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**7-1.2.11 Electric Resistors**

(a) Resistor units shall be supported to minimize vibration effect.

(b) Provision shall be made to prevent broken parts or molten metal from falling from the hoist.

(c) If ventilated or nonventilated resistor enclosures are provided, the enclosures shall be installed to prevent the accumulation of combustible matter.

**7-1.2.12 Switches.** On electric driven hoists, a motor circuit switch or circuit breaker of the enclosed type with provisions for locking in open position shall be provided in the main power supply.

**7-1.2.13 Operator's Cab (When Provided)**

(a) If a cab is provided and windows are glazed, the windows shall be of safety glazing material as defined in ANSI Z26.1. Windows shall be located to provide the operator with visibility in all required directions. Refer to ANSI Z26.1.

(b) A clear passageway shall be provided from the operator's station to an exit door.

(c) Handholds or steps shall be provided to facilitate entrance to and exit from the cab, when necessary.

(d) Cab lighting, either natural or artificial, shall provide a level of illumination that enables the operator to observe the operating controls.

(e) Where internal combustion engines are the prime mover for the hoists, the exhaust shall be piped in such a manner that exhaust gases cannot enter open windows of the cab, or be pulled into the cab ventilating system, where such exists.

(f) The cab construction, when applicable, shall offer protection from falling objects. The protection shall be at least equivalent to that provided by standard 2 in. (51 mm) lumber.

(g) The noise level at the operator's station should be a consideration in the manufacture of all new base-mounted drum hoists.

**7-1.2.14 Lubrication.** Lubricating points should be accessible without the necessity of removing guards or other parts.

**7-1.2.15 Fire Extinguishers.** A portable fire extinguisher with a basic minimum extinguisher rating of 10 BC shall be installed in the cab or operator's station.

**Section 7-1.3: Installation**

**7-1.3.1 Attachments and Anchorages.** Attachments and anchorages for hoist bases shall provide mounting of the hoist and shall be capable of withstanding loads imposed by the hoist under operating conditions. The weight of the hoist and loads imposed by the load ropes shall be provided for.

**7-1.3.2 Location of Drum Hoists.** Drum hoists shall be located in a manner that provides proper rope spooling on the drums.

## CHAPTER 7-2

### Inspection, Testing, and Maintenance

#### Section 7-2.1: Inspection

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

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

(1) *Frequent Inspection.* Visual examinations by the operator or other designated personnel with records not required.

(a) Normal service: monthly;

(b) Heavy service: weekly to monthly;

(c) Severe service: daily to weekly;

(d) Special or infrequent service: recommended by a qualified individual before and after each occurrence.

(2) *Periodic Inspection.* Visual inspection by an appointed person making records of apparent external conditions to provide the basis for a continuing evaluation.

(a) Normal service: equipment in place: yearly;

(b) Heavy service: equipment in place: yearly;

(c) Severe service: equipment in place: quarterly;

(d) Special or infrequent service authorized by a qualified person before the first such occurrence and as directed by the qualified person for any subsequent occurrences.

**7-2.1.1 Frequent Inspection.** Items such as the following shall be inspected for wear or damage at intervals as defined in para. 7-2.1(b)(1), or as specifically indicated below, including observations during operation for wear or damage which might appear between regular inspections. Any deficiencies, such as listed below, shall be carefully examined, and a determination made

by a qualified person as to whether they constitute a hazard:

(a) all control mechanisms for maladjustment or excessive wear interfering with proper operation;

(b) all limit switches or limiting devices for malfunction at the beginning of each work shift;

(c) deterioration or leakage in air or hydraulic systems;

(d) load carrying ropes (visual inspection daily for excessive wear and distortion);

(e) electrical apparatus for malfunctioning, signs of excessive deterioration, and dirt and moisture accumulation.

**7-2.1.2 Periodic Inspection.** Complete inspections of the hoist shall be performed at intervals as defined in para. 7-2.1(b)(2). Any deficiencies, such as listed below, shall be examined and determination made as to whether they constitute a hazard. These inspections shall include the requirements of para. 7-2.1.1 and, in addition, items such as the following:

(a) deformed, cracked, or corroded members;

(b) loose bolts or rivets;

(c) cracked or worn drums or sheaves;

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

(e) excessive wear distortion or damage on brake and clutch system parts and linings, and on pawls and ratchets;

(f) gasoline, diesel, electric, or other power plants for improper performance and noncompliance with applicable safety requirements;

(g) excessive wear of chain drive sprockets and excessive chain stretch;

(h) electrical apparatus for contact pitting or any deterioration of controller contactors, limit switches, and push button stations;

(i) foundations or supports for continued ability to sustain the imposed loads.

#### 7-2.1.3 Hoists Not in Regular Use

(a) A hoist which has been idle for a period of one month or more, but less than six months, shall be

given an inspection conforming with the requirements of para. 7-2.1.1 before being placed in service.

(b) A hoist which has been idle for a period of over six months shall be given a complete inspection conforming with the requirements of paras. 7-2.1.1, 7-2.1.2, and 7-2.4.1(b).

(c) Standby hoists shall be inspected at least semi-annually in accordance with the requirements of paras. 7-2.1.1 and 7-2.4.1(b).

(d) Standby hoists exposed to abnormal operating conditions should be inspected more frequently than required in para. 7-2.1.3(c).

**7-2.1.4 Inspection Records.** Dated inspection reports and records shall be made on critical items such as brakes and ropes. Dated records should be kept where readily available to appointed personnel.

## Section 7-2.2: Testing

### 7-2.2.1 Operational Tests

(a) Prior to initial use, new, altered, modified, reinstalled, or repaired hoists shall be tested to verify compliance with this volume, including the following functions:

- (1) lifting and lowering on each drum;
- (2) swing;
- (3) operation of clutches, brakes, and pawls;
- (4) operation of limit switches, and locking and safety devices when provided.

(b) The trip-setting of limit switches and limiting devices shall be determined by tests under no-load conditions. Tests shall be conducted first under slow speed and then with increasing speeds up to maximum speed. Actuating mechanisms shall be located so that they will trip the switches or limiting devices in time to stop motion without damage to any part of the hoisting arrangement.

(c) All tie-downs shall be acceptable to a designated person.

### (01) 7-2.2.2 Load Test

(a) *New Hoists.* All new hoists shall be tested by the manufacturer. The load test shall not be less than 110% of the rated load nor more than 125% of the rated load. A written report of the test should be prepared and placed on file.

(b) Altered, modified, reinstalled and repaired hoists:

(1) Prior to initial use, altered, modified, reinstalled or repaired hoists shall be functionally tested. A written report of the test should be prepared and placed on

file. A qualified person shall determine the need for a load test.

(2) The load test, if made, shall consist of the following as minimum requirements:

(a) The test load shall not be less than 110% of the rated load nor more than 125% of the rated load, unless otherwise recommended by the manufacturer.

(b) The test load shall be hoisted a vertical distance to assure that the load is supported by the hoist and held by the hoist brake(s).

(c) The test load shall be lowered, stopped and held with the brake(s).

## Section 7-2.3: Maintenance

### 7-2.3.1 Preventive Maintenance

(a) A preventive maintenance program should be established based on the hoist manufacturer's or a qualified person's recommendations. Dated records should be available to appointed personnel.

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

### 7-2.3.2 Maintenance Procedure

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

(1) if electrically powered, the main or emergency switch locked in the *open* position;

(2) the power plant stopped or disconnected at the takeoff;

(3) power plant starting means rendered inoperative;

(4) drum pawls engaged, or other means provided to prevent load ropes from inadvertently rotating the mechanism;

(5) warning or *Out of Order* signs placed on the hoist.

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

(c) Warning or *Out of Order* signs shall be placed or removed by appointed personnel.

### 7-2.3.3 Adjustments and Repairs

(a) Any hazardous condition disclosed by the inspection and requirements of Section 7-2.1 shall be corrected before operation of the hoist is resumed. Adjustments and repairs shall be done only by a designated person.

(b) Adjustments shall be maintained to ensure correct

functioning of components. The following are examples:

- (1) all functional operating mechanisms;
- (2) brakes, clutches, and pawls;
- (3) power plants;
- (4) limit switches and other limiting devices;
- (5) control systems;
- (6) foundations and other anchorages.

(c) Repairs or replacements shall be made as needed.

The following are examples:

- (1) all critical parts which are cracked, broken, bent, or excessively worn;
- (2) pitted or burned electrical contacts should be corrected only by replacement and in sets; controller parts should be lubricated only as recommended by the manufacturer or by a qualified person.

#### 7-2.3.4 Lubrication

(a) All moving parts of the hoist for which lubrication is specified should be regularly lubricated. Lubricating systems should be checked for proper delivery of lubricant. Care should be taken to follow manufacturer's recommendations as to points and frequency of lubrication, levels, and type of lubricant to be used.

(b) All rotating machinery should be stopped, where feasible, while lubricants are being applied and protection provided as called for in paras. 7-2.3.2(a)(1)–(4), unless equipped for automatic or remote lubrication.

### Section 7-2.4: Rope Inspection, Replacement, and Maintenance

#### 7-2.4.1 Inspection

##### (a) Frequent Inspection

(1) Running ropes in continuous service should be visually inspected once each working day. A visual inspection shall consist of observation of all rope which can be expected to be in use during the day's operations. These visual observations should be concerned with discovering damage, such as listed below, which may be a cause for removing the rope from service or for performing a more detailed examination [refer to para. 7-2.4.1(b)]:

- (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 para. 7-2.4.1(c) for further guidance].
- (2) Care shall be taken when inspecting sections

of rapid deterioration such as flange points, crossover points, and repetitive pickup points on drums.

##### (b) Periodic Inspection

(1) The inspection frequency shall be determined by a qualified person and shall be based on such factors as: expected rope life as determined by experience on the particular installation or similar installations, severity of environment, percentage of capacity lifts, frequency rates of operation, and exposure to shock loads. Inspections need not be at equal calendar intervals and should be more frequent as the rope approaches the end of its useful life. This inspection shall be made at least annually.

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

- (a) points listed in para. 7-2.4.1(a);
- (b) reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires;
- (c) severely corroded or broken wires at end connections;
- (d) severely corroded, cracked, bent, worn, or improperly applied end connections.

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

- (a) sections in contact with saddles, equalizer sheaves, or other sheaves where rope travel is limited;
- (b) sections of the rope at or near terminal ends where corroded or broken wires may protrude.

##### (c) Rope Replacement

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

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

- (a) in running ropes, six randomly distributed broken wires in one rope lay, or three broken wires in one strand in one rope lay;

(b) one outer wire broken at the contact point with the core of the rope which has worked its way out of the rope structure and protrudes or loops out from the rope structure;

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

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

(e) evidence of heat damage from any cause;

(f) reductions from nominal diameter greater than those shown below:

Rope Diameter	Max. Allowable Reduction From Nominal Dia.
Up to 5/16 in. (8 mm)	1/64 in. (0.4 mm)
3/8 in. (9.5 mm) to 1/2 in. (13 mm)	1/32 in. (0.8 mm)
9/16 in. (14.5 mm) to 3/4 in. (19 mm)	3/64 in. (1.2 mm)
7/8 in. (22 mm) to 1 1/8 in. (29 mm)	1/16 in. (1.6 mm)
1 1/4 in. (32 mm) to 1 1/2 in. (38 mm)	3/32 in. (2.4 mm)

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

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

(4) Replacement rope shall have strength rating at least as great as the original rope 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.

(d) *Ropes on hoists not in regular use.* Ropes which have been idle for a period of a month or more due to shutdown or storage of a hoist on which they are installed shall be given an inspection in accordance with para. 7-2.4.1(a) before they are placed in service. This inspection shall be for all types of deterioration and shall be performed by a designated person whose approval shall be required for further use of the rope.

(e) *Inspection Records*

(1) *Frequent Inspection.* No records required.

(2) *Periodic Inspection.* In order to establish data as a basis for judging the proper time for replacement, a dated report of rope condition at each periodic inspection shall be available to appointed personnel. This report shall cover points of deterioration listed in para. 7-2.4.1(b)(2).

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

**7-2.4.2 Rope Maintenance**

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

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

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

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

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

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

## CHAPTER 7-3

### Operation

#### Section 7-3.1: Qualifications for and Conduct of Operators and Operating Practices

##### 7-3.1.1 Operators

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

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

(b) No one, other than personnel specified in para. 7-3.1.1(a), shall enter a hoist operator's cab or operating position with the exception of persons such as oilers or supervisors whose duty requires them to do so, and then only in the performance of their duties and with the knowledge of the operator or other appointed person.

##### 7-3.1.2 Qualifications for Operators

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

(b) Operators and the operator trainees shall meet the following physical qualifications:

- (1) have vision of at least 20/30 Snellen in one eye and 20/50 in the other, with or without corrective lenses;
- (2) be able to distinguish colors, regardless of position, if color differentiation is required for operation;
- (3) hearing, with or without hearing aid, must be adequate for the specific operation;
- (4) have sufficient strength, endurance, agility, coordination, and speed of reaction to meet the demands of equipment operation.

(c) Evidence of physical limitations or emotional instability which could render the operator a hazard to himself or others, or which in the opinion of the examiner could interfere with the operator's safe performance, may be cause for disqualification. In such

cases, specialized clinical or medical judgments and tests may be required.

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

(e) Operators and operator trainees should have good depth perception, field of vision, reaction time, manual dexterity, coordination, and should not be prone to dizziness or similar undesirable characteristics.

##### 7-3.1.3 Conduct of Operators

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

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

(c) The operator shall respond to signals only from the person who is directing the lift, or an appointed signalperson. However, the operator shall obey a stop signal at all times, no matter who gives it.

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

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

- (1) land any attached load, except as outlined in para. 7-3.2.3;
- (2) disengage clutches;
- (3) put the handles of controls in the *off* position;
- (4) open main switch or stop the engine;
- (5) engage manual locking devices in the absence of automatic holding equipment.

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

(g) Before closing the switch or starting the hoist engine, the hoist operator shall ensure that all controls are in the *off* position and all personnel are in the clear.

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

- (1) set all brakes or locking devices;

(2) move all clutch or other power controls to the *off* or *neutral* position;

(3) if practical, the suspended load should be landed under brake control.

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

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

## Section 7-3.2: Handling the Load

### 7-3.2.1 Size of Load

(a) No hoist shall be loaded beyond the rated line pull, except for testing.

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

(1) For each such lifting assignment:

(a) a designated person shall direct each lift;

(b) a designated person shall ascertain that the rope is in satisfactory condition [paras. 7-2.4.1(a)(1)(a)–(d)] both before and after lifting; but more than one broken wire in any one lay shall be reason to consider not using the rope for such lifts;

(c) operations shall be conducted in such manner and at such speeds as to minimize dynamic effects.

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

(3) Provisions of para. 7-3.2.1(b) are not intended to permit duty cycle or repetitive lifts to be made with operating design factors less than 5.

### 7-3.2.2 Moving the Load

(a) Care shall be taken in lifting to be certain that:

(1) hoist ropes are not kinked;

(2) there is no sudden acceleration or deceleration of the moving load.

(b) Before starting to lift, if there is a slack rope condition, the operator shall determine that the rope is properly seated on the drum.

(c) The operator should be notified each time a load approaching the maximum rated load is to be handled so that the brakes can be tested by lifting the load a few inches and applying the brakes.

(d) No load hoist drum shall be rotated in the

lowering direction beyond the point where less than two wraps of rope remain on the drum.

(e) When swinging a load by means of a derrick or similar structure, sudden starts and stops should be avoided.

(f) When loads are lowered for long distances, the user should check the thermal capacity of the brakes and motors, as outlined by ratings or charts provided by the manufacturer for both repetitive and intermittent operation. Where maximum rated loads are being lowered for long distances, power controlled lowering usually is necessary to reduce the demand on the brake. Additional cooling provisions may be required on fluid transmissions or torque converters.

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

### 7-3.2.3 Holding the Suspended Load

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

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

(c) As an exception to para. 7-3.2.3(a), the operator may leave the controls, provided that prior to leaving, an appointed individual and the operator shall establish the requirements for dogging the hoist [see para. 7-3.2.3(b)] and furnish notices, set up barricades, or whatever other precautions may be necessary.

(d) Hoists, when holding anchor lines or applying static pressure, are not considered as holding suspended loads; however, prior to the operator leaving the controls, the operator and an appointed individual shall establish the requirements for braking, dogging the hoist [see para. 7-3.2.3(b)], furnishing notices, setting up barricades, or whatever other precautions may be necessary.

### 7-3.2.4 Use of Winch Heads

(a) The winch head shall not be used without the knowledge of the operator.

(b) The operator shall be within convenient reach of the engine disconnect clutch control lever, or the power control lever while a winch head is being used.

## Section 7-3.3: Signals

**7-3.3.1 Standard Signals.** Standard signals to the operator shall be in accordance with the standards prescribed in paras. 7-3.3.2 and 7-3.3.3, unless voice

communication equipment (telephone, radio, or equivalent) is utilized. Signals shall be discernible or audible at all times. No response shall be made unless signals are clearly understood.

**7-3.3.2 Hand Signals.** Hand signals shall be in accordance with Fig. 4 and shall be posted conspicuously.

**7-3.3.3 Bell Signals.** Bells of different tones shall be used for boom and load. The signals shall be as follows:

(a) *When Operating.* One bell or light means "Stop."

(b) *When Stopped.* One bell or light means "Raise;" two bells or lights mean "Lower."

(c) *When Temporarily Stopped.* Two bells or lights alternately on boom and load mean "Dog It Off" or "Stopping For Some Time."

(d) *When Dogged Off.* Before starting, ring four bells or light four lights alternately on boom and load, meaning "Get Ready To Start Work Again."

**7-3.3.4 Special Signals.** Some special operation may require additions to, or modifications of, the standardized signals. These special signals should be agreed upon and thoroughly understood by both the signalperson and the operator, and should not be in conflict with the standard signals.

**7-3.3.5 Instructions.** If it is desired to give instruc-

tions to the operator other than those provided for in the standard signal system, hoist operation shall be stopped.

### Section 7-3.4: Miscellaneous

**7-3.4.1 Fire Extinguishers.** Operating and maintenance personnel shall be familiar with the use and care of the fire extinguishers provided.

#### 7-3.4.2 Refueling

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

(b) Gasoline powered hoists shall not be refueled with the engine running.

(c) Fuel containers shall not be stored in hoist enclosures.

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

#### 7-3.4.3 Cab or Operating Enclosure

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

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

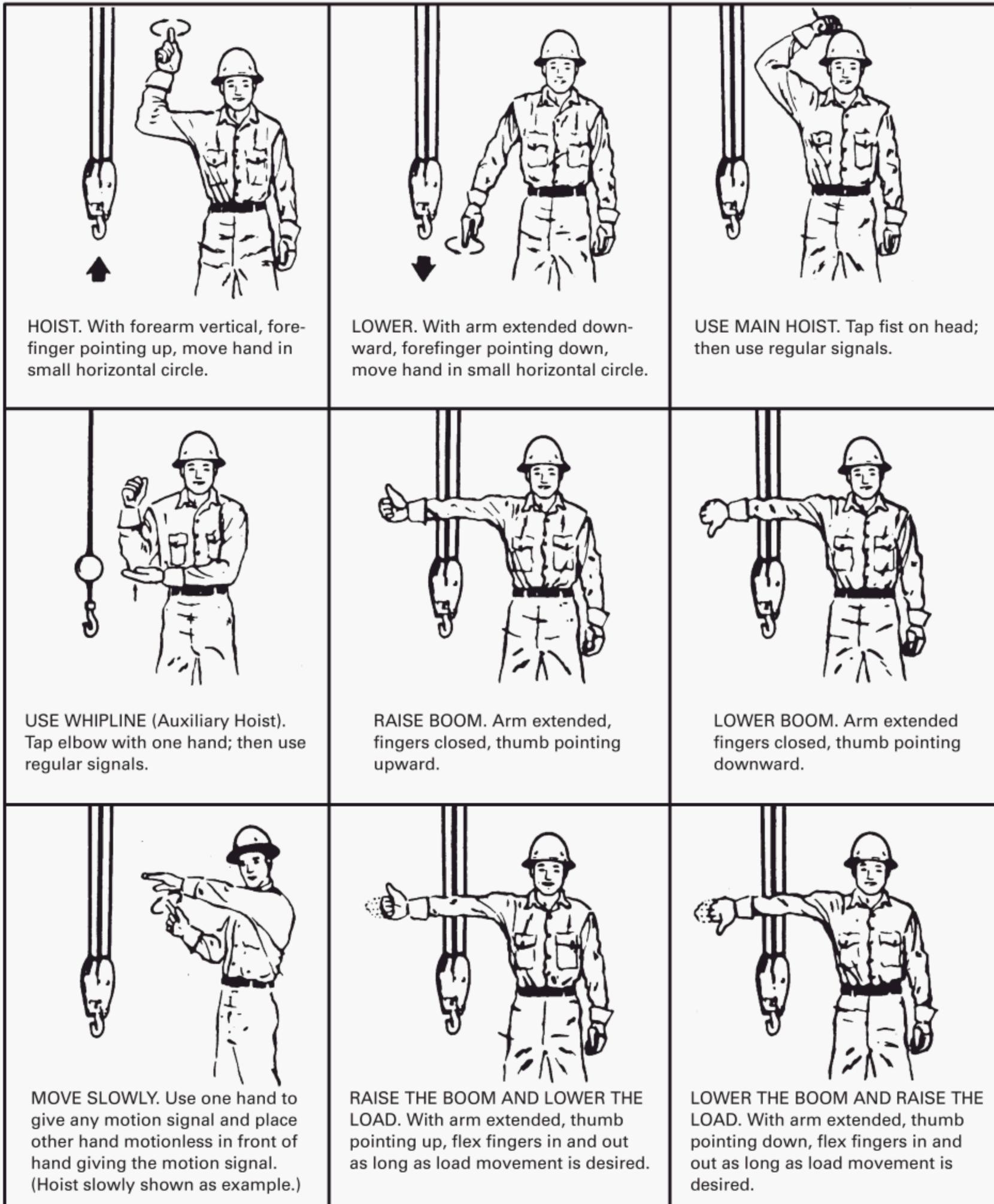


FIG. 4A STANDARD HAND SIGNALS FOR HOIST OPERATION

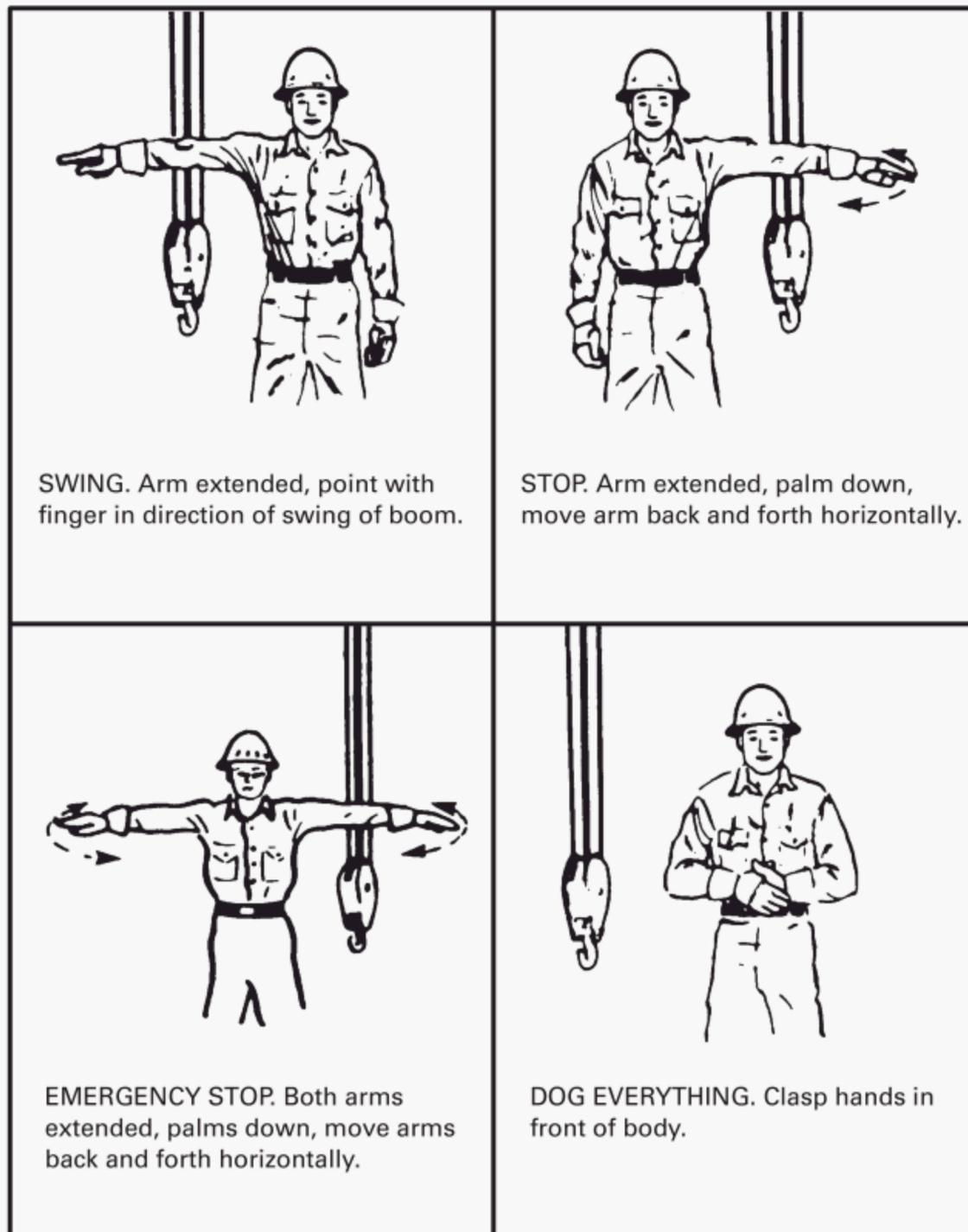


FIG. 4B STANDARD HAND SIGNALS FOR HOIST OPERATION (CONT'D)



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