org/wrtb/index.html)

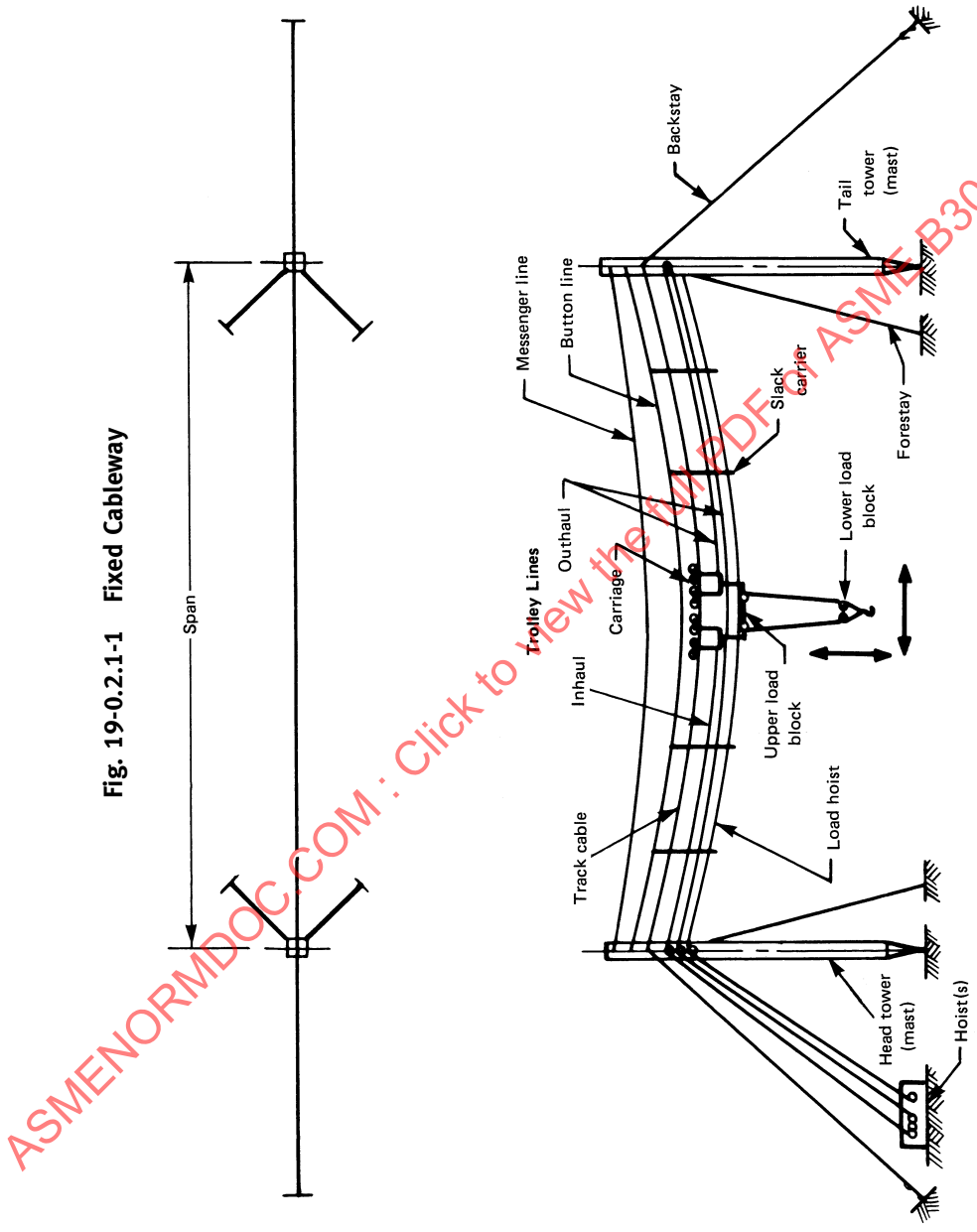


Fig. 19-0.2.1-1 Fixed Cableway

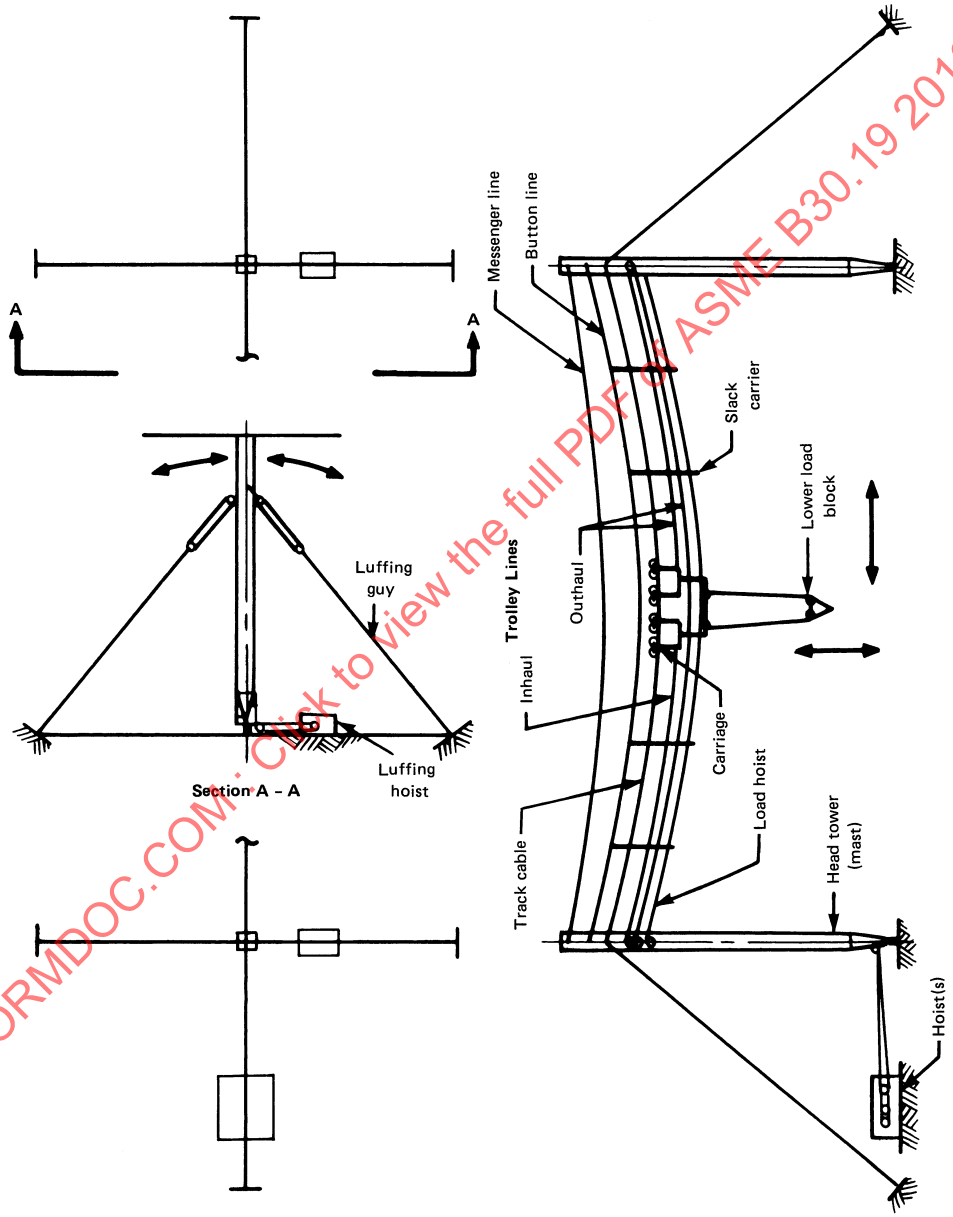


Fig. 19-0.2.1-2 Luffing Cableway

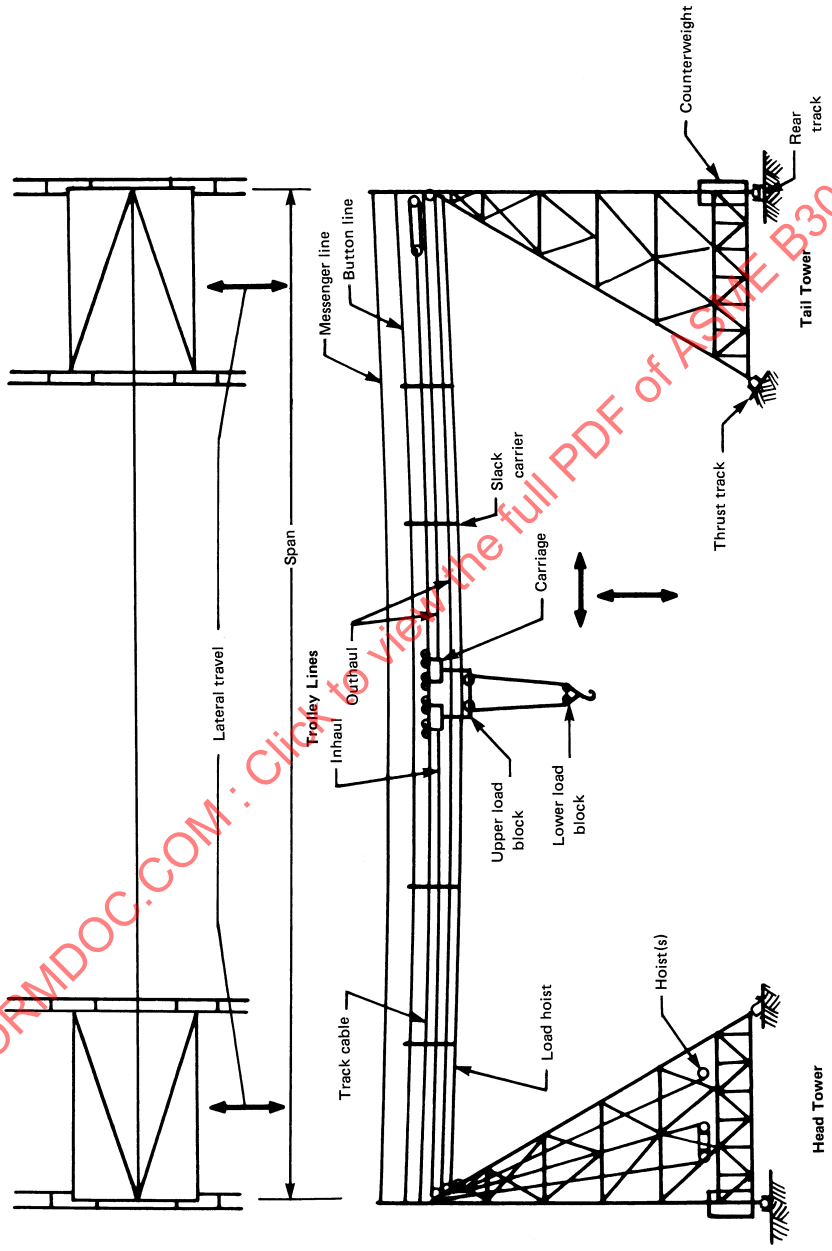


Fig. 19-0.2.1-3 Parallel Cableway

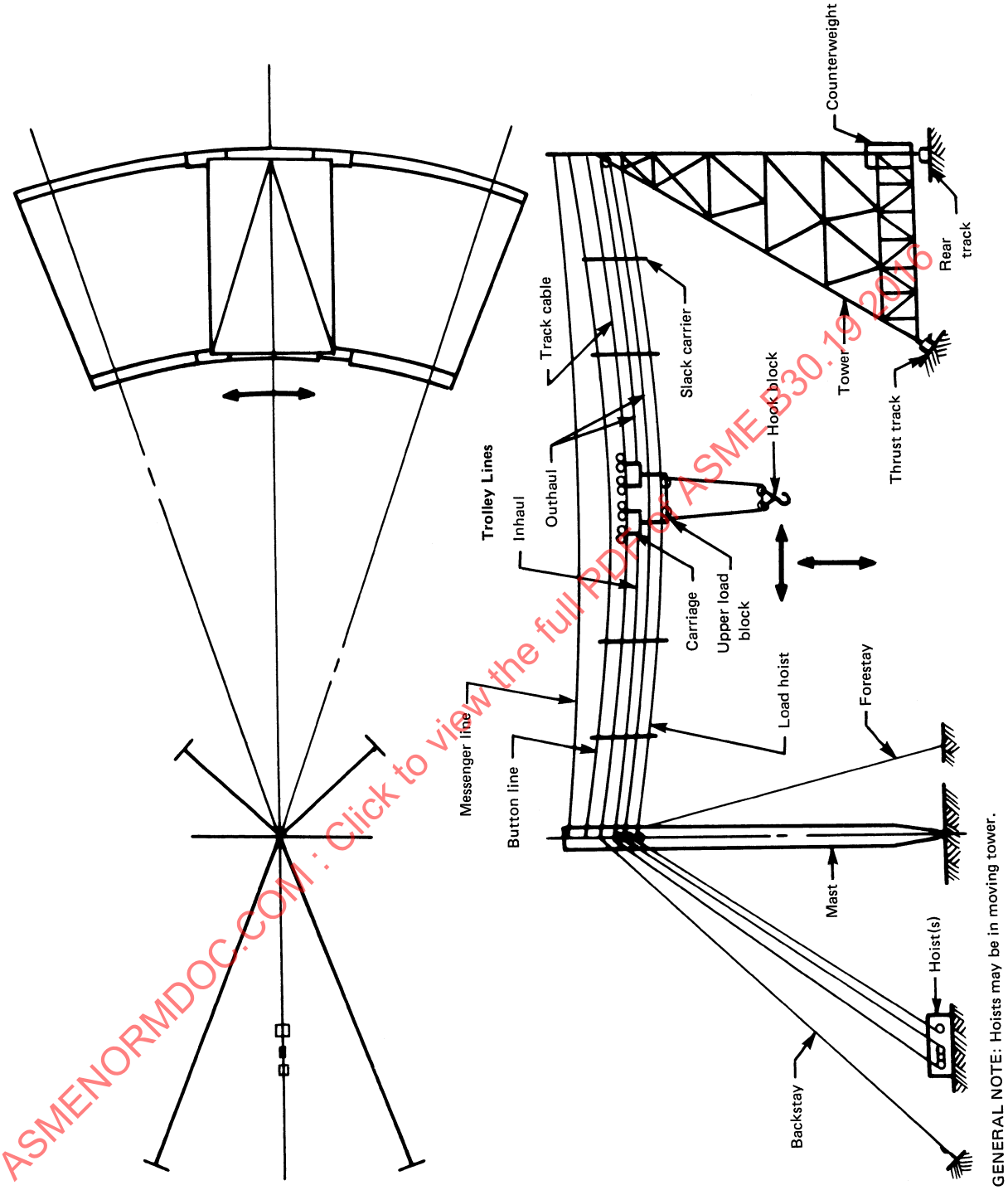


Fig. 19-0.2.1-4 Radial Cableway

Fig. 19-0.2.2-1 Two-Drum Cableway Hoist

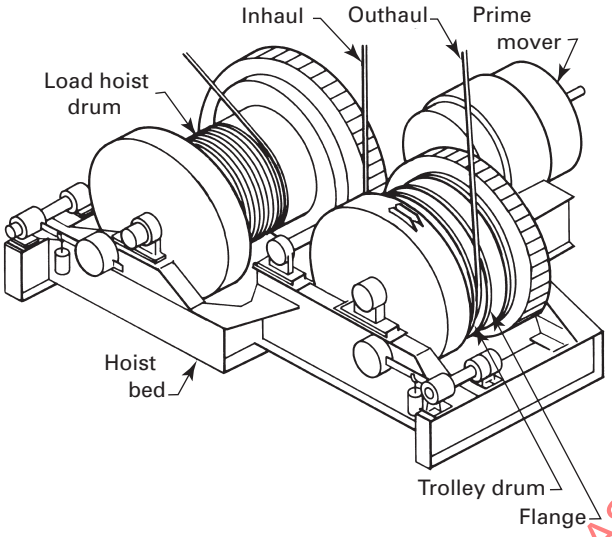


Fig. 19-0.2.2-2 Trolley Hoist Unit

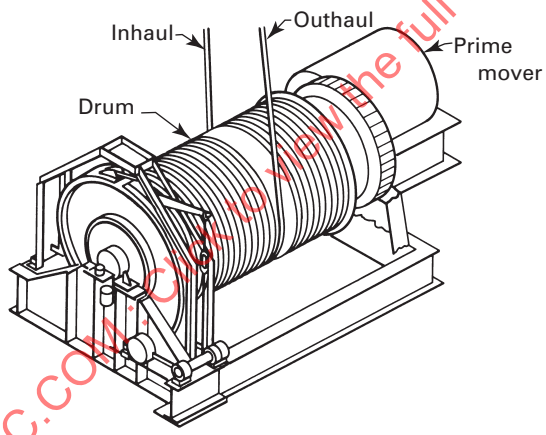


Fig. 19-0.2.2-3 Multisheave Endless Rope Trolley Hoist Unit

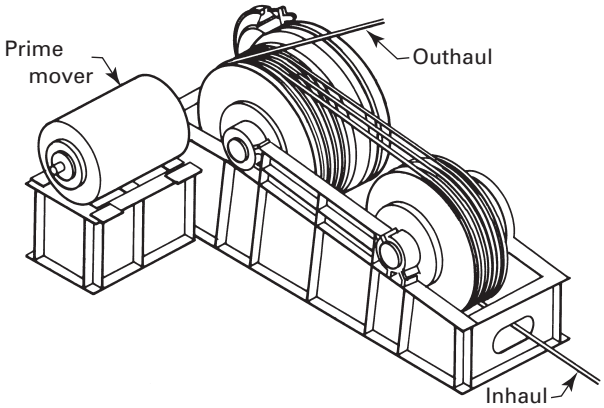
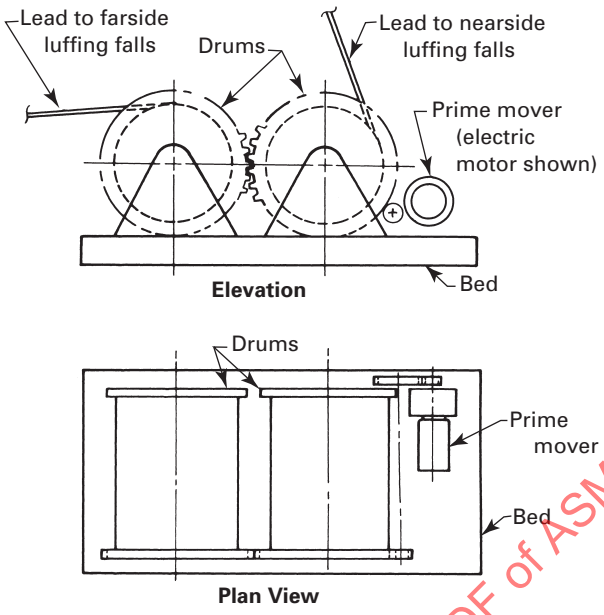


Fig. 19-0.2.2-4 Luffing Hoist Unit



GENERAL NOTE: The two drums are geared to turn together, spooling off one drum while spooling on the other.

Chapter 19-1
Construction and Characteristics

SECTION 19-1.1: LOAD RATINGS

19-1.1.1 Basis

Load ratings are dependent on such factors as anchorage, structural competence, wire rope minimum breaking force, and hoist(s) rating(s).

19-1.1.2 Load Rating Chart

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

(1) manufacturer's model and serial number of the cableway (if applicable)

(2) the designer's approved spans for the cableway and corresponding load ratings

(3) the maximum length of the mast on which the load ratings are based

(4) the required parts for lower load block reeving, including the size and type of rope

(5) the size and type of rope used for the track cables and trolley (inhaul and outhaul) cable shall be shown either on the rating chart or in the operating manual

(6) for luffing cableways, the size and type of ropes and reeving shall be shown either on the rating chart or in the operating manual

(b) The load ratings shall include all permissible locations of operation of the lower load block

(1) throughout the longitudinal length of the span

(2) throughout the transverse luffed positions for the span

SECTION 19-1.2: DESIGN AND MANUFACTURE

19-1.2.1 General

(a) Cableways shall be constructed to support all loads imposed on all cableway components including towers, hoists, carriages, ropes, and blocks when handling loads not exceeding the manufacturer's load ratings with recommended reeving.

(b) Welding of main load and secondary load carrying members shall conform to the recommended practices of ANSI/AWS D1.1/D1.1M.

(c) The design of cableways is unique in that each new installation of the cableway usually will vary the load ratings and component stresses due to the geometric variations of span length and guy angles required for its use. Therefore, each installation shall be redesigned in detail by a qualified person. Load rating shall be established after an analysis of component stresses, anchorage loads, and foundation loads. For this Volume, the designer (original) will be that qualified person who originally designs the cableway for its original installation, and the designer (other than original) will be that qualified person who adapts the cableway to a different geometric pattern and establishes the load rating.

19-1.2.2 Structures

(a) Towers and tower bases shall be constructed to allow movement within the limitations imposed by the designer's ratings and operations.

(b) Tower (mast) structures, fixed, luffed, or moving, and whether guyed or counterweighted, shall have a stability about the critical tipping point of the base at least 50% greater than the maximum tipping moment that could occur when the cableway is operated within any range of the manufacturer's specified load ratings.

(c) When operating ropes sag to a point where they constitute an interference or present a contact hazard to personnel, equipment, or other structures, a sufficient number of slack carriers shall be provided to eliminate the interference or hazard. Slack carriers should be used on cableway spans.

(d) Cotters or other type keepers shall be used on pins or bolts that provide a rotating or swiveling action within an assembly.

19-1.2.3 Foundations

(a) Foundation design loadings shall be provided by the cableway designer.

(b) The loads shall include, but not necessarily be limited to, the maximum total dead load plus live load reactions that will be created on all foundations under any load or combination of loads that may occur as a result of the designer's ratings. These foundation loadings shall include both vertical and horizontal reactions from the towers, wire rope anchorages, and hoists.

SECTION 19-1.3: CONSTRUCTION AND ERECTION

19-1.3.1 Foundations, Anchors, and Guys

(a) Bearing foundations shall be constructed to resist 150% of the maximum design loading.

(b) Guy anchors shall be constructed to resist 150% of the maximum design loads. These loads shall include any variation of loading due to luffing, or other loads out of the plane of the cableway. Guy ropes shall have a minimum design factor of 3.

(c) Anchorages for track cable tension shall be proportioned to resist the nominal breaking strength of the track cable(s).

(d) If it is necessary to install rope or track cable in contact with the earth or in water, the design factor should be doubled.

19-1.3.2 Rigging and Reeving

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

(b) No less than two full wraps of rope shall remain on any drum when the lower load block is in the extreme low position or luffing falls are at their maximum extended length.

(c) The drum end of rope shall be anchored to the drum by an arrangement specified by the cableway or rope manufacturer, the designer, or a qualified person.

(d) Eyes shall be made as recommended by the rope, cableway, or fitting manufacturer or a qualified person. Rope thimbles should be used in the eyes.

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

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

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

(h) If the track cable(s) is supported by saddles, the saddle radius, rope groove, rope lubrication, and inspection provisions shall conform to the recommendations of the rope, saddle, or cableway manufacturer, the designer, or a qualified person.

(i) Any rigging or reeving utilized to attach the track cable(s) to the anchorage shall be proportioned to statically resist the nominal rope break strength of the track cable(s).

19-1.3.3 Ropes

(a) All ropes shall be of a size, grade, and construction to withstand the maximum rated load at the specified design factor.

(b) All nonoperating ropes such as guy ropes and messenger and button lines shall have a minimum design factor of 3.

(c) The track cable(s) shall have a minimum design factor of 3.

(d) All operating ropes such as load ropes, trolley (inhaul-outhaul) ropes, and luffing tackle ropes shall have a minimum design factor of 3.5, except for rotation-resistant rope, which shall have a minimum design factor of 5.

NOTE: The rope size and construction as defined above shall be determined on the basis of rope loads resulting from the designer/manufacturer's ratings, approved reeving, and published nominal breaking strength of new rope under static conditions. Ropes of material other than steel may be used only in accordance with the designer's recommendations.

(e) All operating ropes shall be of sufficient length to permit the entire range of movement specified for the application and leave at least two full wraps of rope on the drum at all times.

19-1.3.4 Sheaves

(a) Sheave grooves shall be free from surface defects that could cause rope damage. The cross-sectional radius at the bottom of the groove should be such as to form a close-fitting saddle for the size of rope used. The sides of the groove shall be tapered outward and rounded at the rim to facilitate entrance of the rope into the groove. Flange rims shall run true about the axis of rotation.

(b) Sheaves carrying ropes 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 shall be equipped with close-fitting guards that will minimize ropes from becoming fouled when the block is landed and the ropes are loose.

(d) Means shall be provided to minimize chafing of the ropes.

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

(f) Load hoist sheaves shall have pitch diameters no less than 18 times the nominal diameter of the rope.

(g) Except for load hoist sheaves, other operating sheaves shall have pitch diameters no less than 16 times the nominal diameter of the rope.

19-1.3.5 Hoists

(a) The main load hoist, inhaul-outhaul hoist, and luffing hoist shall have hoist ratings, drum capacities, and brake and structural competence for the work

intended and shall be securely anchored to prevent displacement due to the imposed loads.

(b) The minimum number of wraps of rope required on the drum of the inhaul-outhaul hoist shall be

(1) a minimum of six wraps, to assure there is no slippage when an endless rope-type trolley arrangement is used (see Figs. 19-0.2.2-1 and 19-0.2.2-3)

(2) a minimum of three wraps shall apply when each end of the inhaul-outhaul rope is applied to the drum (see Fig. 19-0.2.2-2)

(c) Hoists shall be marked with the following identifications:

(1) load rating

(2) drum(s) barrel diameter, length, and flange diameters

(3) rope size(s)

(4) rope speed

(5) rated power supply

(d) Welding shall conform to the recommended practices of ANSI/AWS D14.3.

(e) Each drum end of the rope shall be fixed to the drum by clamp(s) or socket arrangement providing a pull-out strength equal to or greater than the working load based on the design factor of the rope.

(f) Drum flanges shall extend a minimum of one-half rope diameter, but not less than ½ in. (13 mm) above the top layer of rope during operation.

(g) Load hoist, luffing, and inhaul-outhaul drums shall provide a pitch diameter on the first layer of no less than 18 times the nominal diameter of the rope.

(h) Brakes

(1) Each drum shall be equipped with braking power having a torque rating not less than 150% of the maximum rated live load pull at each rope layer on the drum.

(2) When power-actuated brakes having no continuous mechanical linkage between the actuating and braking means are used for controlling loads, an automatic means shall be provided to prevent the load from falling in the event of loss of brake-actuating power.

(3) When a hoist is to be operated from a remote location, a self-setting brake shall be provided to stop and prevent drum rotation in the event of power failure. This requirement does not apply to hoists where brakes are manually applied through mechanical linkages and the operator is at the control position.

(4) Foot-operated brakes shall be constructed so that the operator's foot will not easily slip off the pedal.

(5) Inhaul-outhaul and single drum luffing hoist brakes shall have holding power in both directions to prevent movement of the drum. The brake shall be capable of being set in the holding position and remaining so without attention on the part of the operator.

(6) Brakes and clutches shall be provided with adjustments where necessary to compensate for wear and to maintain tension in springs where used.

19-1.3.6 Guards for Moving Parts

Exposed moving parts such as sheaves, ropes, gears, and projecting keys that might constitute a hazard under operating conditions shall be guarded.

19-1.3.7 Load Hook and Lower Load Block Assembly

(a) The assembly shall be of sufficient weight to overhaul the load hook from the highest hook position located in any place within the span when the maximum number of reeved parts of load rope are in use.

(b) Skid-resistant footwalks with handrail should be provided for maintenance and inspection. In areas where walkways are not practical, ladders and handholds shall be provided.

(c) Contact surfaces shall be provided on the lower structure of the upper load block and on the upper structure of the lower load block. These surfaces shall be the first to make contact in case of two-blocking. Contact between these surfaces serves to minimize damage to sheaves or frames.

(d) The lower load block shall be labeled with its rated load (rated capacity) and weight.

(e) Open throat hooks shall be equipped with latches to bridge the throat opening, except when the latch application makes the use of the hook impractical.

19-1.3.8 Slack Carriers and Upper Load Block Carriage

(a) Construction shall be such that, without the intentional removal of parts, the carriages cannot inadvertently become disengaged from the track ropes.

(b) Skid-resistant footwalks with handrail should be provided for maintenance and inspection access. In areas where walkways are not practical, ladders and handholds shall be provided.

(c) Contact surfaces shall be provided so when carriers and carriage contact each other, no damage is incurred to the support structure, operating mechanisms, sheaves, or rope.

19-1.3.9 Assembly (Construction) Procedure

(a) Prior to the start of assembly, a procedure for the construction of a cableway shall be established by a qualified person(s). The procedure shall consist of procedural drawings, design of special handling equipment, and descriptive information as necessary, and shall include, but not be limited to

(1) tower (mast) erection

(2) rope erection and tensioning

(3) trolley erection

(4) slack carrier erection

(b) Dismantling (removal) procedures shall be provided, similar to those requirements for assembly [see (a)].

19-1.3.10 Cabs and Machinery Enclosures

(a) All cabs and enclosures should be constructed to protect the machinery, brakes, clutches, and the operator's station from the weather.

(b) The operator's compartment shall provide visibility of load block movement, tower travel track, and head tower as far as sight range is possible. All windows shall contain safety glazing material. Where the operator must look through the window for operation of cableway, the optical deviation and visibility distortion of the glazing material shall meet the test requirements of Section 5.15 (Test 15) of ANSI Z26.1.

(c) Walkways and platforms shall be constructed using skid-resistant materials.

(d) Access steps, ladders, and handholds shall be provided to the operator's cab and machinery areas.

(e) Platforms shall be provided with handrails.

(f) Engine exhaust gases shall be piped to the outside of the cab and machinery enclosures and discharged in a direction away from the enclosed areas. All exhaust pipes shall be guarded or insulated to prevent contact with personnel in areas where personnel perform their normal operating and maintenance duties.

(16)

19-1.3.11 Controls

(a) General

(1) At the operator's station, all controls used during the normal operating cycle shall be located within reach of the operator and labeled as to their designated function and direction of movement. Controls shall have means for holding in the neutral position, without the use of positive latches. Remote-operated cableways shall function so that, if the control signal for any cableway motion becomes ineffective, that cableway motion shall stop.

(2) Electric motor-operated cableways shall be provided with a device that will disconnect all motors from the line on failure of power and will not permit any motor to be restarted until the controller handle is brought to the off position, or a reset switch or button is operated. A self-setting brake shall be provided to prevent drum rotation in the event of power failure. Provision shall be made for controlled lowering of the load.

(3) If electric motor-operated cableways are capable of overspeeding the power plant on overhauling regenerative loads, they shall be provided with overspeed protection.

(b) Power Plant Controls. Controls for operating the power plant shall be within reach of the operator and shall include, where applicable

(1) means to start and stop, with provision to lock in the stop position

(2) means to control speed of internal combustion engines

(3) means to stop diesel engines under emergency conditions

(4) means for shifting selective transmission

(c) Control Forces and Movements. Under normal operation

(1) forces to operate controls shall not be greater than 35 lb (155 N) on hand levers, and not greater than 50 lb (255 N) or less than 8 lb (36 N) on foot pedals.

(2) travel distance on hand levers shall not be greater than 14 in. (355 mm) from neutral position on two-way levers, and not greater than 24 in. (610 mm) on one-way levers. Travel distance on foot pedals shall not be greater than 10 in. (250 mm).

(d) Engine Clutch. All cableways with a direct mechanical or hydrodynamic drive (such as torque converter or fluid coupling) to any operating function shall be provided with a clutch or other means for disengaging power. The control shall be within reach from the operator's station.

(e) Electric Drive Control Panels. Controller shall conform to ANSI/NEMA ICS 3, Part ICS 3-44.3.

(f) Resistors

(1) Resistors and connectors shall be of corrosion-resistant material, protected or enclosed with provision for adequate ventilation and installed to minimize the accumulation of combustible matter.

(2) Resistor units shall be supported to minimize vibration.

19-1.3.12 Monitoring Devices

On cableway installations where the tail tower, trolley, and hook block are not visible to the operator, the following monitoring devices shall be used and shall be visible to the operator at his control station:

(a) vertical location of the hook block with respect to the trolley.

(b) location of the trolley along the track cable with respect to the head and tail tower.

(c) the degree of tower (mast) luffing from vertical or lateral displacement of the hook block in feet (meters).

(d) travel trucks on the head and tail towers shall have devices to indicate the relative skew between the two towers.

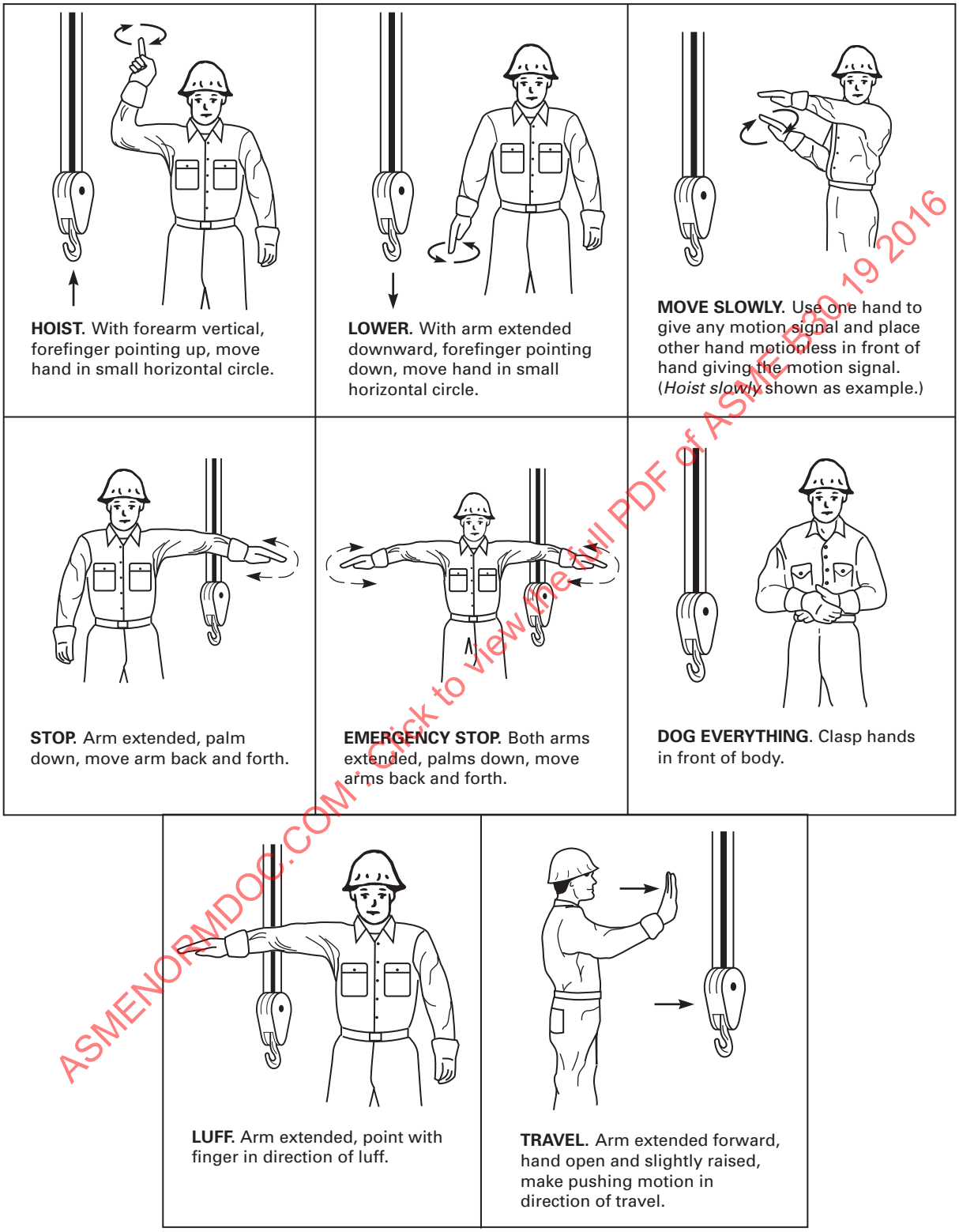
(e) a wind velocity indicating device shall be mounted at or near the top of one of the cableway towers. A velocity readout shall be provided at the operator's station in the cab, and a visible or audible alarm shall be triggered in the cab and at remote control stations when a preset wind velocity has been exceeded.

(f) see Fig. 19-1.3.12-1 for signaling.

19-1.3.13 Traveling Towers

(a) Audible travel signals shall be automatically and continuously activated when the tower(s) is in motion.

Fig. 19-1.3.12-1 Standard Hand Signals for Controlling Cableway Operations



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

LOWER. With arm extended downward, forefinger pointing down, move hand in small horizontal circle.

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

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

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

DOG EVERYTHING. Clasp hands in front of body.

LUFF. Arm extended, point with finger in direction of luff.

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

(b) Ladders or stairs shall be provided for access to areas of operation and requiring maintenance. Ladders shall conform to ANSI A14.3.

(c) *Runway Track and Trucks*

(1) Tower trucks shall be equipped with sweeps that extend to the top of the rail and project in front of the leading wheels in either direction.

(2) Exposed truck wheels shall be fitted with wheel guards.

(3) Means shall be provided to limit the drop of truck frames in case of wheel or axle breakage to an amount that will not cause the tower to overturn.

(4) When rails are spliced (bolted or welded), they shall have smooth joints.

(5) Rails should be level, straight, and properly spaced for the tower trucks in accordance with the manufacturer's recommendations. Where curves or grades are required, they shall be designed for the installation and meet the requirements of the vertical and horizontal forces applied.

(6) Rails shall be attached to the supporting surface in a manner to resist both horizontal and vertical loads.

(7) If the tower receives electrical power from an outside source, the rails shall be electrically grounded.

(8) The ends of all tracks shall be equipped with stops or bumpers (buffers) designed to minimize the possibility of derailment.

(9) Travel trucks on the head and tail towers shall have devices to indicate the relative skew between two towers.

(10) Truck motors shall be equipped with automatic spring set, electrically released brakes. Brakes shall have a torque rating equal to the full load motor torque and have provision for manual release.

(11) Provisions shall be made to prevent traveling towers from rolling on the track due to high winds.

(12) The track and support system shall be designed to limit detrimental dynamic oscillations.

(13) Should traveling crane base counterweight be required, it shall be installed in accordance with the manufacturer's or designer's instructions before erecting and rigging the cableway ropes.

19-1.3.14 Aids to Aviation

(a) Aviation authorities shall be consulted regarding the placement of cableway installations that reach an overall height of 200 ft (61 m) above ground level.

(b) When required, aviation lighting, signals, and notification shall be placed and maintained.

19-1.3.15 Personal Protection (Ropes)

(a) Moving ropes shall be barricaded in areas where persons have access.

(b) Nonmoving ropes shall be conspicuously marked warning persons of their location if located in areas where persons have access.

19-1.3.16 Luffing Hoist

The luffing hoist assembly shall include a lazy guy system.

Chapter 19-2
Inspection, Testing, and Maintenance

(16) SECTION 19-2.1: INSPECTION

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

19-2.1.1 Inspection Classification

(a) Initial Inspection. Prior to initial use, all new, reinstalled, altered, or modified cableways shall be inspected to verify compliance with this Volume and the manufacturer's or designer's requirements.

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

(1) Frequent inspection — daily to monthly intervals

(2) Periodic inspection — 1-month to 12-month intervals, or as specifically recommended by the manufacturer or designer

19-2.1.2 Frequent Inspection

Items such as the following shall be inspected at intervals as defined in para. 19-2.1.1(b)(1), or as specifically indicated by the manufacturer or designer, including observation during operations for any deficiencies that might appear between inspections. Written records are not required for frequent inspections.

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

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

(c) all operational aids for malfunction

(d) hooks and latches for deformation, chemical damage, cracks, and wear (refer to ASME B30.10)

(e) rope reeving in compliance with the plans and specifications

(f) electrical apparatus for malfunctioning and signs of excess deterioration, dirt, and moisture accumulation

(g) slack carriers for spacing and operating to prevent slack rope interferences

(h) towers (masts) shall be luffed to the maximum to ensure proper power, brake, and operational aid operation

(i) correct operation of aids to aviation — daily

(j) visual inspection of cable terminations and attachments for slippage or loose connection material — weekly/monthly

(k) tracks for obstruction

(l) communication systems

(m) all operating controls are labeled with their function and direction of motion

19-2.1.3 Periodic Inspection

Complete inspection of the cableway shall be performed at intervals as defined in para. 19-2.1.1(b)(2). A written record of the most recent periodic inspection shall be maintained and shall include condition of the cableway and its components. These inspections shall include the requirements of para. 19-2.1.2, in addition to the following:

(a) cableway structural members, including rails, for deformation, cracks, or corroded members

(b) structural fasteners for tightness

(c) sheaves and drums for cracked or worn surfaces

(d) pins, bearings, shafts, gears, rollers, and locking devices for wear, cracks, and distortion

(e) brake and clutch system parts, linings, pawls, and ratchets for excessive wear

(f) monitoring and limiting devices over their full range for any significant inaccuracies

(g) power plants for improper performance or noncompliance with applicable safety standards

(h) anchoring devices and structures for damage, unwarranted movement, or corrosion

19-2.1.4 Cableways Not in Regular Use

A cableway that has been idle for a period of less than 6 months shall be given an inspection conforming to the requirements of paras. 19-2.1.2, 19-2.4.2(a), and 19-2.4.3 before being returned to service. A cableway that has been idle for 6 months or more shall be given an inspection conforming to the requirements of paras. 19-2.1.3, 19-2.4.2(b), and 19-2.4.3 before being returned to service.

(16) SECTION 19-2.2: TESTING

19-2.2.1 Operational Tests

(a) Prior to initial use, all newly erected cableways shall be tested by, or under the direction of, a qualified person to ensure compliance with this Standard, including the following functions:

(1) At a minimum, the load test shall consist of load hoisting and lowering — full range.

(2) Track cable sag — to verify that it is in accordance with the manufacturer's or designer's specifications.

(3) Inhaul-outhaul travel — full range.

(4) Tower (mast) luffing for full range; the lazy guys shall support the mast when the tower is fully luffed.

(5) Operational aids.

(6) Tower travel — full range.

(b) A record of the operational tests shall be kept on file.

19-2.2.2 Load Test

(a) Prior to initial use

(1) all new, reinstalled, altered, or modified cableways shall be tested by, or under the direction of, a qualified person. The load test shall consist of the following operations as a minimum requirement:

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

(-b) Transport the test load by means of the inhaul-outhaul cable system for the full span ranges.

(-c) Transport the test load by means of the luffing hoist for the full range of luffing with the trolley as close to the span center as practical.

(-d) Transport the test load by means of the tower travel drive the full length of the track in both directions with the trolley as close to the span center as practical.

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

(2) the test load shall not be less than the rated load or more than 110% of the rated load unless otherwise approved by the cableway manufacturer, designer, or a qualified person.

(3) the need for load testing of repaired cableways shall be determined by a qualified person and may be limited to the function(s) affected by the repair.

(b) A record of the load test shall be kept on file.

SECTION 19-2.3: MAINTENANCE

(16) 19-2.3.1 Preventive Maintenance

(a) A preventive maintenance program shall be established and should be based on the recommendations of the cableway manufacturer or designer, or a qualified person.

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

19-2.3.2 Maintenance Procedures (16)

Before major adjustments or repairs are started on a cableway, the following precautions shall be taken, as applicable:

(a) The cableway to be repaired shall be, if possible, luffed or traveled, or the trolley moved to cause the least interference to other continuing operations.

(b) If a load is attached to the cableway, it shall be landed.

(c) All controllers shall be placed in the off position.

(d) A lockout/tagout procedure shall be performed (see para. 19-3.4.7).

(e) Warning signs and barriers shall be utilized in the area beneath the cableway where overhead maintenance work creates a hazard.

(f) Consideration shall be given to installing special devices such as clamping cables, rail stops, etc., to prevent movement of the cableway operating features.

(g) After adjustments or repairs have been made, the cableway shall not be returned to service until all guards have been reinstalled, special devices removed, operational aid devices reactivated, and maintenance equipment removed. Warning or out-of-order signs shall be removed by a designated person.

19-2.3.3 Adjustments and Repairs

(a) Hazardous conditions disclosed by the inspection requirements of Section 19-2.1 shall be corrected before operation of the cableway is resumed, except where a qualified person determines that the cableway may be operated. Adjustments and repairs shall be performed by, or under the direction of, designated personnel.

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

(1) all functional operating mechanisms

(2) limit switches

(3) control systems

(4) brakes and clutches

(5) power plants

(c) Worn or damaged components shall be replaced or repaired promptly, as needed for operation. The following are examples:

(1) Hooks showing conditions described in para. 19-2.1.2(d) shall be taken out of service.

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

(3) Pitted or burned electrical contacts should be replaced in sets.

(4) Controller parts should be lubricated as recommended by the manufacturer or a qualified person.

(5) Control stations shall be kept clean, and function labels kept legible.