



The American Society of
Mechanical Engineers

CABLEWAYS

AN AMERICAN NATIONAL STANDARD

ASME B30.19-2000
(Revision of ASME B30.19-1993)



The American Society of
Mechanical Engineers

A N A M E R I C A N N A T I O N A L S T A N D A R D

CABLEWAYS

ASME B30.19-2000
(Revision of ASME B30.19-1993)

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

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The 2000 edition of this Standard is being issued with an automatic addenda subscription service. The use of addenda allows revisions made in response to public review comments or committee actions to be published on a regular yearly basis; revisions published in addenda will become effective 1 year after the Date of Issuance of the addenda. The next edition of this Standard is scheduled for publication in 2003.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. The interpretations will be included with the above addenda service.

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FOREWORD

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

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

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

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

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

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

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

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

Committee, in accordance with the format described in Section III, 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.

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

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

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ASME B30.19-2000 SUMMARY OF CHANGES

The 2000 edition of ASME B30.19 includes editorial changes, revisions, and corrections introduced in B30.19a-1994, B30.19b-1995, and B30.19c-1998, as well as the following changes identified by (00).

<i>Page</i>	<i>Location</i>	<i>Change</i>
1	General	Listing of B30 volume updated
14	Section 19-0.3	Revised
15	19-1.2.2(b)	Revised
	19-1.2.3(b)	Revised
27	19-3.2.2(a)(12)	Revised
29	19-3.4.2	Revised

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

INTRODUCTION

(00) General

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

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

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

- B30.21 Manually Lever Operated Hoists
- B30.22 Articulating Boom Cranes
- B30.23 Personnel Lifting Systems
- B30.24 Container Cranes¹
- B30.25 Scrap and Material Handlers
- B30.26 Rigging Hardware¹
- B30.27 Material Placement Systems¹
- B30.28 Balance-Lifting-Units¹

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

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

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

¹ B30.24, B30.26, B30.27, and B30.28 are in the developmental stage.

variable factors that must be considered in each individual case. The rules given in the Standard must be interpreted accordingly, and judgment used in determining their application.

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

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

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

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

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

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

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

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

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

Section I: Scope

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

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

Section II: Purpose

This Standard is designed to:

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

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

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

Section III: Interpretations

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

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

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

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

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

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

ASME procedures provide for reconsideration of any interpretation when or if additional information which might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Section IV: New and Existing Installations

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

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

(c) *Existing Installations.* Inspection, testing, maintenance,

and operation of equipment manufactured and facilities constructed prior to the effective date of this volume shall be done, as applicable, in accordance with the requirements of this volume.

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

Section V: Mandatory and Advisory Rules

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

Section VI: Metric Conversions

The values stated in US customary units are to be regarded as the standard.

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CHAPTER 19-0

Scope, Definitions, and References

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 (non-luffing) towers (masts) which 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. 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. 2).

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

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

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.

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

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

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) and includes the upper load block.

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

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).

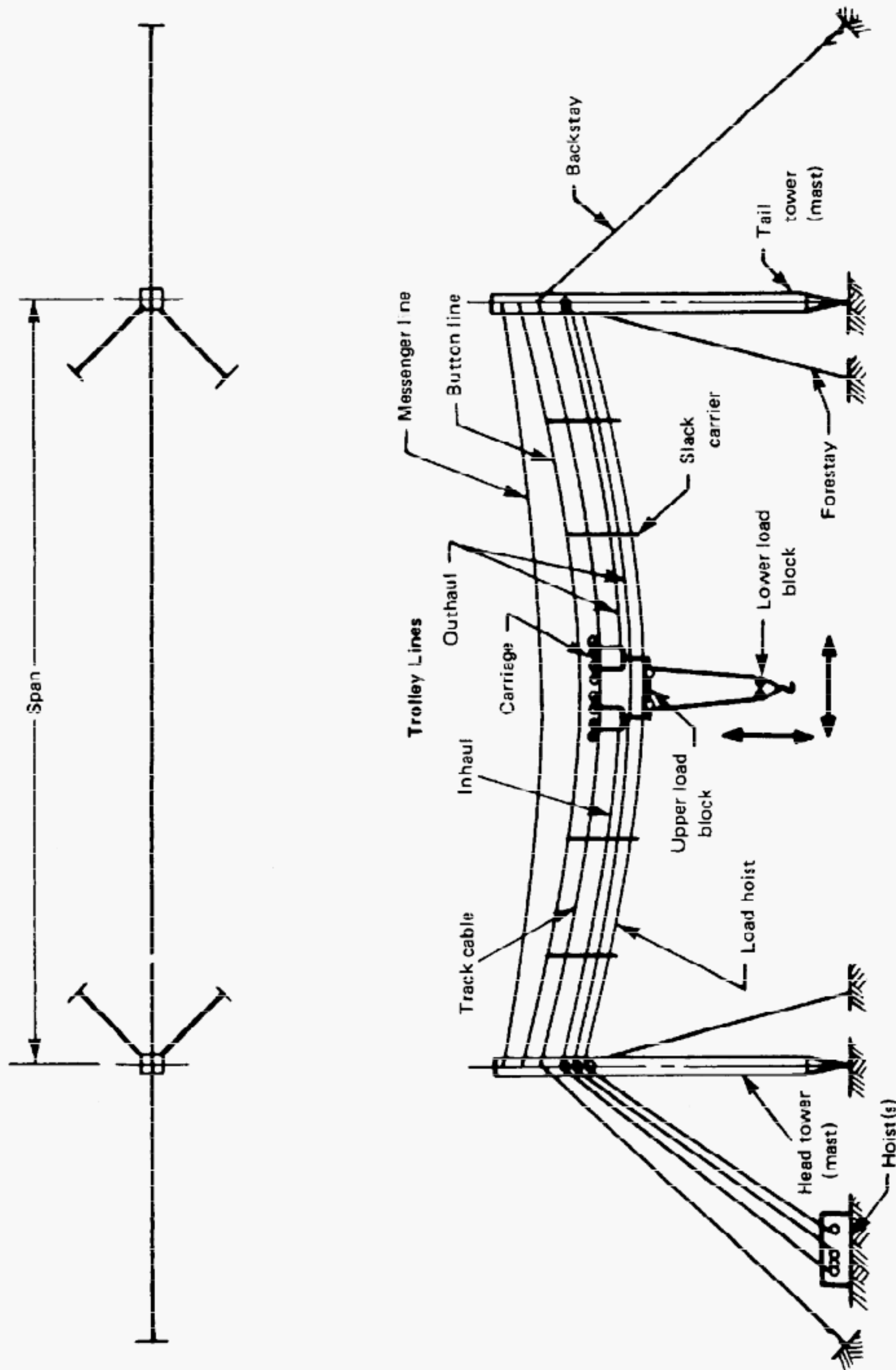


FIG. 1 FIXED CABLEWAY

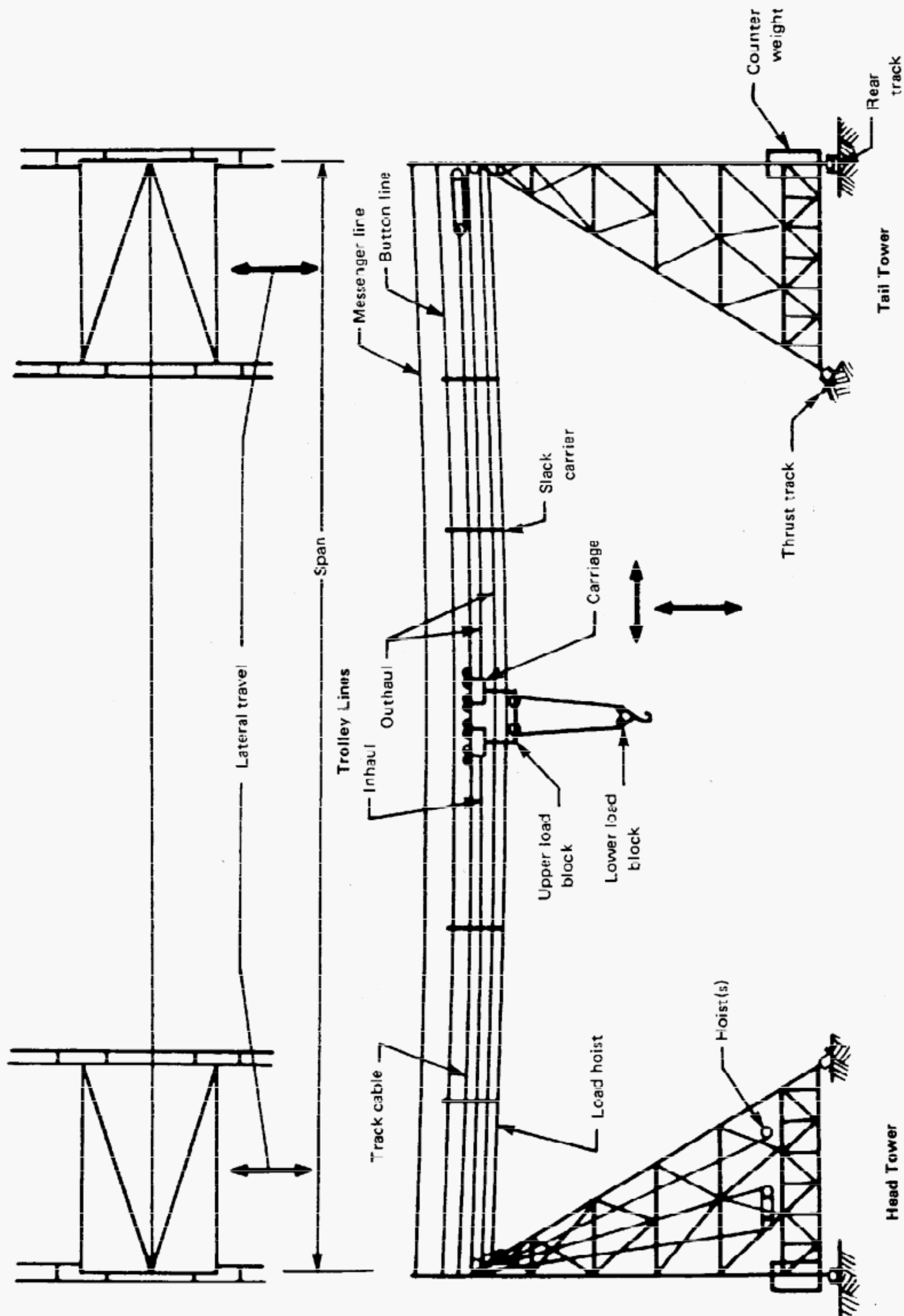


FIG. 3 PARALLEL CABLEWAY

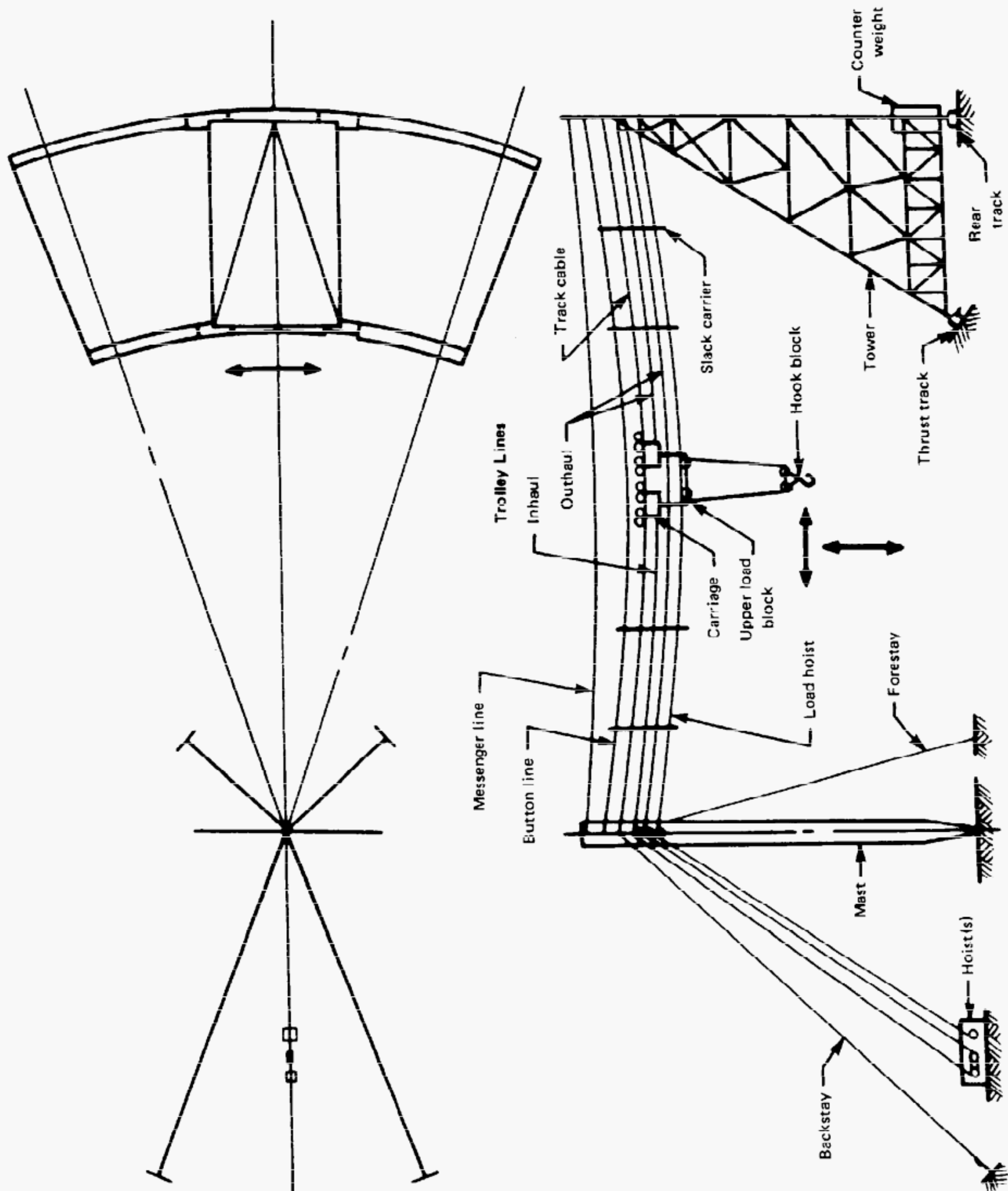


FIG. 4 RADIAL CABLEWAY

GENERAL NOTE: Hoists may be in moving tower.

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 nominal breaking strength 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. 5, 6, and 7). The hoist is powered by a prime mover.

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

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

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

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. 8).

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.

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.

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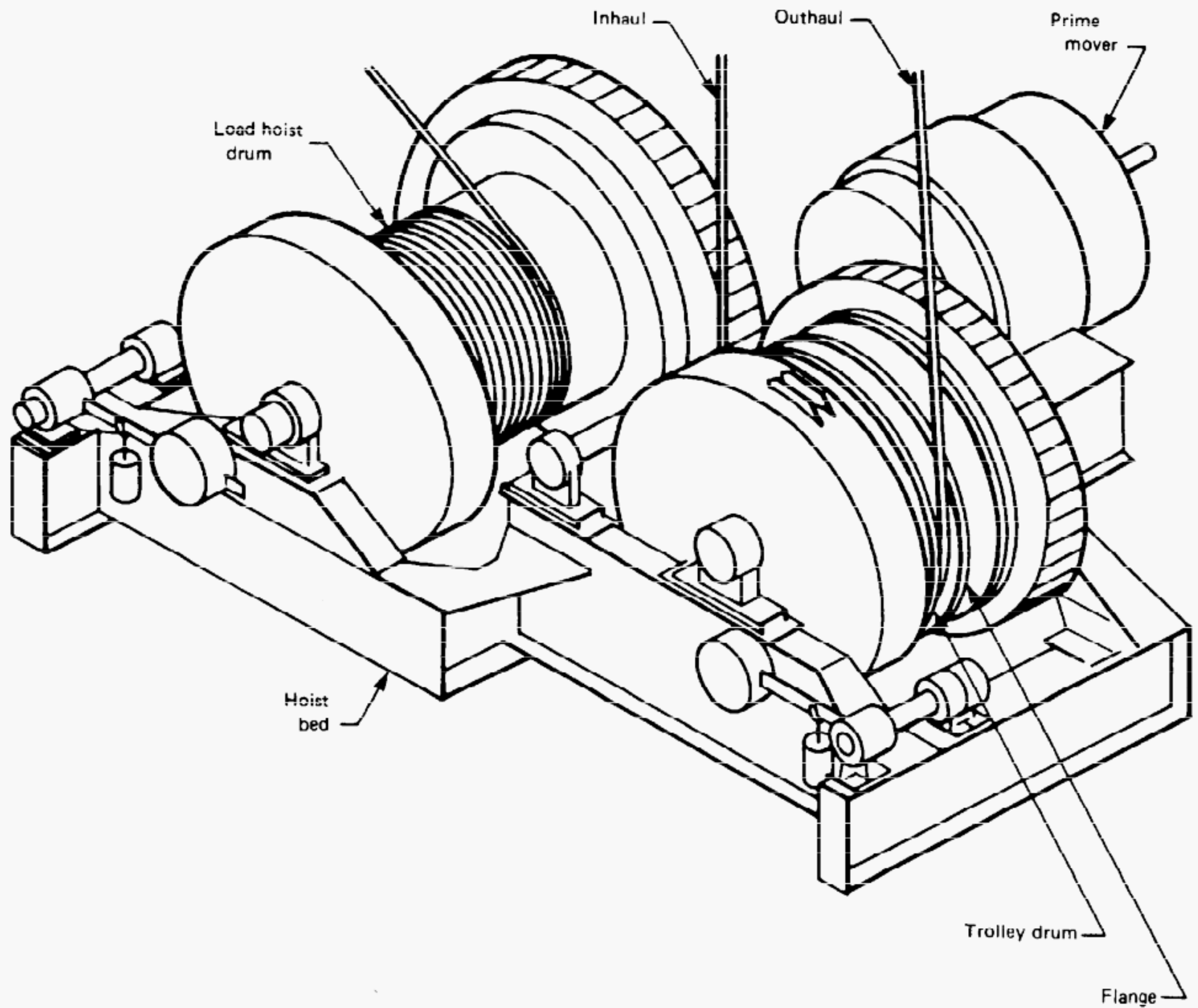


FIG. 5 TWO-DRUM CABLEWAY HOIST

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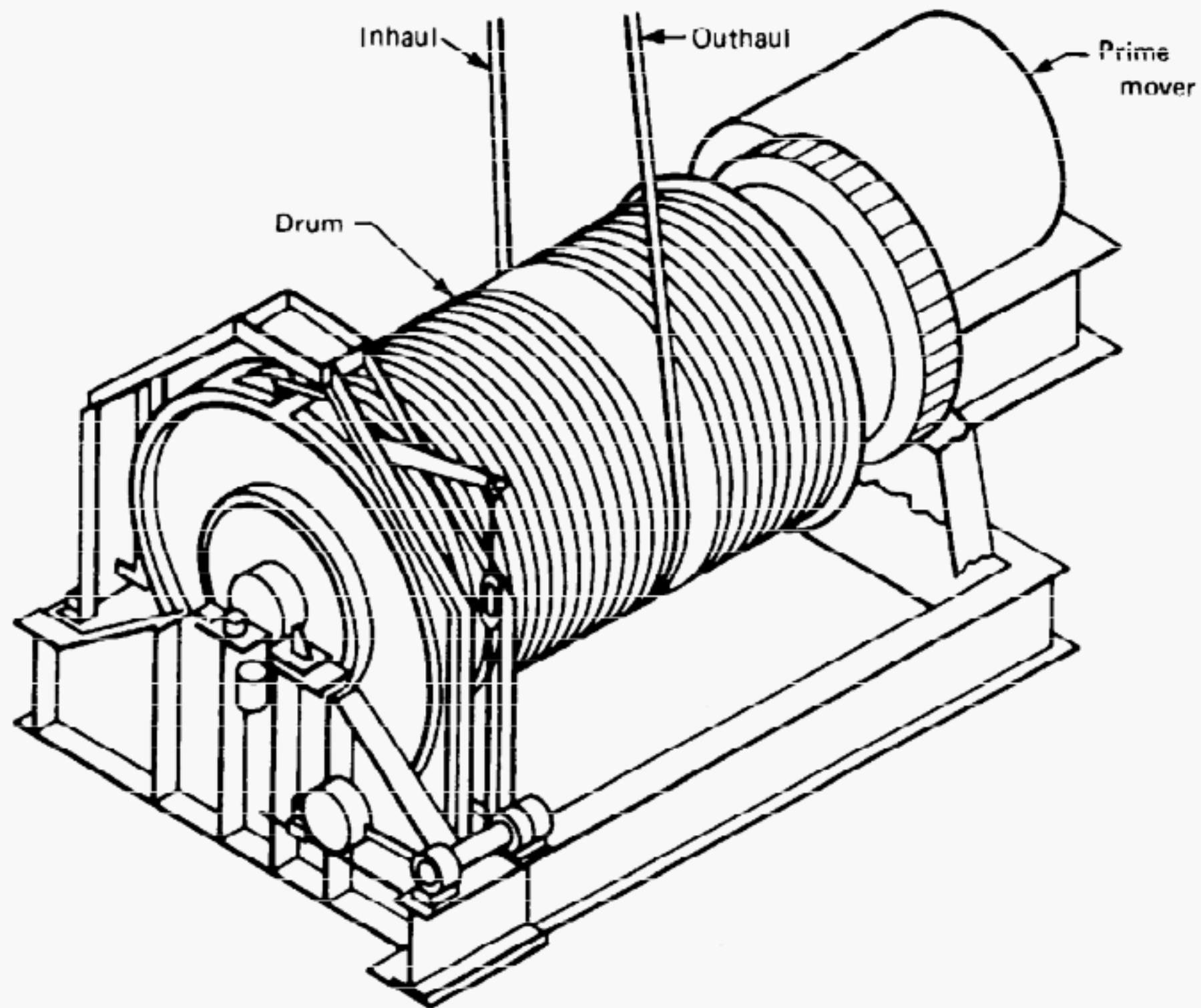


FIG. 6 TROLLEY HOIST UNIT

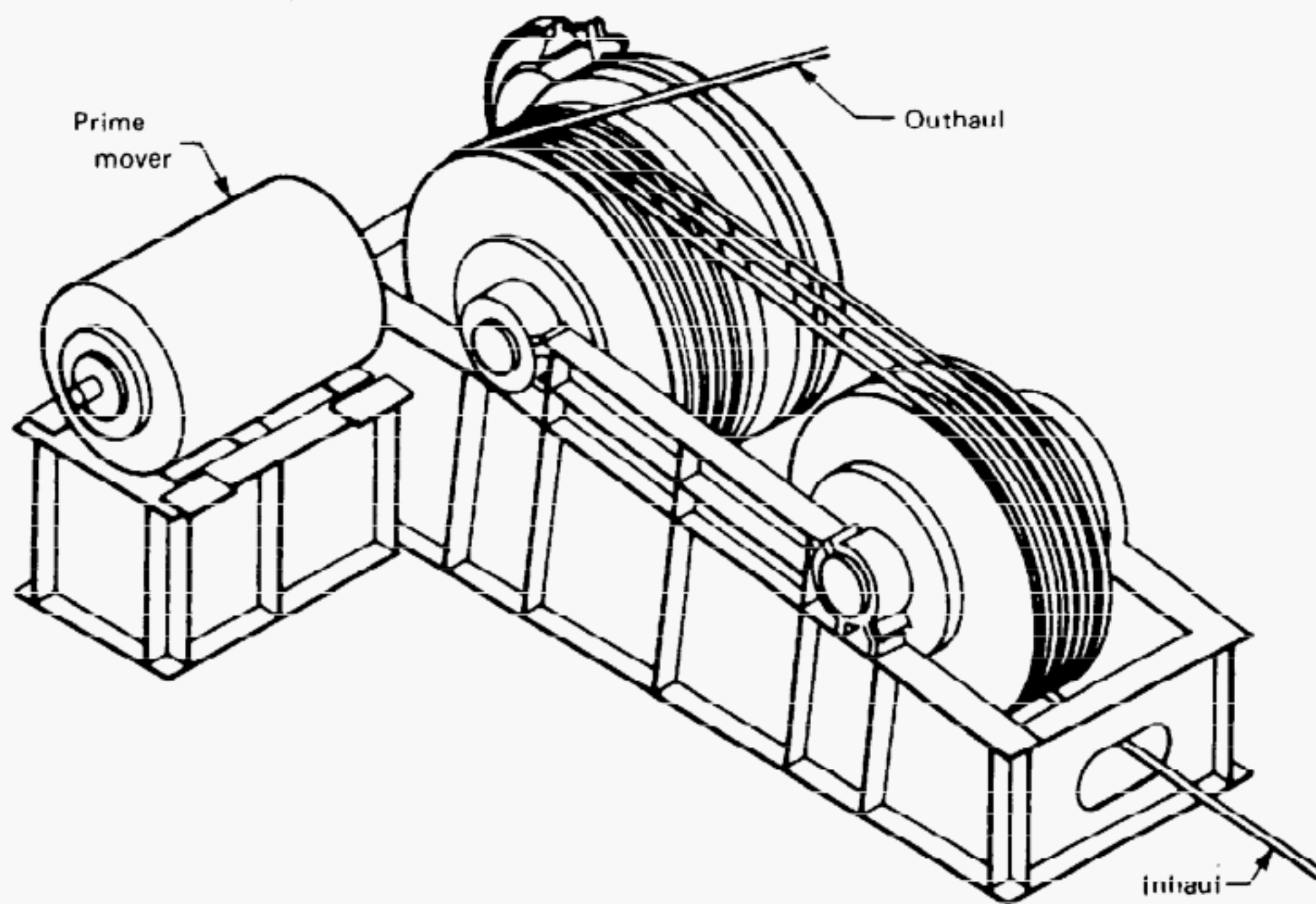
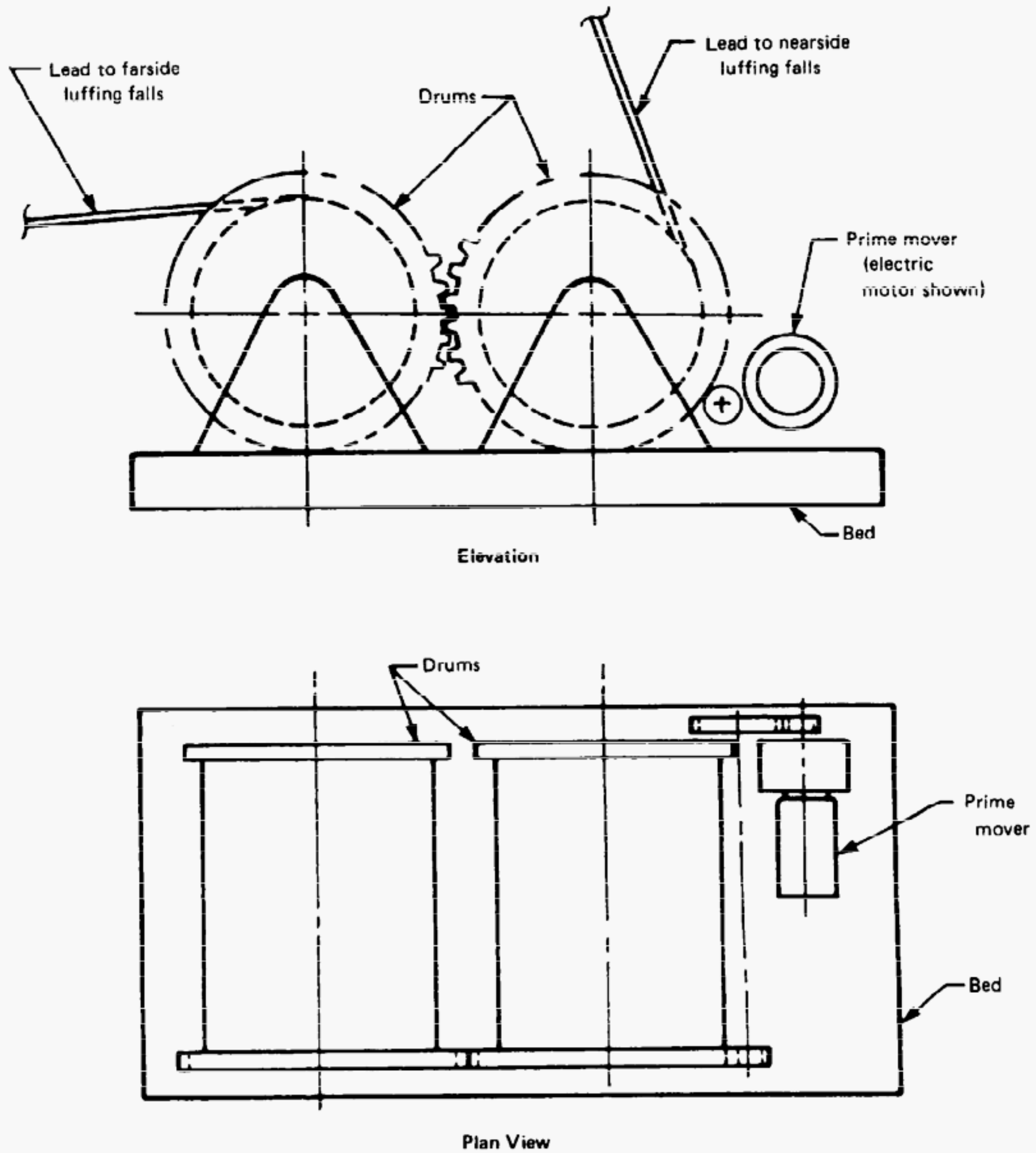


FIG. 7 MULTISHEAVE ENDLESS ROPE TROLLEY HOIST UNIT

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GENERAL NOTE:

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

FIG. 8 LUFFING HOIST UNIT

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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: 2240 lb.

ton, short: 2000 lb.

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

trolley: a carriage traveling on the track cable from which the load blocks are supported. The trolley is pulled along the track cable by the inhaul-outhaul rope.

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

(00) Section 19-0.3: References

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

ANSI/AWS D1.1-92, Structural Welding Code — Steel¹
 Publisher: American Welding Society (AWS), 550 NW
 Le Jeune Road, Miami, FL 33135

ASME B30.10-1999, Hooks¹

Publisher: The American Society of Mechanical Engineers (ASME International), Three Park Avenue,
 New York, NY 10016-5990; Order Department: 22
 Law Drive, P. O. Box 2350, Fairfield, NJ 07007

ANSI A10.28-1990, Safety Requirements for Work
 Platforms Suspended From Cranes or Derricks

ANSI A14.3-1992, Safety Requirements for Fixed
 Ladders

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

Publisher: American National Standards Institute
 (ANSI), 11 West 42nd Street, New York, NY 10036

ANSI/NEMA ICS 3-1988, Industrial Systems¹

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

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

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, rope strength, 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.

(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, B30.19, 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 which could occur when the cableway is operated within any range of the manufacturer's specified load ratings. (00)

(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) Cotter pins or other type keepers shall be used on pins or bolts which 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 (00)

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

(b) Sheaves carrying ropes which can be momentarily unloaded shall be provided with close-fitting guards or other devices to guide the rope back into the groove when the load is applied again.

(c) The sheaves in the lower load block shall be equipped with close-fitting guards that will minimize

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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, 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 6 wraps, to assure there is no slippage when an endless rope-type trolley arrangement is used (see Figs. 5 and 7);

(2) a minimum of 3 wraps shall apply when each end of the inhaul-outhaul rope is applied to the drum (see Fig. 6).

(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 $\frac{1}{2}$ in. (13 mm) over the top layer of rope.

(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) above].

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.

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. 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; and

(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

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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. The devices 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) See Fig. 9 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.

(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 should be consulted regarding the placement of cableway installations.

(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

Section 19-2.1: Inspection

19-2.1.1 Inspection Classification

(a) *Initial Inspection.* Prior to initial use, all new, reinstalled, altered, or modified cableways shall be inspected by a designated person 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 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 which might appear between inspections. Any deficiencies, such as those listed, shall be carefully examined, and a determination shall be made as to whether they constitute a hazard:

(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 safety devices 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) the towers (mast) shall be luffed to the maximum to assure proper power, brake, and monitoring device 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.

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). Conditions, such as those listed, shall be examined, and a determination shall be made as to whether they constitute a hazard. These inspections shall include the requirements of para. 19-2.1.2, in addition to items such as 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 non-compliance 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 one month or more shall be given an inspection conforming to the requirements of paras. 19-2.1.2 and 19-2.4.2(a) before being returned to service.

19-2.1.5 Inspection Records. Dated reports and records shall be made on critical items such as hooks and ropes as defined in para. 19-2.1.3. Records should be kept where available to appointed personnel.

Section 19-2.2: Testing**19-2.2.1 Operational Tests**

(a) Prior to initial use, all newly erected cableways shall be tested to ensure compliance with this Standard, including the following functions:

- (1) 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) limiting, monitoring, and safety devices;
- (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, re-installed, altered, or modified cableways shall be tested and inspected by or under the direction of a designated person. A written test report shall be prepared by the designated person and placed on file.

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

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

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

(3) 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.

(4) 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.

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

Section 19-2.3: Maintenance**19-2.3.1 Preventive Maintenance**

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

(b) Replacement parts shall be at least equal to those parts replaced.

19-2.3.2 Maintenance Procedures

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

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

(2) All controllers shall be at the off position.

(3) Main or emergency switch shall be opened and locked in the open position, except for test purposes.

(4) Warning or out of order signs shall be placed by appointed personnel.

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

(6) After adjustments or repairs have been made, the cableway shall not be returned to service until all guards have been reinstalled, special devices removed, safety devices reactivated, and maintenance equipment removed. Warning or out of order signs shall be removed by appointed personnel.

19-2.3.3 Adjustments and Repairs

(a) Hazardous conditions disclosed by the inspection requirement 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.

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19-2.3.4 Lubrication

(a) All moving parts for which lubrication is specified shall be regularly lubricated. Lubricating systems should be checked for proper delivery of lubricant. Particular care should be taken to follow the recommendation of the manufacturer, designer, or a qualified person, with regard to the maintenance of fluid levels and types of lubricant to be used.

(b) Machinery shall be stationary while lubricants are being applied and protection shall be provided as called for in para. 19-2.3.2, as applicable, unless equipped for automatic or remote lubrication.

**Section 19-2.4: Rope Inspection,
Replacement, and
Maintenance**

19-2.4.1 General. Sheave diameters, drum diameters, and rope design factors are limited because of cableway design configuration. Due to these parameters, inspection in accordance with para. 19-2.4.2 to detect deterioration and timely replacement in accordance with para. 19-2.4.3 are essential.

19-2.4.2 Inspection**(a) Frequent Inspection**

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

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

(b) general corrosion;

(c) broken or cut strands;

(d) number, distribution, and type of visible broken wires [see paras. 19-2.4.3(b)(1), (2), and (7) for further guidance];

(e) core failure in rotation-resistant ropes; when damage is suspected, the rope shall either be removed from service or given an inspection as detailed in para. 19-2.4.2(b).

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

(3) Care shall be taken when inspecting certain

ropes, such as rotation-resistant ropes, because of their higher susceptibility to damage and increased deterioration when working on equipment with limited design parameters. The internal deterioration of rotation-resistant ropes may not be readily observable.

(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 (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. The inspection shall be made at least every 1000 hr of cableway operation or annually, whichever comes first.

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

(a) points listed in para. 19-2.4.2(a);

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

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

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

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

(a) sections in contact with saddles, equalizer sheaves, or other sheaves, including track cable sheaves, where rope travel is limited;

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

19-2.4.3 Rope Replacement

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

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

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

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

(3) Wear of one-third the original diameter of outside individual wires.

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

(5) Evidence of heat damage from any cause.

(6) Reductions from nominal diameter greater than those shown below:

Rope Diameter	Max. Allowable Reduction From Nominal Dia.
Up to $\frac{5}{16}$ in. (8 mm)	$\frac{1}{64}$ in. (0.4 mm)
Over $\frac{3}{8}$ in. up to $\frac{1}{2}$ in. (13 mm)	$\frac{1}{32}$ in. (0.8 mm)
Over $\frac{9}{16}$ in. up to $\frac{3}{4}$ in. (19 mm)	$\frac{3}{64}$ in. (1.2 mm)
Over $\frac{7}{8}$ in. up to $1\frac{1}{8}$ in. (29 mm)	$\frac{1}{16}$ in. (1.6 mm)
Over $1\frac{1}{4}$ in. up to $1\frac{1}{2}$ in. (38 mm)	$\frac{3}{32}$ in. (2.4 mm)

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

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

(d) Replacement rope shall have a nominal strength rating at least equal to the original rope furnished or recommended by the cableway manufacturer or designer, or a qualified person. Any deviation from the original size, grade, or construction shall be specified by the rope manufacturer, the cableway manufacturer or designer, or a qualified person.

(e) *Ropes Not in Regular Use.* All rope that has been idle for a period of a month or more due to shutdown or storage of a cableway on which it is installed shall be given an inspection in accordance with para. 19-2.4.2(b) before it is placed in service. This inspection shall be for all types of deterioration

and shall be performed by an appointed or authorized person.

(f) 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 para. 19-2.4.2(b)(2).

(g) A long-range inspection program should be established and should include records on examination of rope removed from service so a relationship can be established between visual observation and actual condition of the internal structure.

19-2.4.4 Rope Maintenance

(a) Rope should be stored in a manner that prevents damage or deterioration.

(b) Rope shall be unreel or uncoiled 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 place where the rope is to be cut to prevent unlaying of the strands. On preformed rope, one seizing on each side of the cut is required. On nonpreformed ropes of $\frac{7}{8}$ in. (22 mm) diameter or smaller, two seizings on each side of the cut are required; and for nonpreformed rope of 1 in. (26 mm) diameter or larger, three seizings on each side of the cut are required.

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

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

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

CHAPTER 19-3

Operation

Section 19-3.1: Operator Qualifications and Operating Practice

19-3.1.1 Operators

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

- (1) designated persons;
- (2) trainees under the direct supervision of a designated person;
- (3) maintenance and test personnel, when it is necessary in the performance of their duties;
- (4) inspectors (cableways).

(b) No one, other than personnel specified in (a) above, shall enter a control cab, with the exception of persons such as oilers and supervisors whose duties require them to do so, and then only in the performance of their duties and with the knowledge of the operator or other appointed person.

19-3.1.2 Qualifications for Operators

(a) Operators shall be required to pass a practical operating examination. Examination shall be limited to the specific type of equipment to be operated.

(b) Operators shall meet the following physical qualifications:

- (1) vision of at least 20/30 Snellen in one eye and 20/50 in the other, with or without glasses;
- (2) ability to distinguish red, green, and yellow, regardless of position of colors, if color differentiation is required for operation;
- (3) adequate hearing, with or without hearing aid, for the specific operation;
- (4) evidence that an operator is subject to seizures or loss of physical control shall be sufficient reason for disqualification. Specialized medical tests may be required to determine these conditions.

19-3.1.3 Operating Practices

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

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

(c) The operator shall respond to signals only from the appointed signaller, but shall obey a stop signal at any time, no matter who gives it.

(d) The operator shall be responsible for those operations under his/her direct control. Whenever there is any doubt as to safety, the operator shall consult with the supervisor before handling the loads.

(e) Before leaving the controls unattended, the operator shall:

- (1) land any suspended load, bucket, lifting magnet, or other device;
- (2) set tower travel and all cable drum brakes and other locking devices;
- (3) put controls in the off or neutral position;
- (4) stop the engine or turn off electric power;
- (5) secure cableway against accidental operation;
- (6) take measures to secure movable towers when the wind alarm is given or when leaving overnight.

(f) When an out-of-order sign is on the starting controls, the operator shall not power the unit or start operations until the sign has been removed by the person responsible for the initial placing of the out-of-order sign or that person's designated representative.

(g) Before starting a power unit, the operator shall assure that all personnel are in the clear.

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

- (1) if practical, land the suspended load using controls or emergency means;
- (2) set all brakes and locking devices;
- (3) move all clutch or other power controls to the off position.

(i) The operator shall be familiar with the equipment and its proper care. If adjustments or repairs are necessary or any damage is known, it shall be reported to the appointed person, and the next operator shall be notified of the damage upon changing shifts.

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

(k) No cableway operation shall be performed unless a designated signaller directs the operation or the

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operator is within full vision of the operation to be performed.

Section 19-3.2: Operating Practices

19-3.2.1 Handling the Load

19-3.2.1.1 Size of Load

(a) No cableway shall be loaded beyond the rated load, except for authorized tests.

(b) The individual directing the lift shall ascertain that the weight of the load does not exceed the maximum rated load.

19-3.2.1.2 Attaching the Load

(a) The hoist rope shall not be in contact with the load.

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

19-3.2.1.3 Moving the Load

(a) The individual directing the lift shall see that:

(1) cableway trolley is within its operating limits, and the towers are aligned and within the luffing limits for the weight of load;

(2) the load is well secured and properly balanced in the sling or lifting device before it is hoisted more than a few inches;

(3) hoist rope is not kinked;

(4) multiple part lines are not twisted around each other;

(5) the hook is brought over the load in such a manner as to minimize swinging;

(6) the rope is properly seated on the drum and in the sheaves if there had been a slack rope condition.

(b) During the hoisting, the operator shall take care that:

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

(2) the load does not contact any obstructions;

(3) before moving towers, signals are given to all personnel to clear areas affected.

(c) Load drifting operations shall be planned by a qualified person, whose responsibility will be to:

(1) determine that resultant loading of the cableway will be within the load rating;

CAUTION: Do not drift loads when the swing of the drifted load could exceed the luffed load rating.

(2) ensure that the load is under control at all times to avoid excessive drifting and swinging action.

(d) The cableway should not be operated while anyone is on the load or hook, except under circumstances noted in para. 19-3.2.2.

(e) When loads or load hooks must approach the location of personnel, a signalperson shall be provided to warn of the approaching load.

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

(g) The load shall not be lowered below the point where less than two full wraps of rope remain on drums.

(h) When two or more cableways are used to lift one load, one designated person shall be responsible for the operation. This person shall analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made.

19-3.2.1.4 Holding the Load

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

(b) No person should be permitted to stand or pass under a load on the hook.

(c) If the load hoist mechanism is not equipped with an automatic brake and the load must remain suspended for any considerable length of time, the operator shall hold the drum from rotating in the lowering direction by activating the positive braking means.

19-3.2.2 Personnel Lifting. This Standard recognizes that cableways are designed and intended for handling materials. They do not meet personnel lifting or elevator requirements. Therefore, no cableway function shall be performed while a person is on the lower load block, hook, load, manlift platform, or other personnel lifting device attached to the cableway, unless each of the specific, special requirements as follows, is met.

(a) The following special procedures shall be followed when personnel are to be lifted.

(1) The person on the job site specifically responsible for the overall work function to be performed shall determine that there is no practical alternate way to perform the needed work or gain access to the area, and he shall authorize its usage by issuing a statement describing the operation and its time frame. The statement, after being approved by the authorizer, shall be retained at the job site.

(2) For each instance of personnel lifting, the person responsible for the task shall determine that each of the following requirements in paras. (3) through (16) have been met.

(3) The cableway shall be inspected in accordance with the requirements of paras. 19-2.1.2 and 19-2.4.2(a).

(4) The lift shall be made under controlled condi-

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tions and under the direction of an appointed signalperson.

(5) The operator shall be informed that personnel are to be hoisted.

(6) A planned procedure of operations shall be established.

(7) The operator and signalperson shall conduct a test lift with an empty manlift platform.

(8) Communication between the cableway operator, signalperson, and persons being lifted shall be maintained.

(9) Warning or limiting devices shall be installed to prevent two-blocking, unless audible communication has been provided and one of the persons being lifted has been specifically assigned the task of warning of the approach of a two-block condition.

(10) The cableway shall be operated so that downward motion will be controlled load lowering (no freefall).

(11) When welding is done by an employee on the platform, the electrode holders shall be protected from contact with metal components of the platform.

(100) (12) Employees being lifted shall wear fall protection devices with lanyards attached, preferably above the hook or shackle.

(13) The operator shall remain at the controls while persons are suspended.

(14) When lifting or lowering platforms, the operator shall control the speed and it shall not exceed 100 ft/min (0.51 m/s).

(15) The employees being lifted, moved, or positioned shall remain in continuous sight or in communication with the operator or signalperson.

(16) The total weight of the lifted load (including personnel) shall not exceed 50% of the cableway load rating.

(b) The platform shall be designed and constructed in accordance with the following.

(1) The platform shall be designed by a qualified person.

(2) The platform shall be limited to a capacity of six persons.

(3) The platform and attaching devices shall have a minimum design factor of 5.

(4) The platform shall have a plate specifying the weight of the empty platform, and the maximum number of persons and weight for which the platform is rated.

(5) The platform shall have standard railing as defined in ANSI A12.1.

(6) The sides of the platform shall be enclosed from floor to midrail.

(7) If access doors are installed, they shall open only to the interior of the platform. Access doors shall be equipped with a device to restrain the door from inadvertent opening.

(8) The platform shall have overhead protection when there is an overhead hazard.

(9) The platform shall be easily identifiable by high visibility color or marking.

(10) The platform shall be attached by means such as, but not limited to, a shackle, hook (latched or moused), or wedge and socket attachment. A wedge and socket attachment shall have a clip on the free end of the load line.

(11) The suspension system shall minimize inclination of the platform due to the movement of personnel on the platform.

(c) Lower load block mounted platforms should be used for performing inspection and maintenance of the lower/upper load blocks, carriage, rope, and slack carriers when access is not available via the towers. This platform should be part of the lower load block as described in para. 19-1.3.7(b).

Section 19-3.3: Signals

19-3.3.1 Standard Signals. Standard signals to the operator shall be in accordance with the standards prescribed in para. 19-3.3.2, 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.

19-3.3.2 Hand Signals. Hand signals shall be in accordance with Fig. 9 and shall be posted conspicuously.

19-3.3.3 Special Signals. For operations not covered by para. 19-3.3.2 or for special conditions that occur from time to time, additions to or modifications of the standard signals may be required. In such cases these special signals shall be agreed to in advance by the operator and the signalperson and should not be in conflict with the standard signals.

19-3.3.4 Instructions. If it is desired to give instructions to the operator, other than those provided by the established signal system, the cableway motions shall be stopped.

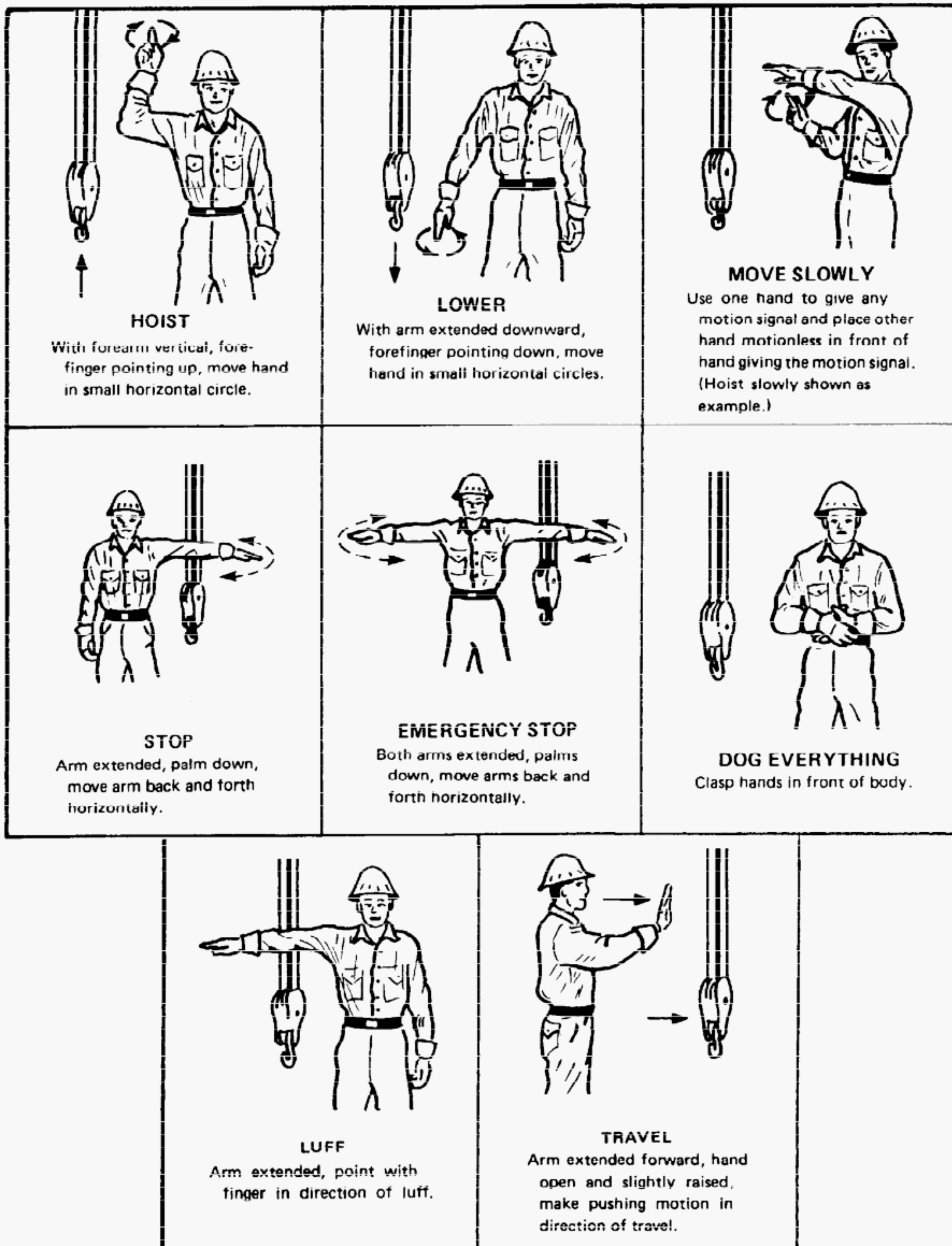


FIG. 9 STANDARD HAND SIGNALS FOR CONTROLLING CABLEWAY OPERATIONS

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Section 19-3.4: Miscellaneous

19-3.4.1 Ballast or Counterweight. Cableways shall not be operated without the full ballast or counterweight in place as specified by the manufacturer or designer.

- (00) **19-3.4.2 Aerial Marking.** When required, towers and suspension cables shall be marked and lighted in accordance with applicable Federal Aviation Administration requirements (see para. 19-1.3.14).

19-3.4.3 Hoist, Ropes, and Rope Anchors. A cableway shall not be operated until hoists and ropes have been installed, attached, and anchored as specified by the manufacturer.

19-3.4.4 Operating Near Electric Power Lines

(a) Cableways shall be operated so that no part of the cableway or load enters into the danger zone shown in Fig. 10.

EXCEPTIONS:

(1) The danger zone may be entered if the electrical distribution and transmission lines have been deenergized and visibly grounded at the point of work; or

(2) The danger zone may be entered if insulating barriers (not a part of nor an attachment to the cableway) 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 cableway or load (including handling appendages) shall be 10 ft (3 m). For higher voltages, see Table 1.

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

(3) A qualified signalperson shall be assigned to observe the clearance when the cableway moves within the proximity of the limits specified in Table 1. The operator may not be in the best position to judge distance between the power line and the cableway or its protuberances.

(b) If insulating links or proximity warning devices are used on cableways, such devices shall not be a substitute for the requirements of (a) above, even if such devices are required by law or regulation. In view of the complex, invisible, and lethal nature of the electrical hazard involved, and to lessen the potential of false security, limitations of such devices, if used, shall be understood by operating personnel and tested in the manner and at intervals prescribed by the manufacturer of the device or a qualified person. Compliance

with (a) above is the recommended practice of this Volume in determining permissible proximity of the cableway and its protuberances, including load, to electrical power lines.

(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, provide them with all pertinent information, and request 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 warning that electrocution or serious bodily injury may occur unless a minimum clearance of 10 ft (3 m) is maintained between the cableway or the load being handled and energized power lines. Greater clearances are required because of higher voltage as stated in (a)(1) above. These signs shall be revised when local jurisdiction requires greater clearances.

19-3.4.5 Cabs

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

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

19-3.4.6 Refueling

(a) When refueling with a small portable container, it shall be Underwriters Laboratories or Factory Mutual Laboratories approved (or equivalent) safety-type can equipped with automatic closing cap and flame arrester.

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

(c) Smoking or open flames shall be prohibited in the refueling area. Refueling areas shall be posted as such.

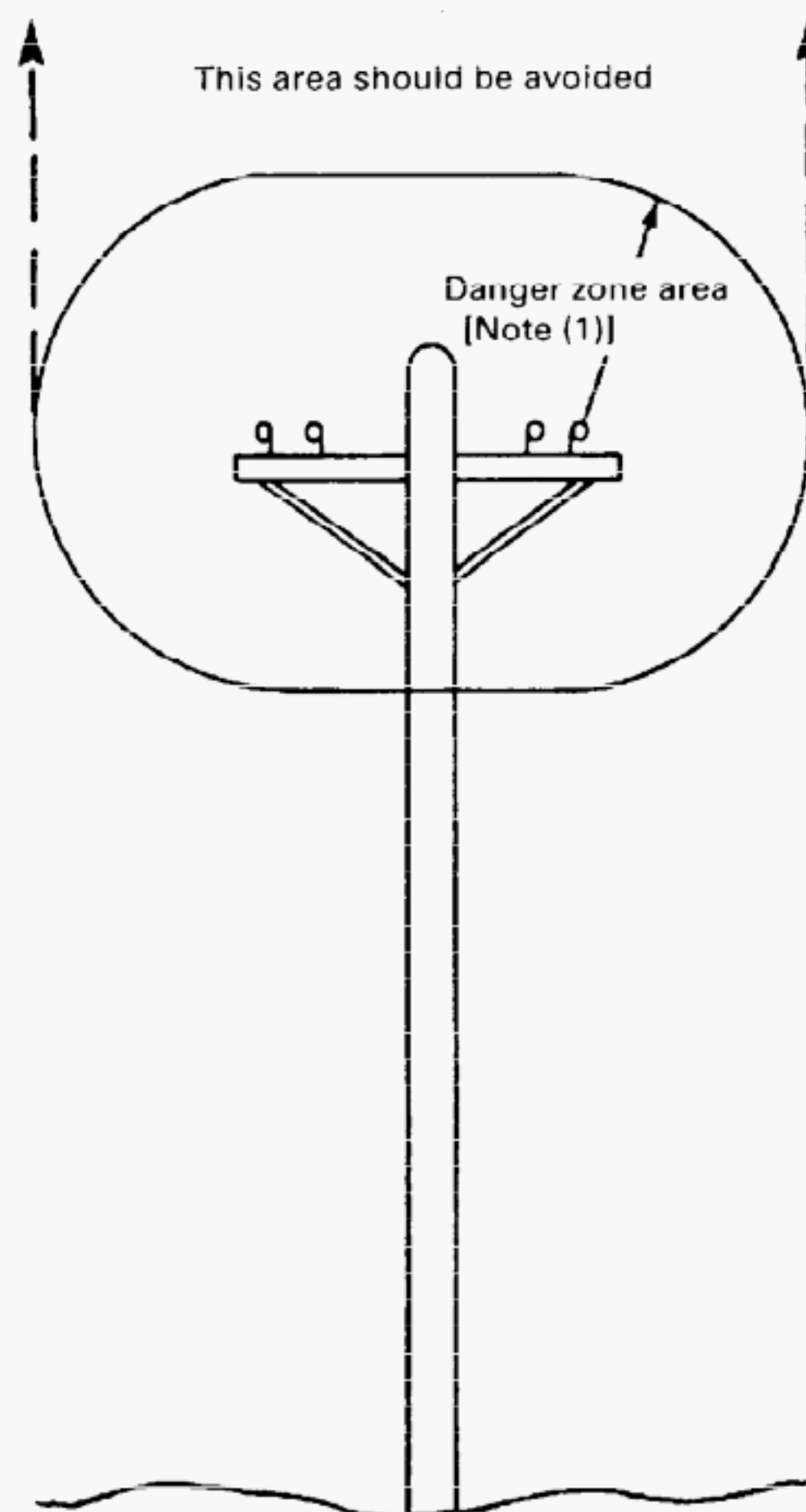
19-3.4.7 Fire Extinguishers

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

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

**TABLE 1 REQUIRED CLEARANCE FOR
NORMAL VOLTAGE IN OPERATION NEAR
HIGH VOLTAGE POWER LINES**

Normal Voltage, kV (Phase to Phase)	Minimum Required Clearance, ft (m)
Operation Near High Voltage Power Lines	
To 50	10 (3.05)
Over 50 to 200	15 (4.60)
Over 200 to 350	20 (6.10)
Over 350 to 500	25 (7.62)
Over 500 to 750	35 (10.67)
Over 750 to 1000	45 (13.72)



NOTE:

(1) For minimum radial distance of danger zone, see para. 19-3.4.4.

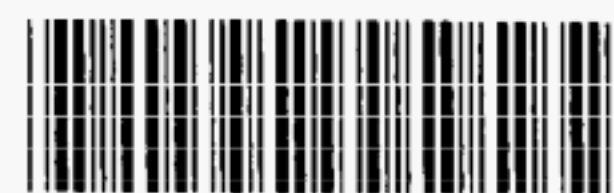
**FIG. 10 DANGER ZONE FOR CABLEWAYS AND LIFTED LOADS OPERATING NEAR ELECTRICAL
TRANSMISSION LINES**

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