

OVERHEAD UNDERHUNG AND STATIONARY HOISTS

Chapter 16-0

(17)

Scope, Definitions, Personnel Competence, and References

SECTION 16-0.1: SCOPE OF B30.16

Volume B30.16 includes provisions that apply to the construction, installation, operation, inspection, testing, and maintenance of overhead underhung and stationary hoists, including hand-chain-operated, electric-powered, and air-powered chain and wire rope hoists used for, but not limited to, vertical lifting and lowering of freely suspended, unguided loads that consist of equipment and materials (see Figs. 16-0.1-1 through 16-0.1-6).

Requirements for a hoist that is used for a special purpose, such as, but not limited to, tensioning a load, nonvertical lifting service, lifting a guided load, lifting personnel, or drawing both the load and the hoist up or down the load chain or rope when the hoist is attached to the load, are not included in this Volume.

SECTION 16-0.2: DEFINITIONS

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

block, load: the assembly of hook or shackle, swivel, bearing, sheaves, sprockets, pins, and frame suspended by the hoisting rope or load chain. This shall include any appurtenances reeved in the hoisting rope or load chain.

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

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

brake, mechanical load: an automatic type of friction brake used for controlling loads in a lowering direction. This unidirectional device requires torque from the motor or hand chain wheel to lower a load but does not impose any additional load on the motor or hand chain wheel when lifting a load. This may also be used as a holding brake if designed as such by the manufacturer.

braking, control: a method of controlling speed by removing energy from the moving body or by imparting energy in the opposite direction.

braking, countertorque (plugging): a method of control by which the power to the motor is reversed to develop torque in the direction opposite to the rotation of the motor.

braking, dynamic: a method of controlling speed by using the motor as a generator, with the energy being dissipated in resistors.

braking, eddy current: a method of controlling or reducing speed by means of an energy induction load brake.

braking, mechanical: a method of controlling or reducing speed by friction.

braking, regenerative: a method of controlling speed in which the electrical energy generated by the motor is fed back into the power system.

chain, hand: the chain grasped by a person to apply force required for the lifting or lowering motion.

chain, load: the load-bearing chain in a hoist.

chain, roller: a series of alternately assembled roller links and pin links in which the pins articulate inside the bushings and the rollers are free to turn on the bushings. Pins and bushings are press fit in their respective link plates.

chain, welded link: a chain consisting of a series of interwoven links, formed and welded.

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

equalizer: a device that compensates for unequal length or stretch of a rope or chain.

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

guide, chain: a means to guide the load chain at the load sprocket.

hazardous (classified) locations: locations where fire or explosion hazards may exist. Locations are classified depending on the properties of the flammable vapors,

liquids, or gases, or combustible dusts or fibers that may be present, and the likelihood that a flammable or combustible concentration or quantity is present (see ANSI/NFPA 70).

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

hoist, stationary: a base or deck-, ceiling-, or wall-mounted hoist used for vertical lifting and lowering of freely suspended, unguided loads (see Fig. 16-0.1-6).

hoist, underhung: trolley hoists or hoists suspended from trolleys traveling on the lower flanges of beams or similar hoists that are hook- or lug-suspended.

hoist operator, dedicated: an employee whose job is normally confined solely to the operation of the equipment.

lifting devices: devices that are not normally reeved onto the hoist rope or chain, such as hook-on buckets, magnets, grabs, and other supplemental devices used for ease of handling certain types of loads. The weight of these devices is to be considered part of the load to be lifted.

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

load, rated (capacity): the maximum load designated by the manufacturer for which the equipment is designed and built.

load, working: the external load applied to the equipment, including the weight of load-attaching equipment, such as shackles and slings.

load suspension parts: the load suspension parts of the hoist are the means of suspension (hook or lug), the structure or housing that supports the drum or load sprocket, the drum or load sprocket, the rope or load chain, the sheaves or sprockets, and the load block or hook.

lockout/tagout: the placement of a lock/tag on the energy-isolating device in accordance with an established procedure.

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

normal operating conditions: conditions during which equipment is performing functions within the scope of the original design.

operator, nondedicated: an employee who uses the equipment as a tool to assist in the performance of his/her regular job.

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

overload: any load greater than the rated load.

overtravel restraint: a device used to prevent the slack load chain from inadvertently being lowered out of the load sprocket.

parts (lines): number of lines of rope or chain supporting the load block or hook.

pawl: a device that engages a ratchet to prevent rotation.

pendant station: controls suspended from the equipment for operating the unit from the floor.

power transmission parts: the machinery components including the gears, shafts, clutches, couplings, bearings, motors, and brakes.

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

ratchet: a toothed member for engagement with the pawl.

reeving: a system in which a rope or chain travels around drums, sheaves, or sprockets.

rope: refers to wire rope unless otherwise specified.

service, heavy: service that involves operation within the rated load limit that exceeds normal service.

service, normal: service that involves operation with randomly distributed loads within the rated load limit, or uniform loads less than 65% of rated load for not more than 15% of the time for manually operated hoists and 25% of the time for electric- or air-powered hoists.

service, severe: service that involves normal or heavy service with abnormal operating conditions.

shall: a word indicating a requirement.

sheave: a wheel or pulley used with a rope or chain to change direction and point of application of a pulling force.

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

sheave, running: a sheave that rotates as the load block is lifted or lowered.

should: a word indicating a recommendation.

side pull: the component of the hoist pull acting horizontally when the hoist lines are not operated vertically.

sprocket, idler: a freely rotating device that changes the direction of the load chain.

sprocket, load: a hoist component that transmits motion to the load chain. This component is sometimes called *load wheel*, *load sheave*, *pocket wheel*, or *chain wheel*.

stripper: a device that aids the load chain in leaving the load sprocket.

switch: a device for making, breaking, or changing the connections in an electric or pneumatic circuit (valve).

transmitter: the device used for remote control that is not electrically connected to the hoist.

unattended: a condition in which the operator is not at the operating control devices. If, however, the control devices are within sight of the operator, the equipment should be considered attended.

wheel, hand chain: a wheel with formed pockets on its periphery to allow torque to be transmitted when a force is applied to the hand chain.

SECTION 16-0.3: PERSONNEL COMPETENCE

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.

SECTION 16-0.4: REFERENCES

The following is a list of standards and specifications referenced in this Standard.

AA ADM-1-2015, Aluminum Design Manual
 Publisher: Aluminum Association, Inc. (AA),
 1400 Crystal Drive, Suite 430, Arlington, VA 22202
 (<http://www.aluminum.org>)

AISC/ASD Manual of Steel Construction,
 14th Edition, 2011

AISC/LRFD Manual of Steel Construction, 2nd Edition,
 2nd Revision, 1998

Publisher: American Institute of Steel Construction
 (AISC), 130 East Randolph Street, Suite 2000, Chicago,
 IL 60601 (<http://www.aisc.org>)

ANSI ECMA 15-2010, Specifications for Cable-less
 Controls for Electric Overhead Traveling Cranes

Publisher: Monorail Manufacturers Association, Inc.
 (MMA), 8720 Red Oak Boulevard, Charlotte, NC 28217
 (<http://www.mhia.org/industrygroups/mma>)

ANSI/NEMA Standards Publication No. ICS 6-1993,
 Industrial Control and Systems: Enclosures¹

¹ May also be obtained from American National Standards
 Institute (ANSI), 25 West 43rd Street, New York, NY 10036
 (<http://www.ansi.org>)

ANSI Z535.4-2007, Product Safety Signs and Labels¹
 Publisher: National Electrical Manufacturers
 Association (NEMA), 1300 North 17th Street, Suite
 900, Arlington, VA 22209 (<http://www.nema.org>)

ANSI/NFPA 70-2011, National Electrical Code¹
 Publisher: National Fire Protection Association (NFPA),
 1 Batterymarch Park, Quincy, MA 02169-7471
 (<http://www.nfpa.org>)

ASME B29.24-2002, Roller Load Chains for Overhead
 Hoists (R2009)

ASME B30.9-2014, Slings

ASME B30.10-2014, Hooks

ASME B30.11-2010, Monorails and Underhung Cranes

ASME B30.17-2015, Overhead and Gantry Cranes (Top
 Running Bridge, Single Girder, Underhung Hoist)

ASME HST-1-1999, Performance Standard for Electric
 Chain Hoists

ASME HST-2-1999, Performance Standard for Hand
 Chain Manually Operated Chain Hoists

ASME HST-4-1999, Performance Standard for Overhead
 Electric Wire Rope Hoists

ASME HST-5-1999, Performance Standard for Air Chain
 Hoists

ASME HST-6-1999, Performance Standard for Air Wire
 Rope Hoists

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

ASSE Z244.1-2003 (R2008), Safety Requirements for the
 Lockout/Tagout of Energy Sources¹

Publisher: The American Society of Safety Engineers
 (ASSE), 520 N. Northwest Hwy, Park Ridge, IL 60068
 (<http://www.asse.org>)

ASTM E2349-2009, Standard Practice for Safety
 Requirements in Metal Casting Operations: Sand
 Preparation, Molding, and Core Making; Melting and
 Pouring; and Cleaning and Finishing¹

Publisher: American Society for Testing and Materials
 (ASTM International), 100 Barr Harbor Drive, P.O. Box
 C700, West Conshohocken, PA 19428-2959
 (<http://www.astm.org>)

ISO 7000-2012, Graphical symbols for use on equip-
 ment — Registered symbols

ISO 7296-1991, Cranes — Graphical symbols — Parts 1–3

Publisher: International Organization for
 Standardization (ISO), Central Secretariat, Chemin de
 Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva,
 Switzerland (<http://www.iso.org>)

Fig. 16-0.1-1 Hand-Chain-Operated Chain Hoist

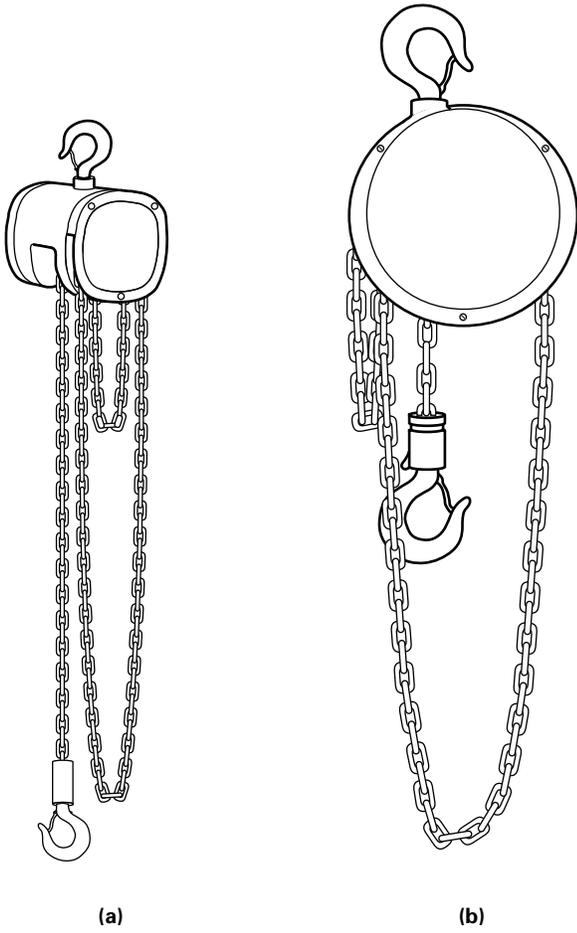


Fig. 16-0.1-2 Electric-Powered Chain Hoist

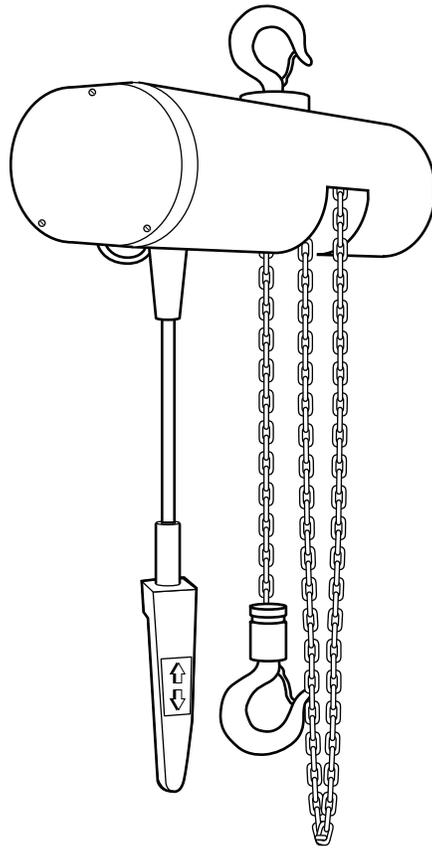


Fig. 16-0.1-3 Air-Powered Chain Hoist

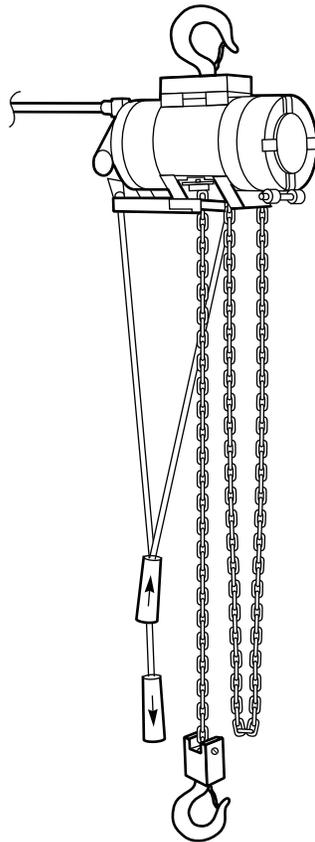
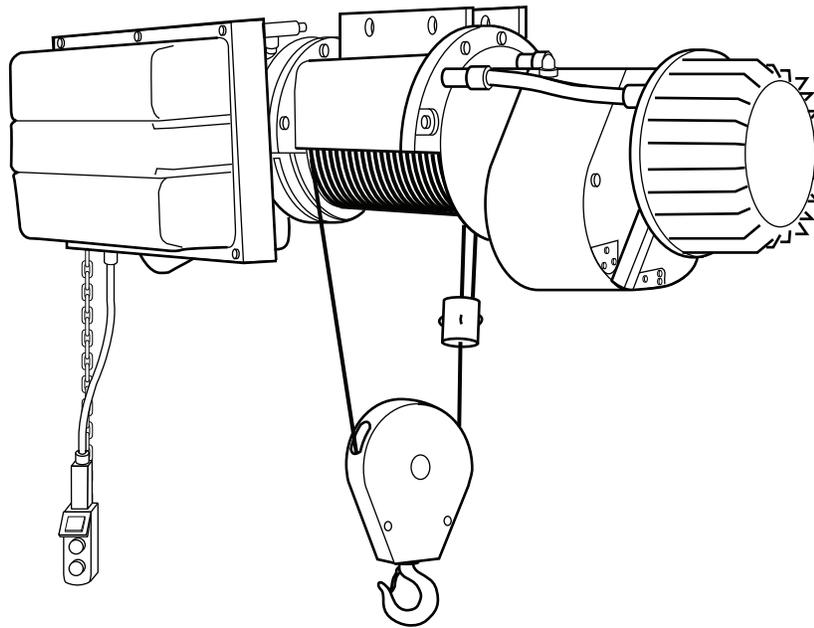
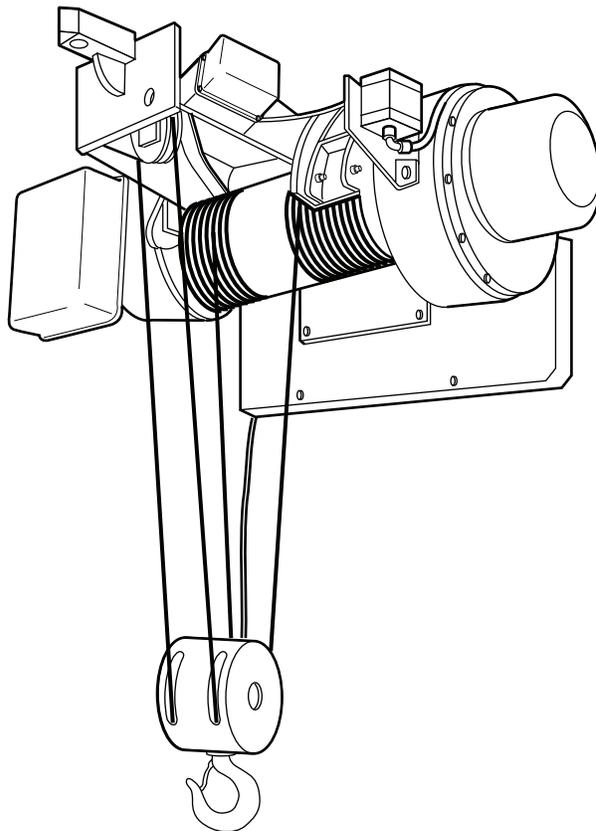


Fig. 16-0.1-4 Electric-Powered Wire Rope Hoist



(a)



(b)

Fig. 16-0.1-5 Air-Powered Wire Rope Hoist

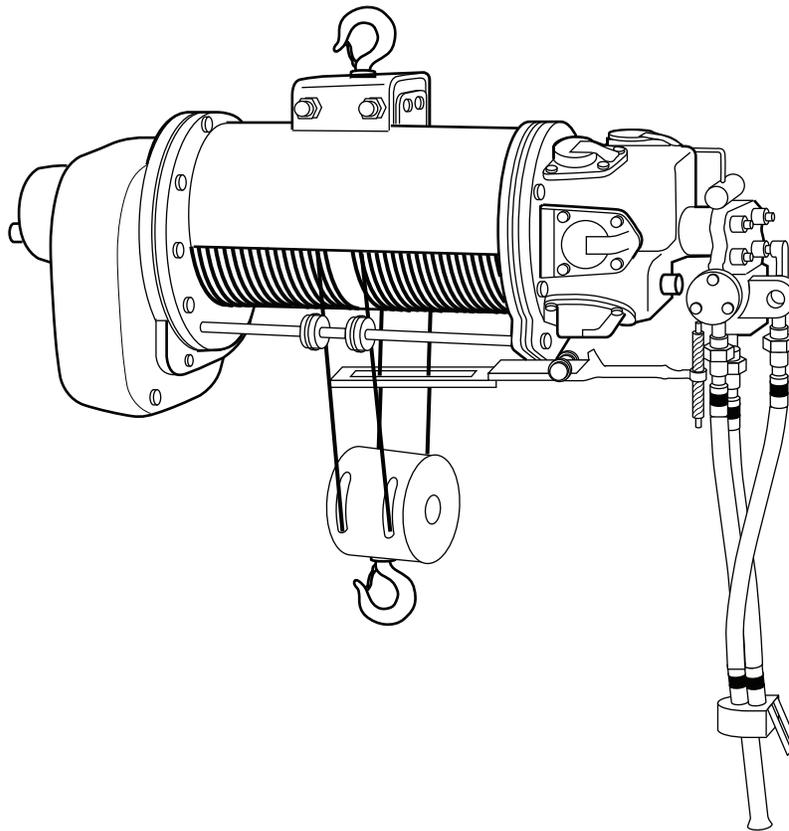
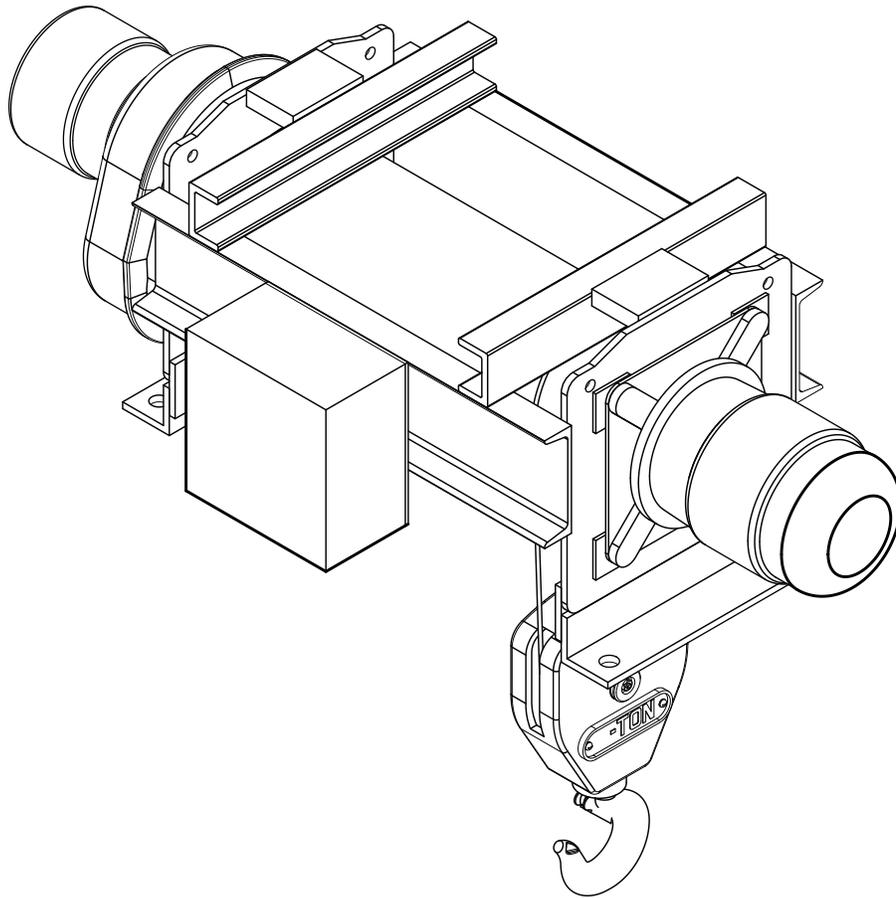
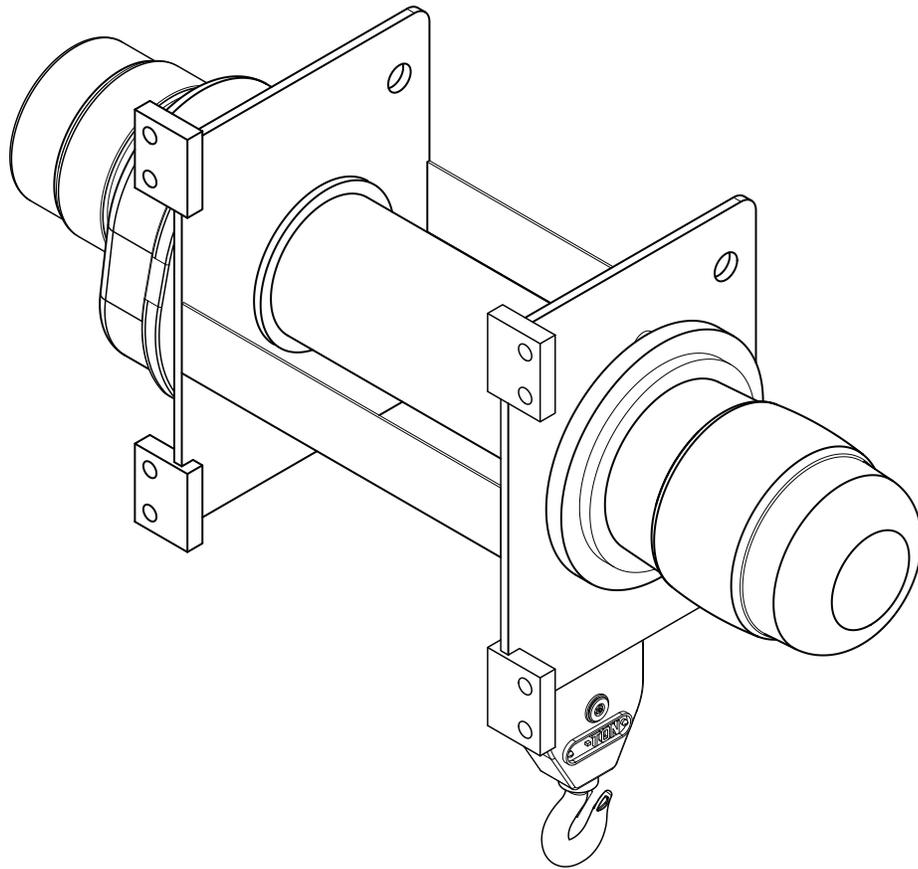


Fig. 16-0.1-6 Stationary Hoist



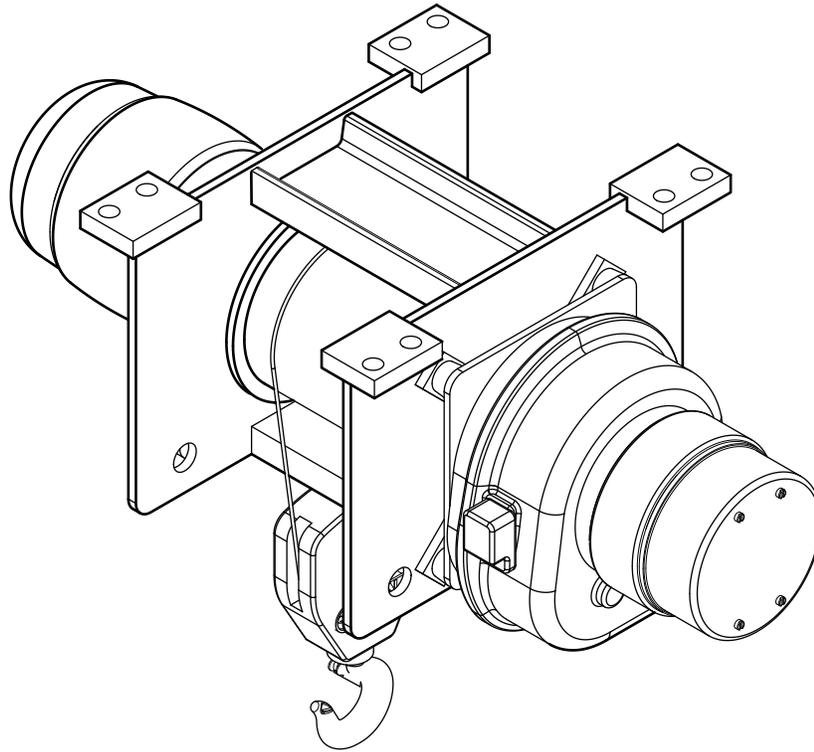
(a) Base or Deck Mounted

Fig. 16-0.1-6 Stationary Hoist (Cont'd)



(b) Wall Mounted

Fig. 16-0.1-6 Stationary Hoist (Cont'd)



(c) Ceiling Mounted

Chapter 16-1

Marking, Construction, and Installation

SECTION 16-1.1: MARKING

16-1.1.1 Rated Load

The rated load of the hoist shall be marked on the hoist or its load block and shall be legible from the ground or floor.

16-1.1.2 Controls

(a) Each control actuator of an electric-powered or air-powered hoist shall be marked to indicate the direction of resultant motion.

(b) In locations or areas where multiple electric-powered or air-powered hoists are used, the arrangement of control actuator markings for directions of motion on pendant push-button stations and radio-controlled transmitters should be the same for all hoists in that location or area.

(17) 16-1.1.3 Identification

The hoist shall be marked with manufacturer's identification information on a plate or label attached to the hoist, or cast, forged, or stamped on the hoist, as follows:

(a) *Hand-Chain-Operated Hoist*

- (1) name of manufacturer
- (2) manufacturer's model or serial number

(b) *Electric-Powered Hoist*

- (1) name of manufacturer
- (2) manufacturer's model or serial number
- (3) voltage of AC or DC power supply and phase and frequency of AC power supply
- (4) full load amperage (FLA)
- (5) hoist duty service classification per ASME HST-1 or ASME HST-4, as appropriate

(c) *Air-Powered Hoist*

- (1) name of manufacturer
- (2) manufacturer's model and serial number
- (3) rated air pressure
- (4) hoist duty service classification per ASME HST-5 or ASME HST-6, as appropriate

16-1.1.4 Product Safety Information

(a) All hand-chain-operated hoists shall have affixed to the hoist or load block a label or labels displaying information concerning operating procedures. The label or labels shall be in compliance with ANSI Z535.4, and shall include cautionary language against

- (1) lifting more than rated load

(2) operating hoist with twisted, kinked, or damaged chain

- (3) operating damaged or malfunctioning hoist
- (4) lifting people
- (5) lifting loads over people
- (6) operating hoist with other than manual power
- (7) removing or obscuring label

(b) All electric-powered or air-powered hoists shall have affixed to the hoist, load block, or controls a label or labels displaying information concerning operating procedures. The label or labels shall be in compliance with ANSI Z535.4, and shall include cautionary language against

- (1) lifting more than rated load
- (2) operating hoist when load is not centered under hoist
- (3) operating hoist with twisted, kinked, or damaged chain or rope
- (4) operating damaged or malfunctioning hoist
- (5) lifting people
- (6) lifting loads over people
- (7) operating a rope hoist with a rope that is not properly seated in its groove
- (8) removing or obscuring label

(c) A label shall be affixed on all electrical control enclosures. The label shall be in compliance with ANSI Z535.4, and shall include, but not be limited to, information such as

- (1) "DISCONNECT POWER AND LOCKOUT/TAGOUT DISCONNECTING MEANS BEFORE REMOVING COVER OR SERVICING THIS EQUIPMENT"
- (2) "DO NOT OPERATE WITHOUT COVER IN PLACE"

16-1.1.5 Technical and Safety-Related Information (17)

The manufacturer shall provide instructions [manual(s)] for the operation, inspection, testing, maintenance, assembly, and disassembly of the equipment.

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

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

(c) Translations of the original language instructions (if the manufacturer no longer exists, translation of the

instructions with the machine is acceptable) shall meet professional translation industry standards, which include, but are not limited to, the following:

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

(2) ensuring grammatical accuracy

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

(4) translating the terminology accurately

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

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

(17) SECTION 16-1.2: CONSTRUCTION

16-1.2.1 Mechanical Design

(a) The hoist and appurtenances shall be designed to withstand all stresses imposed under normal operating conditions while handling loads within the rated load.

(b) Load suspension parts, except for roller load chain, of hand-chain-operated hoists shall be designed so that the static stress calculated for the rated load shall not exceed 25% of the minimum tensile strength. Roller load chain shall be designed so that the static stress calculated for the rated load shall not exceed 25% of the minimum tensile strength as stated in ASME B29.24.

(c) Load suspension parts, except for roller load chain, of electric-powered or air-powered hoists shall be designed so that the static stress calculated for the rated load shall not exceed 20% of the minimum tensile strength. Roller load chain shall be designed so that the static stress calculated for the rated load shall not exceed 20% of the minimum tensile strength as stated in ASME B29.24.

(d) Power transmission and load suspension parts shall be designed so that the dynamic stress calculated for the rated load shall not exceed the fatigue limits established by the manufacturer.

(e) Modifications to upgrade, rerate, or modernize hoist equipment shall be as authorized only by the original equipment manufacturer or a qualified person.

(f) The hoist shall be designed in accordance with applicable hoist design and performance standards. Refer to ASME HST-1, ASME HST-2, ASME HST-4, ASME HST-5, and ASME HST-6.

16-1.2.2 Electrical Design (Electric-Powered Hoists Only)

(a) Electrical construction shall comply with Article 610 of ANSI/NFPA 70.

(b) Electrical equipment shall be so located or enclosed such that personnel will not be exposed to

inadvertent contact with energized parts under normal operating conditions.

(c) Enclosures for resistors (if required) shall provide means for heat dissipation. Provision shall be made to prevent broken resistor parts or molten metal from falling onto the operator, other personnel, or combustible materials. Conductors connected to resistors shall have a flame-resistant outer covering or be covered with flame-resistant tape.

(d) Control panels and other electrical equipment, such as switchboards and panelboards that are likely to require inspection, adjustment, servicing, or maintenance while energized, shall be marked to warn of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to personnel before inspection, adjustment, servicing, or maintenance of the equipment.

16-1.2.3 Controls (Electric- or Air-Powered Hoists Only)

(a) Controls, except in automatic cycling operation, shall return to the off position when released, and hook motion shall stop.

(b) The reversing contactor of electric-powered hoists shall be mechanically or electrically interlocked to prevent line-to-line faults.

(c) The voltage at pendant push-button station of electric-powered hoists shall not exceed 150 V for AC or 300 V for DC.

(d) A pendant station shall be supported in a manner that will protect the electrical conductors or air hoses against strain. Any pendant station that might present a hazard to the operator, if a ground fault occurs, shall be grounded.

(e) Hoists using radio controls shall be provided in accordance with ANSI ECMA 15.

(f) Push buttons of pendant stations shall be guarded or shrouded to prevent accidental actuation of hoist motion.

(g) A minimum of two collectors for each runway conductor shall be furnished when a hoist uses inverters.

(h) For hoists utilizing brake failure detection, a unique visual or audible warning should be provided to alert the operator of a brake failure.

16-1.2.4 Rope Sheaves (Electric- or Air-Powered Hoists Only)

(a) The pitch diameter of running sheaves should not be less than 16 times the rope diameter.

(b) The pitch diameter of nonrunning sheaves should not be less than 12 times the rope diameter.

(c) The grooves shall be free from surface conditions or damage that could cause accelerated wear or damage to the rope. 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.

(d) Sheaves shall be so mounted as to guard against rope jamming during normal operating conditions.

(e) All running sheave bearings, except permanently lubricated bearings, should be equipped with means for lubrication.

16-1.2.5 Rope Drum (Electric- or Air-Powered Hoists Only)

(a) The pitch diameter of the drum should not be less than 18 times the rope diameter.

(b) For grooved drums, the grooves shall be free from surface conditions or damage that could cause accelerated wear or damage to the rope. The cross-sectional radius at the bottom of the groove should form a close-fitting saddle for the size of rope used. This requirement does not preclude the use of multiple layer spooling.

16-1.2.6 Ropes (Electric- or Air-Powered Hoists Only)

(a) The hoisting ropes shall be of a construction recommended for hoist service. The rated load divided by the number of parts (lines) of rope shall not exceed 20% of the minimum breaking force of the rope. When rope and rope core may be exposed to an environmental condition under which rope or core would be damaged, a rope and core having resistance to the conditions shall be used.

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

(c) The rope ends shall be attached to the hoist in a manner to prevent disengagement throughout rated hook travel. No less than two wraps of rope shall remain on each anchorage of the hoist drum when the hook is in its extreme low position unless a lower-limit device is provided, in which case no less than one wrap shall remain on each anchorage of the hoist drum.

(d) Eye splices shall be made in a manner recommended by the rope or hoist manufacturer or a qualified person. Rope thimbles should be used in the eye.

(e) Wire-rope clips shall be drop-forged steel of the single-saddle-type (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 or compressed fittings shall be applied as recommended by the rope, hoist, or fitting manufacturer or a qualified person.

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

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

16-1.2.7 Load Sprockets

(a) Load sprockets shall have pockets or teeth to allow engagement of the load chain.

(b) Load sprockets shall be guarded.

(c) Provision shall be made to guard against jamming of the load chain within the hoisting mechanism under normal operating conditions.

16-1.2.8 Load Chain

(a) Load chain may be either roller or welded link type. Chain shall be pitched (calibrated) so as to pass over all load sprockets without binding.

(b) Roller load chain shall comply with ASME B29.24.

(c) Welded-link-type load chain shall be proof tested by the chain or hoist manufacturer with a load at least equivalent to 1½ times the hoist's rated load divided by the number of chain parts supporting the load.

(d) If a load is supported by more than one part of load chain, the tension on the parts shall be equalized.

(e) Welded-link-type load chain properties do not conform to those shown in ASME B30.9.

16-1.2.9 Hooks

If hooks are of the swiveling type, they should rotate freely. Hooks shall be equipped with latches unless use of the latch creates a hazardous condition. When required, a latch shall be provided to bridge the throat opening of the hook, and retain, under slack conditions, such items as, but not limited to, slings and chains. Refer to ASME B30.10.

16-1.2.10 Load Blocks

(a) *Hand-Chain-Operated Hoist.* Means shall be provided to guard against load chain jamming in the load block under normal operating conditions.

(b) *Electric- or Air-Powered Hoist.* Load blocks shall be of the enclosed type, and means shall be provided to guard against rope or load chain jamming in the load block under normal operating conditions.

16-1.2.11 Brakes

(a) *Hand-Chain-Operated Hoist.* Hand-chain-operated hoist(s) shall be so designed that, when the actuating force is removed, it will automatically stop and hold any test load up to 125% of the rated load.

(b) Electric-Powered Hoist

(1) Under normal operating conditions with rated load and test conditions with test loads up to 125% of rated load, the braking system shall perform the following functions:

(-a) stop and hold the load hook when controls are released

(-b) limit the speed of load during lowering to a maximum speed of 120% of rated lowering speed for the load being handled

(-c) stop and hold the load hook in the event of a complete power failure

(2) The braking system shall have thermal capacity for the frequency of operation required by the service.

(3) The braking system shall have provision for adjustments where necessary to compensate for wear.

(4) Electric-powered hoists that handle molten material shall be equipped with one of the following arrangements, which may also be specified for other specific applications:

(-a) Two holding brakes shall be provided, one of which is applied to a gear reducer shaft, plus control braking means. Each holding brake shall have a torque rating not less than 100% of rated load hoisting torque at the point where the brake is applied.

(-b) One holding brake shall be provided if the hoisting unit has a mechanical load brake or a control braking means that provides controlled lowering of the load upon loss of power. The holding brake shall have a torque rating not less than 150% of rated load hoisting torque at the point where the brake is applied.

(c) Air-Powered Hoist

(1) Under normal operating conditions with rated load and test conditions with test loads up to 125% of rated load, the braking system shall perform the following functions:

(-a) stop and hold the load hook when controls are released

(-b) stop and hold the load hook in the event of a loss of air pressure when the controls are returned to neutral

(2) The braking system shall have thermal capacity for the frequency of operation required by the service.

(3) The braking system shall have provision for adjustments where necessary to compensate for wear.

16-1.2.12 Hand Chain (Hand-Chain-Operated Hoists Only)

(a) The hand chain shall be of a shape and pitch to fit the hand chain wheel without binding or jamming under normal operating conditions.

(b) The hand chain shall be guarded to prevent disengagement from the hand chain wheel.

(c) The hand chain shall withstand, without permanent distortion, a force of three times the pull required to lift the rated load.

(d) Hand chain properties do not conform to those shown in ASME B30.9.

16-1.2.13 Overtravel Restraint (Hand-Chain-Operated Hoists Only)

Before the load chain can be completely run out of the hoist, it shall be restrained in its fully extended position. The restraint shall be such that the unloaded hoist can withstand a lowering hand chain force equivalent to twice the pull required to lift the rated load or, with rated load on the hoist, a hand chain force equivalent to the pull required to lift the rated load.

16-1.2.14 Overtravel Protection (Electric- or Air-Powered Hoists Only)

The hoist shall be so designed and constructed that the load hook, either loaded or empty, shall not exceed the upper limit of travel. On powered-chain hoists, the use of a travel-limiting clutch as overtravel protection is permitted. If installed, overtravel protection components shall be designed by the manufacturer according to the requirements of para. 16-1.2.1(a). On wire-rope hoists, if a geared or other lift-limiting device that operates in relation to drum turns is used, an additional lift-limiting device that operates independently of drum rotations shall be provided. The activation point of all lift-limiting devices shall be located to allow for maximum stopping distance of the motion being stopped for the braking system being used.

16-1.2.15 Power Failure Protection (Electric- or Air-Powered Hoists Only)

Partial or complete interruption of the power supply (air or electric) during operation shall not result in uncontrollable motion of the load.

16-1.2.16 Lubrication

If lubrication is required, accessible means for lubrication should be provided.

16-1.2.17 Manual

The manufacturer shall furnish an instruction manual with each hoist. The manual shall include information on the following:

(a) installation

(b) operation

(c) inspection and testing (including travel limit clutches when used as limit devices)

(d) lubrication, maintenance, and repair

(e) wiring diagram (electric powered only; may be supplied separately)

SECTION 16-1.3: INSTALLATION**16-1.3.1 Procedure**

(a) Procedures for installation recommended in the manual should be followed.

(b) When a hoist is suspended from a trolley, a trolley and monorail, or a trolley and crane, and the rated load of each of these pieces of equipment is different, the rated load for the system utilizing this combination of equipment shall be based on the lowest minimum rated load of any individual piece of equipment or structure within the system.

(17) 16-1.3.2 Support

The supporting structure, including trolleys, monorail, or crane, shall be designed to withstand the loads and forces imposed by the hoist for the rated load. The supporting structure should conform to the design parameters as specified in the applicable AISC Manual of Steel Construction, Aluminum Design Manual, or applicable design manual or standard for the material used.

(17) 16-1.3.3 Location

(a) Hoists shall be installed in locations that will allow movement of the operator to stay clear of the load.

(b) When hoists are used in hazardous locations as defined by ANSI/NFPA 70, modifications to these rules or additional safety requirements may be necessary.

(c) When hoists are used to handle molten material, modifications to these rules or additional safety requirements may be necessary. Refer to ASTM E2349.

(d) When electric hoists are used in locations other than general indoor applications, control enclosures should be selected in accordance with ANSI/NEMA No. ICS 6.

(e) Pendant controls of electric- or air-powered hoists should be located at a convenient level above the operating floor.

(f) An electric- or air-powered hoist shall not be installed where the load hook can be lowered beyond

the rated hook travel under normal operating conditions unless the hoist is equipped with a lower-limit device.

(g) Where the slack load chain hanging from the hoist may create a hazard to operations or personnel, a chain container recommended by the hoist manufacturer or qualified person should be used.

(h) When hoists are supported and used on cranes, trolleys, or monorails, modifications to these rules or additional safety requirements may be necessary. Refer to ASME B30.17.

16-1.3.4 Power Connections

(a) Electric-powered hoists shall be connected in accordance with ANSI/NFPA 70.

(b) Air-powered hoists shall be connected to an air supply not exceeding the rated pressure at the hoist under normal operating conditions. To prevent excessive brake wear or heating, the air supply should be sufficient to operate the brake-release mechanism, if provided.

16-1.3.5 Direction of Motion (Electric- or Air-Powered Hoists Only)

(a) *Electric-Powered Hoists.* Polyphase hoist motors shall be connected to the power supply lines in such a manner that the hook motion agrees with the control marking. Internal connections in the hoist or pendant station wiring shall not be changed to accomplish this. Phase reversal (motor reversal), if necessary, shall be accomplished by reversing the power leads to the hoist unit.

(b) *Air-Powered Hoists.* Air hoist motors shall be connected in such a manner that the hook motion agrees with the control marking.

16-1.3.6 Checkpoints

After installation, a check should be made as indicated in para. 16-2.1.4.

Chapter 16-2

Inspection and Testing

(17) SECTION 16-2.1: INSPECTION

16-2.1.1 General

(a) All inspections shall be performed by a designated person in accordance with the manufacturer's recommendations and requirements of this Volume. 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.

(b) *Inspection Frequency.* The intervals shall be determined by a qualified person based on intended operating conditions and their effects on critical hoist components.

16-2.1.2 Inspection Classification

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

(b) *Other Inspections.* Inspection procedures for hoists in regular service are divided into three 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 hoist and the degree of their exposure to wear, deterioration, or malfunction. The three general classifications are herein designated as preoperation, frequent, and periodic, with respective intervals between inspections as follows:

(1) *preoperation inspection:* visual inspection with records not required, performed before the first use of each shift.

(2) *frequent inspection:* visual examinations with records not required.

(-a) normal service — monthly

(-b) heavy service — weekly

(-c) severe service — daily

(3) *periodic inspection:* visual inspection with records of external conditions to provide the basis for a continuing evaluation. An external coded mark on the hoist is an acceptable identification in lieu of records.

(-a) normal service — yearly

(-b) heavy service — semiannually

(-c) severe service — quarterly

16-2.1.3 Preoperation Inspection

(a) The preoperation inspection shall be performed at intervals defined in para. 16-2.1.2(b)(1).

(b) The following items shall be inspected:

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

(2) hoist limit device(s) of electric- or air-powered hoists without a load on the hook. The load block shall be inched into its limit device or run in at slow speed on multispeed or variable-speed hoists. When travel-limiting clutches are used as limit devices, follow the methods for inspecting the travel-limiting clutch in the manual provided with the hoist.

(3) hooks for gross damage, which may be an immediate hazard.

(4) hook latches, if used, for proper operation.

(5) hoist rope for gross damage, which may be an immediate hazard.

(6) load chain for gross damage, which may be an immediate hazard.

16-2.1.4 Frequent Inspection (See Also Tables 16-2.1.4-1 and 16-2.1.4-2)

(a) Frequent inspections shall be performed at intervals defined in para. 16-2.1.2(b)(2) and shall include observations during operation.

(b) The following items shall be inspected:

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

(2) hoist limit device(s) of electric- or air-powered hoists without a load on the hook. The load block shall be inched into its limit device or run in at slow speed on multispeed or variable-speed hoists. When travel-limiting clutches are used as limit devices, follow the methods for inspecting the travel-limiting clutch in the manual provided with the hoist.

(3) hoist braking system for proper operation.

(4) lines, valves, and other parts of air systems for leakage.

(5) hooks, in accordance with ASME B30.10.

(6) hook latches, if used, for proper operation.

(7) hoist rope for gross damage, which may be an immediate hazard, such as the following:

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

(-b) general corrosion

(-c) broken or cut strands

(-d) number, distribution, and type of visible broken wires [see paras. 16-4.4.1(b)(1) through (b)(4)]

Table 16-2.1.4-1 Inspection for Hand-Chain-Operated Hoists

Item	Normal Service		Heavy Service		Severe Service	
	Visual Monthly [Note (1)]	Record Yearly [Note (2)]	Visual Weekly [Note (1)]	Record Semiannually [Note (3)]	Visual Daily [Note (1)]	Record Quarterly [Note (3)]
Frequent Inspection (Refer to para. 16-2.1.4)						
All functional operating mechanisms for maladjustment and unusual sounds	X	...	X	...	X	...
Hoist braking system for proper operation	X	...	X	...	X	...
Hooks in accordance with ASME B30.10	X	...	X	...	X	...
Hook latch operation, if used	X	...	X	...	X	...
Load chain in accordance with para. 16-2.1.4(b)(8)	X	...	X	...	X	...
Load chain reeving for compliance with hoist manufacturer's recommendations	X	...	X	...	X	...
Periodic Inspection (Refer to para. 16-2.1.5)						
Requirements of frequent inspection	...	X	...	X	...	X
Load chain in accordance with paras. 16-2.1.5(c)(13), (14), and (15)	...	X	...	X	...	X
Evidence of loose bolts, nuts, or rivets	...	X	...	X	...	X
Evidence of worn, corroded, cracked, or distorted parts such as load blocks, suspension housing, hand chain wheels, chain attachments, clevises, yokes, suspension bolts, shafts, gears, bearings, pins, rollers, and locking and clamping devices	...	X	...	X	...	X
Evidence of damage to hook-retaining nuts or collars and pins, and welds or rivets used to secure the retaining members	...	X	...	X	...	X
Evidence of damage or excessive wear of load sprockets, idler sprockets, or hand chain wheel	...	X	...	X	...	X
Evidence of worn, glazed, or oil-contaminated friction disks; worn pawls, cams, or ratchet; corroded, stretched, or broken pawl springs in brake mechanism	...	X	...	X	...	X
Evidence of damage of supporting structure or trolley, if used	...	X	...	X	...	X
Label or labels required by para. 16-1.1.4 for legibility	...	X	...	X	...	X
End connections of load chain for wear, cracks, corrosion, or distortion	...	X	...	X	...	X

NOTES:

- (1) Records not required.
- (2) Visual inspection with records of conditions to provide the basis for a continuing evaluation.
- (3) As in Note (2), unless conditions indicate that disassembly should be done to permit detailed inspection.

Table 16-2.1.4-2 Inspection for Electric- or Air-Powered Hoists

Item	Normal Service		Heavy Service		Severe Service	
	Visual Monthly [Note (1)]	Record Yearly [Note (2)]	Visual Weekly [Note (1)]	Record Semiannually [Note (3)]	Visual Daily [Note (1)]	Record Quarterly [Note (3)]
Frequent Inspection (Refer to para. 16-2.1.4)						
All functional operating mechanisms for maladjustment and unusual sounds	X	...	X	...	X	...
Limit devices for operation	X	...	X	...	X	...
Hoist braking system for proper operation	X	...	X	...	X	...
Air lines, valves, and other parts for leakage	X	...	X	...	X	...
Hooks in accordance with ASME B30.10	X	...	X	...	X	...
Hook latch operation, if used	X	...	X	...	X	...
Hoist rope in accordance with para. 16-2.1.4(b)(7)	X	...	X	...	X	...
Load chain in accordance with para. 16-2.1.4(b)(8)	X	...	X	...	X	...
Rope or load chain reeving for compliance with hoist manufacturer's recommendations	X	...	X	...	X	...
Periodic Inspection (Refer to para. 16-2.1.5)						
Requirements of frequent inspection	...	X	...	X	...	X
Hoist rope in accordance with paras. 16-2.1.5(c)(11) and (12)	...	X	...	X	...	X
Load chain in accordance with paras. 16-2.1.5(c)(13), (14), and (15)	...	X	...	X	...	X
Evidence of loose bolts, nuts, or rivets	...	X	...	X	...	X
Evidence of worn, corroded, cracked, or distorted parts such as load blocks, suspension housing, chain attachments, clevises, yokes, suspension bolts, shafts, gears, bearings, pins, rollers, and locking and clamping devices	...	X	...	X	...	X
Evidence of damage to hook-retaining nuts or collars and pins, and welds or rivets used to secure the retaining members	...	X	...	X	...	X
Evidence of damage or excessive wear of load sprockets, idler sprockets, and drums or sheaves	...	X	...	X	...	X
Evidence of excessive wear on motor or load brake	...	X	...	X	...	X
Electrical apparatus for signs of pitting or any deterioration of visible controller contacts	...	X	...	X	...	X
Evidence of damage of supporting structure or trolley, if used	...	X	...	X	...	X
Function labels on pendant control stations for legibility	...	X	...	X	...	X
Label or labels required by para. 16-1.1.4 for legibility	...	X	...	X	...	X
End connections of rope or load chain for wear, cracks, corrosion, or distortion	...	X	...	X	...	X

NOTES:

(1) Records not required.

(2) Visual inspection with records of conditions to provide the basis for a continuing evaluation.

(3) As in Note (2), unless conditions indicate that disassembly should be done to permit detailed inspection.

(8) load chain for gross damage, which may be an immediate hazard, such as the following:

(-a) Examine visually for gouges, nicks, weld spatter, corrosion, and distorted links.

(-b) Observe operation of the chain and sprockets with a load to remove chain slack, in lifting and lowering directions. The chain should feed smoothly into and away from the sprockets.

(9) rope or load chain reeving for compliance with recommendations of the hoist manufacturer.

16-2.1.5 Periodic Inspection (See Also Tables 16-2.1.4-1 and 16-2.1.4-2)

(a) Periodic inspections shall be performed at intervals defined in para. 16-2.1.2(b)(3) and may be performed with the hoist at its normal location. Periodic inspections do not require the hoist to be disassembled.

(b) Covers and other items supplied to allow inspection of components shall be opened or removed.

(c) The following items shall be inspected:

(1) the items listed in para. 16-2.1.4(b).

(2) fasteners for evidence of loosening.

(3) load blocks, suspension housings, hand chain wheels, chain attachments, clevises, yokes, suspension bolts, shafts, gears, bearings, pins, rollers, and locking and clamping devices for evidence of wear, corrosion, cracks, and distortion.

(4) hook-retaining nuts or collars, and pins, welds, or rivets used to secure the retaining members for evidence of damage.

(5) load sprockets, idler sprockets, drums, and sheaves for evidence of damage and wear.

(6) the brake mechanism on hand chain hoists for evidence of worn, glazed, or oil-contaminated friction disks; worn pawls, cams, or ratchets; and corroded, stretched, or broken pawl springs.

(7) the motor brake and load brake on electric- or air-powered hoists for evidence of wear.

(8) electrical apparatus on electric-powered hoists for evidence of pitting or deterioration of controller contacts.

(9) supporting structure or trolley, if used, for evidence of damage.

(10) label or labels required by para. 16-1.1.4 for legibility.

(11) hoist rope over its entire length. The individual outer wires in the strands of the rope shall be visible to the inspecting person during the inspection. Any deterioration resulting in appreciable loss of original strength, such as the following, shall be noted and determination made as to whether further use of the rope would constitute a hazard:

(-a) points listed in para. 16-2.1.4(b)(7)

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

(-c) reduction of nominal diameter of more than 5%

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

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

(12) sections of rope subject to rapid deterioration, such as the following:

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

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

(-c) rope subject to reverse bending

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

(13) welded link chain for gouges, nicks, weld spatter, corrosion, and distorted links. Slacken the chain and move the adjacent links to one side to inspect for wear at the contact points. If wear is observed or if stretching is suspected, the chain should be measured as outlined in the hoist manufacturer's manual. If instructions are not available, proceed as follows:

(-a) select an unworn, unstretched length of the chain (e.g., at the slack end)

(-b) suspend the chain vertically under tension and, using a caliper-type gauge, measure the outside length of any convenient number of links approximately 12 in. (305 mm) to 24 in. (610 mm) in overall length

(-c) measure the same number of links in the used sections and calculate the percentage increase in length

(14) roller chain, which should first be inspected while it is in the hoist. With the hoist suspended in normal position, a light load of approximately 50 lb (23 kg) shall be applied.

(-a) Chain shall be inspected for elongation as outlined by the hoist manufacturer. In absence of specific instructions, the chain should be inspected by determining the nominal pitch and measuring a 12-in. (305-mm) section of chain that normally travels over the chain sprocket. The dimension from the edge of one chain pin to the corresponding edge of another pin shall be measured using a caliper-type gauge for the number of pitches per foot. If elongation exceeds $\frac{1}{4}$ in. (6.3 mm) in 12 in. (305 mm), the chain shall be replaced. For example, a $\frac{3}{4}$ -in. (19-mm) pitch chain should measure 12 in. (305 mm) over 16 pitches. Chain shall be rejected if measurement over 16 pitches exceeds $12\frac{1}{4}$ in. (311 mm).

(-b) Chain shall be inspected for twist. The chain shall be replaced if the twist in any 5-ft (1.52-m) section exceeds 15 deg.

(-c) The chain shall be inspected for side bow in plane perpendicular to plane of roller. A chain that has a side bow exceeding $\frac{1}{4}$ in. (6.3 mm) in any 5-ft (1.52-m) section shall be replaced.

(15) Additional inspection of the roller chain should be made by removing the chain from the hoist

and cleaning it thoroughly in an acid-free solvent. A check should then be made for any of the following deficiencies:

- (-a) pins turned from their original position
- (-b) rollers that do not run freely with light finger pressure
- (-c) joints that cannot be flexed by easy hand pressure
- (-d) side plates that are spread open (a visual check of the pin head extension at the damaged area, as compared to the pin extension at the free end of the chain, can determine the amount of spread and the condition of the chain)
- (-e) corrosion, pitting, or discoloration of chain (generally indicative of serious impairment)
- (-f) gouges, nicks, or weld spatter
- (16) function labels on pendant control stations on electric- and air-powered hoists for legibility.
- (17) the hoist and hoist mounting for evidence of missing items.

16-2.1.6 Hoists Not in Regular Service

(a) A hoist that is used infrequently and has been idle for a period of 1 month or more, but less than 1 yr, shall be inspected in accordance with the requirements listed in para. 16-2.1.4 before being placed in service.

(b) A hoist that is used infrequently and has been idle for a period of 1 yr or more shall be inspected in accordance with the requirements listed in para. 16-2.1.5 before being placed in service.

16-2.1.7 Inspection Records

(a) Dated inspection reports and records should be maintained at time intervals specified in para. 16-2.1.2(b)(3). Records should be stored where they are available to appointed persons.

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

SECTION 16-2.2: TESTING

(17) 16-2.2.1 Operational Tests

New hoists shall be tested by the hoist manufacturer to verify compliance with this Volume as specified in (a) or (b). Altered or repaired hoists, or hoists that have not been used within the preceding 12 months, shall be tested by a designated person prior to the hoist being placed in service to verify compliance with this Volume as specified in (a) or (b).

(a) Hand-Chain-Operated Hoists

(1) Lifting and lowering functions shall be tested under no-load conditions (testing through complete rated lift length is not required).

(2) After testing under no-load conditions, a load of at least 50 lb (23 kg) times the number of load-supporting parts of chain shall be applied to the hoist, and the hoist shall be tested to check proper load control.

(b) Electric-Powered or Air-Powered Hoists

(1) Lifting and lowering functions shall be tested under no-load conditions (testing through complete rated lift length is not required).

(2) Operation of brake(s) shall be tested under no-load conditions.

(3) Activation-setting of limit devices shall be determined by tests under no-load conditions. Tests shall be conducted first by hand, if practical, and then under slowest speed obtainable. Test with increasing speeds up to maximum speed. Actuating mechanisms shall be located so that they will trip the switches or limiting devices in sufficient time to stop motion without damage to any part of the hoisting arrangement. On hoists with adjustable trip-setting limit devices, care shall be exercised to achieve adjustment setting without the load block striking the hoist frame, or without all the slack being taken out of the unloaded chain or less than one wrap of rope on the drum. When travel-limiting clutches are used as limit devices, follow the methods for testing the travel-limiting clutch in the manual provided with the hoist.

16-2.2.2 Load Test

(a) Hand-Chain-Operated Hoists

(1) New hoists shall be load tested by the manufacturer using the method specified in para. 16-2.2.1(a)(1) with a test load of not less than 125% of the rated load. If load testing of the hoist cannot be performed by the manufacturer, the user shall be notified and the load test shall be accomplished at another location or job site, by or under the direction of a designated person, prior to the hoist being placed in service.

(2) Hoists in which load-suspension parts have been altered, replaced, or repaired should be statically or dynamically load tested as determined by a qualified person. If a qualified person determines that a load test is required, the load test shall be performed.

(-a) If a load test is conducted, the load test shall be conducted by or under the direction of a designated person. Lifting and lowering functions shall be tested. (Testing through complete rated lift length is not required.)

(-b) If the load test is conducted, the test load shall not be less than 100% of the rated load of the hoist or more than 125% of the rated load of the hoist unless otherwise recommended by the hoist manufacturer or a qualified person.

(-c) If a load test is conducted, the person conducting the load test shall prepare a written report of the load sustained during the test and the operations performed during the test. Reports shall be placed on file.

(-d) The replacement of load chain is specifically excluded from this load test; however, an operational test of the hoist should be made in accordance with para. 16-2.2.1(a)(2) prior to putting the hoist back in service.

(b) Electric-Powered or Air-Powered Hoists

(1) Complete new hoists shall be dynamically load tested by the manufacturer using the method specified in paras. 16-2.2.1(b)(1) and (b)(2) with a test load of not less than 125% of the rated load. If testing of the hoist cannot be performed by the manufacturer, the user shall be notified and the load test shall be accomplished at another location or job site, by or under the direction of a designated person, prior to the hoist being placed in service.

(2) Hoists in which load-suspension parts have been altered, replaced, or repaired should be statically or dynamically load tested as determined by a qualified person.

(-a) If a load test is conducted, the load test shall be conducted by or under the direction of a designated person.

(-1) Lifting and lowering functions shall be tested. (Testing through complete rated lift length is not required.)

(-2) Operation of brake(s) shall be tested.

(-b) If a load test is conducted, the test load shall not be less than 100% of the rated load of the hoist or more than 125% of the rated load of the hoist unless otherwise recommended by the hoist manufacturer or a qualified person.

(-c) If a load test is conducted, the person conducting the load test shall prepare a written report of the load sustained during the test and the operations performed during the test. Reports shall be placed on file.

(-d) The replacement of load chain or rope is specifically excluded from this load test; however, an operational test of the hoist should be made in accordance with paras. 16-2.2.1(b)(1), (b)(2), and (b)(3) prior to putting the hoist back in service.

(c) Test anchorages or suspensions shall be approved by a qualified person.

(17)

Chapter 16-3

Operator Training and Operation

SECTION 16-3.1: OPERATOR TRAINING

When the hoist is a component of equipment addressed by another B30 volume, the training and operation requirements of that volume shall apply.

16-3.1.1 Purpose of Operator Training

Operator training shall be provided to ensure proper operation of the equipment in compliance with instructions provided by the equipment manufacturer and the provisions of this Volume.

16-3.1.2 Operator Training – General

(a) Training shall include those items that apply to the equipment and the particular application of the hoist. Refer to para. 16-3.1.3 as a guide for sources of training material.

(b) Training programs and their contents shall be based upon, but not be limited to

- (1) physical characteristics of the workplace.
- (2) performance characteristics and complexity of the equipment.
- (3) types of load to be handled.
- (4) responsibilities of the hoist operator and other persons involved in the movement of the load. Refer to paras. 16-3.3.3 through 16-3.3.6.

(c) Trainees shall operate equipment under the supervision of a designated person.

16-3.1.3 Sources of Training Material

Examples of sources of training material are as follows:

- (a) information outlined in the manual provided with the hoist
- (b) information available through trade associations
- (c) government training resources such as the Department of Labor
- (d) organized labor groups
- (e) courses, seminars, and literature offered by manufacturers of hoists, consultants, trade schools, continuing education schools, employers, and manufacturers of hoist component parts
- (f) requirements and recommendations found in national consensus standards such as this Volume

SECTION 16-3.2 TRAINING FOR PERSONS OTHER THAN HOIST OPERATORS

When it is necessary for other persons, such as, but not limited to, maintenance personnel, test personnel,

and inspectors, to operate a hoist in the performance of their duties, they shall be trained in accordance with the training requirements of this Volume for their duties.

SECTION 16-3.3 OPERATION

16-3.3.1 Scope of Hoist Operation

The operation of hoists shall be in accordance with the provisions included in this Volume and in manuals furnished by the equipment manufacturer.

The requirements of an operator of a hoist apply to both dedicated operators, whose primary job is the operation of a hoist, and nondedicated operators, who use a hoist as another tool in performing their job.

16-3.3.2 General Requirements to Be Followed During Hoist Operation

All personnel involved with the hoist operation shall comply with the following:

- (a) Equipment lockout/tagout procedures (see Section 16-3.6).
- (b) Safety signs, labels, plates, or tags.
- (c) The hoist shall not be used to lift or lower while anyone is on the load or hook.
- (d) The hoist chain or rope shall be free from kinks or twists and shall not be wrapped around the load.
- (e) A hook latch shall be used when provided.
- (f) The hook latch (when provided) shall be closed and shall not be used to support any part of the load.
- (g) The load, sling, or lifting device shall be seated in the bowl of the hook.
- (h) The hoist chain(s) or rope(s) shall be seated in its chain sprockets or drum and sheave grooves.
- (i) Persons shall stay clear of a suspended load.
- (j) Caution shall be exercised when using a hoist to maneuver a lifting magnet.
- (k) Hoists shall be used to lift loads vertically without side pull except when specifically authorized by the manufacturer(s) or a qualified person for the equipment and a qualified person for the supporting structure who have determined that

- (1) the various parts of the equipment, support system, and supporting structure will not be overstressed
- (2) the stability of the equipment is not thereby endangered
- (3) such side pulls will not cause the hoist rope to be pulled out of the sheave or across drum grooves

(4) such side pulls will not cause damage to the hoist

(l) The hoist shall not be used to lift loads in excess of the rated load of the hoist except during properly authorized tests or planned engineered lifts in accordance with Section 16-3.5.

NOTE: Devices such as load cells, dynamometers, and scales may be used to determine the load to be lifted. Notify a qualified person before attempting to lift an unknown load.

(m) The hoist should not be used in any way that subjects it to shock loads.

(n) A load-limiting device shall not be used to measure the weight of the load.

(o) The hoist rope or chain shall be protected, so far as it is practical, from weld spatter or other damaging contaminants.

(p) Gloves that interfere with the operation of the controls shall not be worn.

(q) The harness or belt (when provided) shall be used with the wireless transmitter, or the transmitter shall be placed in the location intended for its support.

(r) The safety devices on the wireless transmitter shall not be overridden.

(s) The wireless transmitter shall be stored in a designated and protected location.

(t) The wireless transmitter shall be shut off when a power failure occurs.

(u) When two or more hoists are used to lift a single load, one designated person shall be in charge of the operation. This person shall analyze the operation and instruct all personnel involved in the proper positioning and rigging of the load and the movements to be made.

(v) The operator shall test the hoist brake(s) at the start of each shift for proper operation. This shall be done by lifting the load a few inches (centimeters) and applying the brake(s).

(w) The load shall not be lowered below the point where less than two wraps of rope remain on each hoisting drum unless a lower-limit device is provided, in which case no less than one wrap shall remain.

16-3.3.3 Responsibilities of Management (Owners/ Users)

Management (owners/users) shall

(a) identify, document, and assign responsibilities of the hoist operator and other persons involved in the movement of the load(s) (see paras. 16-3.3.2, 16-3.3.4, 16-3.3.5, and 16-3.3.6).

(b) provide training or verify that persons who will operate the hoist have been trained.

(c) provide a written and practical examination that verifies that the person has acquired the knowledge and skill to properly operate the specific type of hoist that will be used. The examinations shall be defined by the owner/user and shall be in accordance with any local, state, and federal provisions that may apply.

(d) issue a certificate or formal record that verifies that the person has been trained and has passed the examination required in para. (c).

(e) translate technical and safety-related information and manual(s). The entities responsible for the operation, use, inspection, testing, and maintenance of the covered equipment shall have the technical and safety-related information available in a language that their employees can read and understand. If the information is not available in a language understood by their employees, the entities shall obtain a translation of the original manufacturer's written safety information and manuals from the manufacturer or from a translation service provider. The translation(s) shall meet the requirements of paras. 16-1.1.5(c) and (d).

16-3.3.4 Responsibilities of Operators

(a) *Lifting/Lowering the Load*

(1) Three phases of lifting/lowering the load shall be addressed

(-a) before the lift (lifting/lowering)

(-b) during the lift (lifting/lowering)

(-c) after the lift (lifting/lowering)

(2) Rigging the load, attaching the load to the hook, and other tasks related to lifting/lowering the load may be performed by the hoist operator or by persons other than the hoist operator (see para. 16-3.3.5).

(3) Hoist operation may require the use of a signalperson(s) or other personnel who have responsibility for directing the lift/lower functions and shall be assigned prior to the lift (see para. 16-3.3.6).

(b) *Before the Lift (Lifting/Lowering)*. Operators shall

(1) be familiar with the applicable provisions of the equipment safety standards and the instructions listed in the manual(s) provided with the hoist.

(2) be familiar with controls, instructions, and product safety information located on the hoist.

(3) operate the hoist only when physically and otherwise fit.

(4) not energize the main switch or open the main valve if a warning sign, lock, or tag is on the device until the sign, lock, or tag is removed by the person who placed it on the device or by an authorized person.

(5) not remove a warning sign, lock, or tag that is on any device that controls power to the hoist, such as, but not limited to, the hoist disconnect, if the sign, lock, or tag was placed on the device by another person.

(6) place all controllers in the off position before closing the main line disconnect or opening the main valve.

(7) verify that no worker is on or adjacent to the hoist before closing the main disconnect switch or opening the main valve.

(8) perform a preoperation inspection before the first use of each shift in accordance with para. 16-2.1.3.

(9) not remove or obscure the safety labels, plates, or tags furnished on the hoist.

(10) be familiar with and understand hand signals (see Section 16-3.4).

(11) verify that the hook travels in the same direction as shown on the controls.

(12) verify that chains or wire ropes are not kinked or twisted, or that multiple-part chain or wire ropes are not twisted about each other.

(13) verify that the hoist load chain or rope is seated in the sprockets or drum grooves and in the sheave(s) sprockets or grooves if there is or has been a slack condition.

(14) verify that the transmitter (if provided) is the correct transmitter for the hoist to be operated.

(15) verify that the load to be lifted does not exceed the rated load of the hoist [see para. 16-3.3.2(l)].

NOTE: Devices such as load cells, dynamometers, and scales may be used to determine the weight of the load to be lifted. Notify a qualified person before attempting to lift an unknown load.

(16) verify operation of the upper-limit device under no-load conditions prior to the initial use of any electric-powered or air-powered hoist during each shift. If more than one upper-limit device is present, only the operation of the primary upper-limit device need be verified. Care shall be exercised; the block shall be inched into the limit device or run in at slow speed. If the device does not operate properly, the operator shall immediately notify a qualified person. When travel-limiting clutches are used as limit devices, follow hoist manufacturer instructions when checking the travel-limiting clutch.

(17) verify that the hoist limit device that controls the upper limit of travel of the load block is not used as an operating control in normal operation unless additional means are provided to prevent damage from overtravel. When travel-limiting clutches are used as limit devices, follow hoist manufacturer instructions when checking the travel-limiting clutch.

(18) make certain personnel are clear of the load before and during a lift.

(c) *During the Lift (Lifting/Lowering).* Operators shall

(1) be responsible for the hoist operation.

(2) respond to commands from the person directing the lift or a designated signalperson.

(3) obey any stop signal regardless of who gives it.

(4) verify that multiple-part chains or ropes are not twisting around each other when the lift is made.

(5) take up slack load chain or rope carefully, lift the load a few inches (centimeters) to check the hoist operation, and verify that the load is secured, balanced, and positioned on the hook and in the sling or lifting device.

(6) minimize swinging the load or load hook.

(7) maintain firm footing when operating lifting equipment.

(8) avoid sudden acceleration and deceleration of the load.

(9) minimize applying shock loads to the hoist.

(10) use the hoist to lift vertically, without side pull, except when specifically authorized by a qualified person [see para. 16-3.3.2(k)].

(11) verify that the load and rigging are free to move and will clear all obstructions.

(12) test the hoist brake(s) for proper operation by lifting the load a few inches (centimeters) and applying the brake(s).

(13) stop the lifting of the load before the upper-limit device is engaged. The hoist limit device that controls the upper limit of travel of the load block shall not be used as an operating control in normal operation unless additional means are provided to prevent damage from overtravel.

(14) avoid carrying loads over people.

(15) concentrate on operating the hoist, and do not allow attention to be diverted while operating the equipment.

(16) protect the load chain or rope, so far as it is practical, from weld spatter or other damaging contaminants.

(17) promptly report to the person responsible for the hoist any malfunction, unusual performance or sound, or damage of equipment.

(18) place all controllers or master switches in the off position, and shut off transmitters when power is interrupted during operation.

(19) check the controllers for correct direction of motion when power is restored after a power outage.

(20) follow the directions of the designated person in charge of the operation when two or more hoists are used to lift a single load.

(21) not leave a suspended load unattended unless provisions have been made to provide auxiliary supporting means under the suspended load, or guards or barriers are used on the floor to prevent people from entering the area affected by the suspended load.

(22) not lower the load below the point where less than two wraps of rope remain on each hoisting drum unless a lower-limit device is provided, in which case no less than one wrap shall remain.

(23) stop the lowering of the load before the lower-limit device is engaged, when furnished, and not use it as an operating control in normal operation.

(24) not wear gloves that interfere with the operation of the controls.

(25) use the harness or belt, if provided, for use with the transmitter, or place the transmitter in the location intended for its support.

(26) not override safety devices on the transmitter.

(27) stop the hoist in a controlled manner when the operator has doubt as to the safety of the operations. Lift operations shall resume only after safety concerns have been addressed.

(d) *After the Lift (Lifting/Lowering)*. Operators shall

- (1) lift the load block above the highest movable obstruction under the hoist when the hoist is not in use
- (2) notify the next operator or supervisor of adjustments, repairs, or replacements that need to be made
- (3) place the controllers in the off position before leaving
- (4) shut off and store the transmitter in a designated and protected location
- (5) not use the hoist to remove slings from under a landed load

16-3.3.5 Responsibilities of Riggers

Riggers assigned to a load handling activity shall, at a minimum, be responsible for

- (a) ensuring that the weight of the load and its approximate center of gravity have been obtained, provided, or calculated.
- (b) selecting the proper rigging equipment, inspecting it, and complying with the applicable operating practices according to the criteria of the applicable ASME volume (e.g., B30.9, B30.10, B30.20, B30.23, or B30.26).
- (c) ensuring the rated load of the rigging equipment as selected and configured is sufficient for the load to be handled, based on the number of legs, hitch configuration, and effects of angles.
- (d) properly attaching the rigging equipment to the hook, shackle, or other load handling device.
- (e) verifying that the hoist unit is centered over the load's center of gravity, except when authorized by a qualified person [see para. 16-3.3.2(k)].
- (f) verifying that the load, sling, or lifting device is seated in the bowl of the hook.
- (g) verifying that the hook latch (when provided) is closed, functioning properly, and not supporting any part of the load.
- (h) verifying the hoist chain or wire rope is not wrapped around the load.
- (i) ensuring the rigging equipment is adequately protected from abrasion, cutting, or other damage during load handling activities.
- (j) rigging the load in a manner to ensure stability during the load handling activity.
- (k) knowing and understanding the applicable signals for the equipment in use.
- (l) installing and using a tag line(s) when additional load control is required.

16-3.3.6 Responsibilities of Signalpersons

The signalperson assigned to a load handling activity shall, at a minimum, be responsible for

- (a) ensuring that a form of communication is maintained with the operator during all load moving activities.

(b) verifying that load handling equipment movements are stopped if there is a need to give instructions to the operator, other than those provided by the established signal system.

(c) ensuring that standard, discernable hand, or voice signals provided to the operator are in accordance with Section 16-3.4.

(d) confirming with the operator the method of communication and the associated signals that are to be used during the load handling activity.

(e) ensuring that telephones, radios, or other equipment intended for use as the primary signal system are tested prior to the load handling activity.

(f) identifying himself/herself as the signalperson to the load handling equipment operator(s) before commencing a load handling activity.

(g) ensuring that all directions given to the operator shall be given from the operator's perspective (e.g., lower 2 ft).

(h) ensuring that each series of voice signals contains three elements stated in the following order:

- (1) function and direction
- (2) distance and/or speed
- (3) function stop

NOTE: The following are some examples of signals:

- (a) Lower 100 ft, 50 ft, 40 ft, 30 ft, ...2 ft, lower stop.
- (b) Hoist slow, slow, slow, hoist stop.

(i) ensuring that special signals (when needed) that are not covered in Section 16-3.4 do not conflict with standard signals.

(j) giving signal commands that would result in loads being handled in nonoccupied areas whenever possible.

(k) making certain personnel are clear of the load before and during a lift.

SECTION 16-3.4 SIGNALS

16-3.4.1 Standard Signals

Signals to the operator shall be in accordance with the standards prescribed in Fig. 16-3.4.1-1, unless voice communication equipment (telephone, radio, or equivalent) is used. Signals shall be discernible or audible at all times. Some special operations may require additions to, or modifications of, the basic signals.

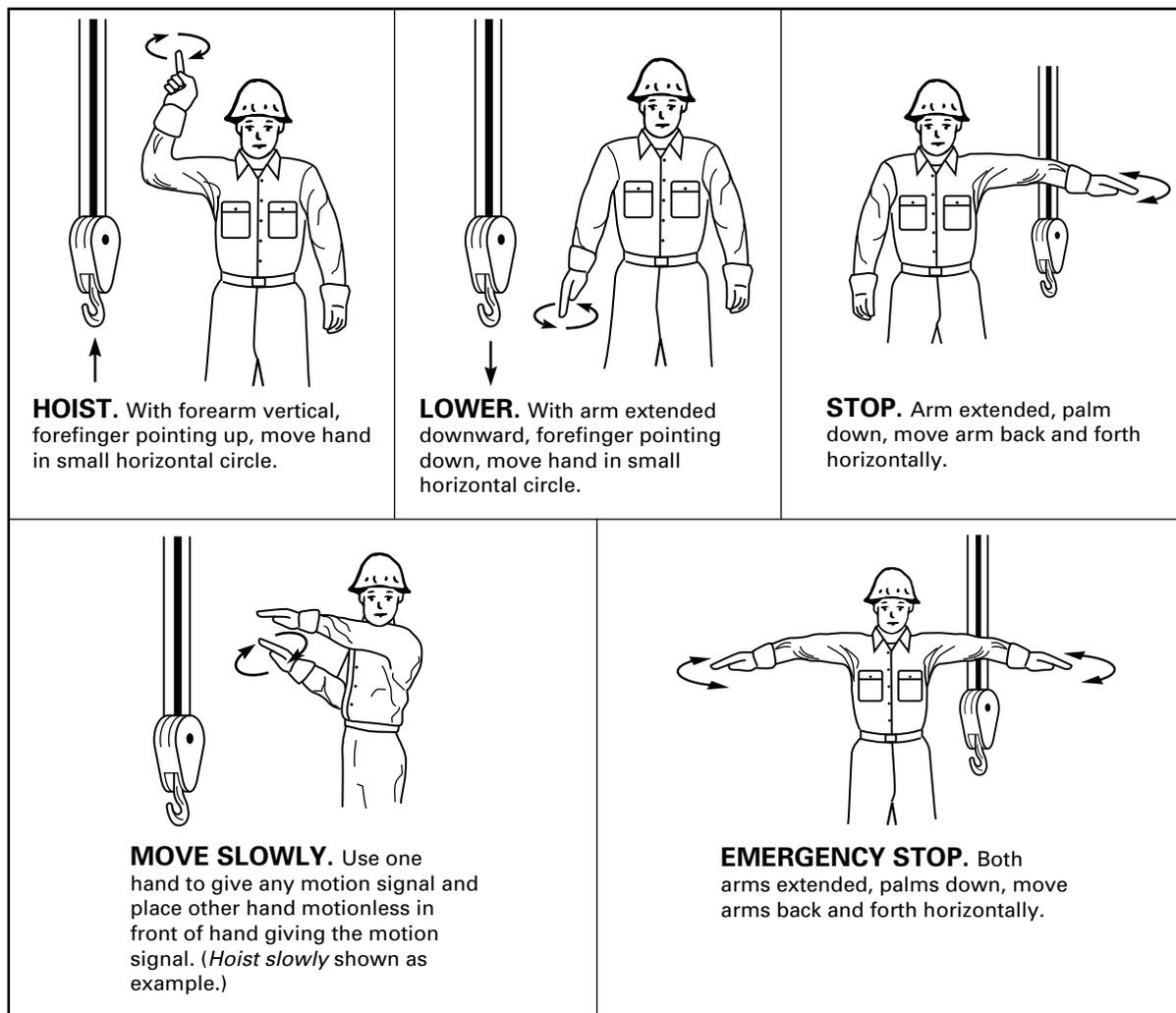
16-3.4.2 Hand Signals

When hand signals are used, they should be posted conspicuously and should be as illustrated in Fig. 16-3.4.1-1.

SECTION 16-3.5 PLANNED ENGINEERED LIFTS

Lifts in excess of the rated load may be required from time to time on a limited basis for specific purposes such as new construction or major repairs. Every planned

Fig. 16-3.4.1-1 Standard Hand Signals for Controlling Hoists



engineered lift exceeding the rated load shall be treated as a special and separate event.

Limitations and planned requirements shall be applicable as follows:

(a) Planned engineered lifts shall be limited to powered hoists.

(b) When planned engineered lifts are made, the load shall not exceed 125% of the hoist load rating, except as provided in (d).

(c) Planned engineered lifts shall be limited to two occurrences on any hoist within any continuous 12-month period, except as provided in (d). If greater lift frequency is desired, consideration shall be given to rerating or replacing the hoist.

(d) The equipment manufacturer or a qualified person shall be consulted if the planned engineered lift exceeds 125% of rated load or if the frequency of planned engineered lifts exceeds two during a continuous 12-month period.

(e) Each planned engineered lift shall comply with the following requirements:

(1) A written review of the hoist's service history shall be prepared, including reference to previous planned engineered lifts, structural repairs, and modifications of original design.

(2) The design of the structural, mechanical, electrical, pneumatic, and hydraulic components of the equipment shall be reviewed by means of applicable calculations for the load to be lifted and approved by the equipment manufacturer or a qualified person according to accepted hoist design standards (refer to Chapter 16-1).

(3) The design of the equipment's supporting structure shall be reviewed and approved by a qualified person for conformance to applicable design criteria. The supporting structure shall be inspected and any deterioration or damage shall be taken into consideration in design calculations for the load to be lifted.

(4) The equipment shall be inspected in accordance with para. 16-2.1.5 just prior to making the lift.

(5) The lift shall be made under the direction of a designated person in accordance with a previously prepared lift plan. All persons in the area of the equipment shall be alerted that the lift is being made.

(6) The operator shall test the hoist at the planned engineered load by lifting the load a few inches (centimeters) and setting the brakes. The lift shall only be continued if the brake stops and holds the load. Any failure to hold the load shall be corrected before proceeding with the lift.

(7) The hoist shall be inspected in accordance with para. 16-2.1.5 after the lift is completed and prior to being used for the lifting of any other load.

(8) A record of the planned engineered lift, including calculations, inspections, and all distances moved, shall be placed on file for availability to appointed personnel.

(f) The load test specified in para. 16-2.2.2 is not applicable to planned engineered lift provisions.

SECTION 16-3.6 EQUIPMENT LOCKOUT/TAGOUT

(a) A lockout/tagout policy and procedure shall be developed, documented, and implemented by the owner or user of the hoist.

(b) The lockout/tagout policy and procedure shall comply with the requirements of ASSE Z244.1.

(c) The policy shall include, but not be limited to, hoists and may also include other related equipment, such as trolleys.

Chapter 16-4

Maintenance Training and Maintenance

SECTION 16-4.1: MAINTENANCE TRAINING AND MAINTENANCE REQUIREMENTS

When the hoist is a component of equipment addressed by another B30 volume, the maintenance training and maintenance requirements of that volume shall apply in addition to the requirements of this Volume.

SECTION 16-4.2: MAINTENANCE TRAINING

16-4.2.1 Purpose of Maintenance Training

Maintenance training shall be provided to promote proficient adjustments, repairs, and replacements on hoists that will allow the equipment to perform in accordance with manufacturer's specifications and the provisions of this Volume.

16-4.2.2 Hoist Maintenance Training — General

This Volume of the B30 Standard recognizes that hoists are used for many different purposes, handling many different kinds of loads, in a variety of workplaces, and are maintained in a manner relative to these purposes, kinds of loads, and workplaces. Nevertheless, the requirement for training as a hoist maintenance person applies to all persons who maintain the mechanical, structural, and electrical components of the equipment.

16-4.2.3 Sources of Training Material

Examples of sources of maintenance training material are as follows:

- (a) information outlined in the manual(s) provided by the equipment manufacturer
- (b) information available through trade associations
- (c) government training resources such as the Department of Labor
- (d) organized labor groups
- (e) courses, seminars, and literature offered by manufacturers of hoists, consultants, trade schools, continuing education schools, and employers
- (f) requirements and recommendations found in national consensus standards such as this Volume

16-4.2.4 Responsibilities of Maintenance Persons

Responsibilities of hoist maintenance persons shall include, but not be limited to

- (a) reading the applicable equipment safety standard referenced and the instructions outlined in the

manuals(s) provided for the equipment by the equipment manufacturer.

- (b) not attempting to repair electrical apparatus or make other major repairs on the equipment unless specific authorization has been received and the power is locked out/tagged out.

(c) lowering the load block to the ground or otherwise securing the load block before attempting any repairs or adjustments on the lifting equipment that would allow the load block to lower.

(d) using replacement parts that are at least equal to the original manufacturer's specifications.

(e) becoming familiar with load chain and wire rope replacement criteria.

(f) installing wire rope clips correctly. Refer to the manufacturer's manual provided with the equipment.

(g) not using the wire rope, load chain, or hook as a ground for welding.

(h) not touching a live electrode to the wire rope, load chain, or hook.

(i) not attempting to repair a damaged wire rope or load chain.

(j) not removing or obscuring the safety labels, plates, or tags furnished on the lifting equipment.

(k) replacing safety labels, plates, or tags when they are obscured or illegible.

(l) replacing all protective covers and guards before returning the hoist to normal operation.

(m) lubricating the wire rope or load chain as recommended by the hoist, wire rope, or chain manufacturer.

SECTION 16-4.3 EQUIPMENT MAINTENANCE

16-4.3.1 General Maintenance

General maintenance should be performed in accordance with the manufacturer's specifications and the conditions and practices of a particular workplace. Some factors that influence how maintenance is performed are

(a) whether there are trained and experienced in-house maintenance persons such as mechanics or millwrights and electricians who can perform maintenance work on hoists

(b) whether an outside service company is contracted to do inspections and perform preventive maintenance, repairs, and replacements

(c) size of workplace and number of employees

(d) whether the hoist has sophisticated performance characteristics such as adjustable frequency controls or basic single-speed or two-speed control systems

(e) the recommendations in the equipment manufacturer's manual and, when appropriate, recommendations by a qualified person based upon review of the equipment application and operation

16-4.3.2 Preventive Maintenance

(a) A preventive maintenance program shall be established. The program should be based on recommendations of the hoist manufacturer. If a qualified person determines it is appropriate, the program should also include that individual's additional recommendations based upon a review of the hoist application and operation. Dated records should be placed on file.

(b) Lubrication, per para. 16-4.3.5, is considered part of a preventive maintenance program.

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

(17) 16-4.3.3 Maintenance Procedure

(a) Refer to the hoist manufacturer's manual.

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

(1) If a load is attached to the hoist, it shall be removed.

(2) If the hoist is electric- or air-powered, all controllers shall be placed in the off position.

(3) If the hoist is electric- or air-powered, a lockout/tagout procedure shall be performed (see Section 16-3.6).

(4) If the hoist is suspended from a trolley, provisions should be taken to prevent movement of the trolley.

(5) Warning signs and barriers shall be used on the floor beneath the hoist where overhead maintenance work creates a hazard.

(c) After adjustments and repairs have been completed and before restoring the hoist to normal operation

(1) covers and guards shall be reinstalled

(2) safety devices shall be reactivated

(3) parts that have been replaced and loose material shall be removed

(4) maintenance equipment shall be removed

(5) warning signs and barriers, when used and placed at the hoist in accordance with (b)(5), shall be removed

(6) the hoist shall be tested in accordance with Section 16-2.2

(d) Warning signs and barriers, when used, shall be placed and removed only by designated persons.

16-4.3.4 Adjustments, Repairs, and Replacements

(a) Any condition disclosed by the inspections performed in accordance with the requirements of Section 16-2.1 that is determined by a qualified person

to be a hazard to continued operation shall be corrected by adjustment, repair, or replacement before continuing the use of the hoist.

(b) Adjustments, repairs, and replacements shall be performed by a designated person.

(c) Adjustments, repairs, or replacements shall be made to the following on an as-needed basis:

(1) all operating mechanisms.

(2) all excessively worn braking components, such as friction disks, ratchets, pawls, and pawl springs.

(3) all critical parts, including load suspension components, that are cracked, broken, bent, or excessively worn.

(4) control systems of electric- and air-powered hoists.

(5) worn, corroded, or otherwise damaged load chain in accordance with Section 16-4.5 or Section 16-4.6.

(6) worn or otherwise damaged rope in accordance with Section 16-4.4.

(7) damaged or worn hooks as described in ASME B30.10. Repairs by welding or reshaping are not recommended.

(8) pitted or burned electrical contacts on electric-powered hoists. These should be corrected only by replacement and in sets. Controller parts should be lubricated as recommended by the manufacturer.

(9) missing or illegible function labels on pendant control stations.

(10) missing or illegible product safety labels.

(11) items that are determined to be missing.

(d) Dated records should be placed on file.

16-4.3.5 Lubrication

(a) All moving parts of the hoist for which lubrication is specified should be regularly lubricated. Lubricating method should be checked for delivery of lubricant. Care should be taken to follow recommendations outlined in the hoist manufacturer's manual as to points and frequency of lubrication and quantity and types of lubricant to be used.

(b) Hoist machinery shall be stationary while lubricants are being applied, except when lubricating load chain or rope, unless equipped for automatic or remote lubrication.

SECTION 16-4.4: ROPE REPLACEMENT AND MAINTENANCE

16-4.4.1 Rope Replacement

(17)

(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 the rope replacement shall be as follows:

(1) in running ropes, six randomly distributed broken wires in six rope diameters, or three broken wires in one strand in six rope diameters, except as noted in (b)(2)

(2) in rotation-resistant ropes, two randomly distributed broken wires in six rope diameters, or four randomly distributed broken wires in thirty rope diameters

(3) 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 or loops out from the rope structure

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

(5) evidence of heat damage from any cause

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

(7) reductions from nominal diameter greater than 5%

Deviation shall be allowed from the removal criteria in (b)(1) through (b)(7) only with written approval of the hoist manufacturer, rope manufacturer, or a qualified person.

(c) Broken wire removal criteria, cited in this Volume, apply to wire rope operating on steel and cast iron sheaves and drums and wire rope operating on multilayer drums regardless of sheave material. When drum spooling is single layer, synthetic sheaves or sheaves with synthetic linings should not be used because there are no broken wire removal criteria for this configuration, and internal wire breaks may occur in large numbers before any breaks or signs of substantial wear are visible on the outside wires of the rope.

(d) Attention shall be given to end connections. Upon development of two broken wires adjacent to a socketed end connection, the rope should be resocketed or replaced. Resocketing shall not be attempted if the resulting rope length will be insufficient for proper operation.

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

16-4.4.2 Rope Maintenance

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

(b) Rope shall be unreeled or uncoiled in a manner to avoid kinking or inducing a twist in the rope.

(c) Before cutting rope, means shall be used to prevent unlaying of the strands.

(d) During installation, care should be taken 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. Lubricant applied as part of a maintenance program shall be compatible with the original lubricant. Lubricant applied shall be of the type that does not hinder visual inspection. Those sections of rope that are located over sheaves or otherwise hidden during inspection and maintenance procedures require special attention when lubricating rope. The object of rope lubrication is to reduce internal friction and to prevent corrosion.

SECTION 16-4.5: WELDED LINK CHAIN REPLACEMENT AND MAINTENANCE

16-4.5.1 Welded Link Chain Replacement

(a) If the used chain exceeds the hoist manufacturer's recommended length (or in the absence of such recommendation, if the used chain for hand-chain-operated hoists is 2½% longer than the unused chain, or the used chain for powered hoists is 1½% longer than the unused chain), the chain shall be replaced. Repairing of load chain by welding or any other means shall not be attempted by anyone other than the chain manufacturer.

(b) The existence of gouges, nicks, corrosion, weld spatter, or distorted links is sufficient reason to question chain safety and consider chain replacement. Safety in this respect depends largely upon the use of good judgment by a qualified person in evaluating the degree of deficiency.

(c) Replacement chain shall be the same size, grade, and construction as the original chain furnished by the hoist manufacturer unless otherwise recommended by the hoist manufacturer or a qualified person, due to actual working conditions.

(d) Load chain links that pass over the hoist load sprocket on edge (alternate to those that lie flat in the pockets) shall be installed with the welds away from the center of the sprocket unless otherwise recommended by the hoist manufacturer. This precaution is not required on idler sprockets that change the direction but not the tension in the chain.

(e) The chain shall be installed without any twist between the hoist and an anchored end on either the loaded side or slack side.

(f) When chain is replaced, the mating parts (sprockets, guides, stripper) shall be disassembled and inspected for wear and replaced if necessary.

(g) Discarded load chains shall not be used for slings.

16-4.5.2 Welded Link Chain Maintenance

(a) Load chains and hand chains should be kept clean and free from any coating or deposit that will build up and change their dimensions or reduce flexibility. The cleaning process shall not damage these chains and any solution used in the cleaning process shall be acid free.

(b) Load chains articulate slowly under high bearing pressures and should be lubricated as specified by the hoist manufacturer. Hand chains are lightly loaded and normally need little or no lubrication; however, the hoist manual should be reviewed for specific lubrication information.

SECTION 16-4.6: ROLLER CHAIN REPLACEMENT AND MAINTENANCE**16-4.6.1 Roller Chain Replacement**

(a) Roller chains shall be replaced if any of the conditions exist as stated in para. 16-2.1.5(c)(14). Repairing the roller chain by welding or heating shall not be attempted.

(b) The existence of any of the conditions stated in para. 16-2.1.5(c)(15) is reason to question chain safety and for a qualified person to give consideration for replacement. Roller chains are subject to hidden wear and deterioration that must be considered.

(c) Replacement chain shall be the same size, grade, and construction as the original chain furnished by the hoist manufacturer unless otherwise recommended by the hoist manufacturer or a qualified person, due to actual working conditions.

(d) When chain is replaced, the mating parts (sprockets, guides, stripper) shall be disassembled and inspected for wear and replaced if necessary.

(e) When chain is replaced, it should be reeved as outlined by the hoist manufacturer and should operate freely over all load and idler sprockets. All connecting links and chain end fastenings should be inspected and properly secured. The selection and installation of connecting links should be as outlined in the hoist manufacturer's manual or as determined by a qualified person.

(f) Discarded roller chains shall not be used for slings.

16-4.6.2 Roller Chain Maintenance

(a) Roller chains should be kept clean and free from rust. Excessively dirty chains should be soaked in a clean, acid-free solvent. Chains should be agitated to ensure that all joints are free from grit and foreign matter.

(b) Roller chains should be lubricated as outlined in the hoist manufacturer's manual. In absence of specific lubrication instructions, the chains should be lubricated with a good grade of automotive motor oil (SAE grade 20 or grade 30). Never apply grease to the chain.