ASME HST-6–2015
[Revision of ASME HST-6–1999 (R2010)]

# Performance Standard for Air Wire Rope Hoists

AN AMERICAN NATIONAL STANDARD

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Two Park Avenue • New York, NY • 10016 USA

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This Standard will be revised when the Society approves the issuance of a new edition.

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

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# FOREWORD

This Standard is one in a series that provides performance requirements for hoists and was originally issued in 1986. It was developed by the ASME HST Standards Committee, Hoists — Overhead. It is intended to serve as a guide to manufacturers of the equipment, and to the purchasers and users of the equipment.

Standards in this series are

HST-1 Performance Standard for Electric Chain Hoists
HST-2 Performance Standard for Hand Chain Manually Operated Chain Hoists
HST-3 Performance Standard for Manually Lever Operated Chain Hoists
HST-4 Performance Standard for Overhead Electric Wire Rope Hoists
HST-5 Performance Standard for Air Chain Hoists
HST-6 Performance Standard for Air Wire Rope Hoists

This edition contains a Nonmandatory Appendix that, in conjunction with ASME HST-6, is intended to replace MIL-H-2813.

The format of this Standard is in accordance with the 2010 edition of The ASME Codes & Standards Writing Guide.

This Standard was approved as an American National Standard on December 14, 2015.

# ASME HST COMMITTEE
# Hoists — Overhead

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

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**Proposing Revisions.** Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

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| | |
|---|---|
| Subject: | Cite the applicable paragraph number(s) and the topic of the inquiry. |
| Edition: | Cite the applicable edition of the Standard for which the interpretation is being requested. |
| Question: | Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information. |

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

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# PERFORMANCE STANDARD FOR AIR WIRE ROPE HOISTS

# Chapter 6-0
# Scope, Definitions, References, and Appendices

## SECTION 6-0.1 SCOPE

*(a)* This Standard establishes performance requirements for air wire rope hoists for vertical lifting service involving material handling of freely suspended (unguided) loads using wire rope as the lifting medium with one of the following types of suspension:

*(1)* lug

*(2)* hook or clevis

*(3)* trolley

*(4)* base or deck mounted (does not include winches of the type covered by ASME B30.7)

*(5)* wall or ceiling mounted (does not include winches of the type covered by ASME B30.7)

*(b)* This Standard is applicable to hoists manufactured after the date on which this Standard is issued. It is not applicable to the following:

*(1)* damaged or malfunctioning hoists

*(2)* hoists that have been misused or abused

*(3)* hoists that have been altered without authorization of the manufacturer or a qualified person

*(4)* hoists used for lifting or supporting people

*(5)* hoists used for the purpose of drawing both the load and the hoist up or down the hoist's own wire rope

*(6)* hoists used for marine and other applications as required by the U.S. Department of Defense (DOD)

*(c)* The requirements of this Standard shall be applied together with the requirements of ASME B30.16. Please also refer to ASME B30.16 for requirements pertaining to marking, construction, and installation; inspection, testing, and maintenance; and operations.

## SECTION 6-0.2 DEFINITIONS

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

*ambient temperature:* the temperature of the atmosphere surrounding the hoist.

*base or deck mounted:* a type of mounting where the hoist is mounted to the top side of a horizontal supporting surface.

*beam:* an overhead standard structural or specially fabricated shape on which the trolley operates.

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

*brake, holding:* a friction brake for a hoist that is automatically applied and prevents motion when the air supply is interrupted.

*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 to lower a load, but does not impose additional load on the motor when lifting a load.

*ceiling mounted:* a type of mounting where the hoist is mounted to the underside of a horizontal supporting surface.

*chain, hand:* the chain provided to control movement of a hand-chain-operated trolley.

*control actuator:* a manual means at the operator station by which hoist or trolley controls are energized.

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

*braking, dynamic:* a method of controlling speed by using the motor as a compressor.

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

*control, pendant:* a valve system, connected to the hoist or trolley by hoses, that either directly controls flow of air to the motor or controls a pilot-operated valve system at the motor inlet.

*control, pull:* cords or chains suspended from the hoist by means of which a valve system on the hoist can be operated.

*control, rod:* a rigid rod suspended from the hoist with which a valve system on the hoist can be operated.

*cushioned start:* a pneumatic or mechanical method for reducing the rate of acceleration of trolley motion.

*hazardous (classified) locations:* locations where fire or explosion hazards may exist. Locations are classified depending on the properties of the flammable vapors, liquids, gases, or combustible dusts or fibers that may be present, and the likelihood that a flammable or combustible concentration or quantity is present (refer to NFPA 70).

*Class 1 locations:* locations in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

*Class 2 locations:* locations that are hazardous because of the presence of combustible dust.

*Class 3 locations:* locations that are hazardous because of the presence of easily ignitable fibers or flyings, but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.

*headroom:* measured with the load hook at its upper limit of travel, headroom is the distance from the saddle of the load hook to the following locations (see Fig. 6-0.2-1):

*(a)* centerline of the suspension holes on lug-suspended hoists

*(b)* saddle of the top hook on hook-suspended hoists

*(c)* wheel treadline on trolley-suspended hoists

*(d)* supporting surface on base-, deck-, and ceiling-mounted hoists

*(e)* uppermost point of hoist on wall- and ceiling-mounted hoists

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

*hoist speed:* the rate of motion of the load hook.

*hook suspended:* suspension of the hoist from a trolley or rigid structure by means of a hook at the top of the hoist.

*lateral hook travel:* the lateral movement of the load hook between its position at the upper limit of travel and its position at the lower limit of travel.

*lift:* the maximum vertical distance through which the load hook can travel; it is the total hook movement between its upper limit of travel and its position when at the lower limit of travel (see Fig. 6-0.2-1).

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

*limit device:* a pneumatic or mechanical device for limiting the upward or downward travel of the load hook at the extremities of lift. This device may limit lift at any point within the extremities of lift, if designed to be adjustable.

*load:* the total superimposed weight on the load block or load hook, including lifting devices.

*load block:* the assembly of hook or shackle, swivel, bearing, pins, sheaves, and frame suspended by the rope. This shall include all appurtenances reeved into the ropes.

*load hook:* the hook used to connect the load to the hoist.

*load suspension parts:* the means of suspension (trolley, hook, or lug), the structure or housing that supports the drum, and the drum, the rope, the sheaves, and the load block.

*lug suspended:* suspension of the hoist from a trolley(s) or permanent structure by means of a bolt(s) or pin(s) through a rigid or swivel-type lug(s).

*minimum radius:* the smallest radius of the beam, measured to the centerline of the web of the beam, on which the trolley will operate.

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

*overload:* any load greater than the rated load.

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

*pitch diameter:* the distance from center to center of a rope passing over a sheave or wound on a drum, measured across the diameter of the sheave or drum.

*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 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.

*rated air pressure:* the air pressure, at the hoist inlet, at which the hoist is designed to lift rated load at rated speed.

*rated load:* the maximum load for which a hoist or trolley is designated by the manufacturer or a qualified person.

*reach:* the distance from the saddle of the load hook at its lower limit of travel to the upper point of the headroom measurement. Reach is equal to lift plus headroom (see Fig. 6-0.2-1).

*reeving:* a system in which the wire rope travels around sprockets (see Fig. 6-0.2-2).

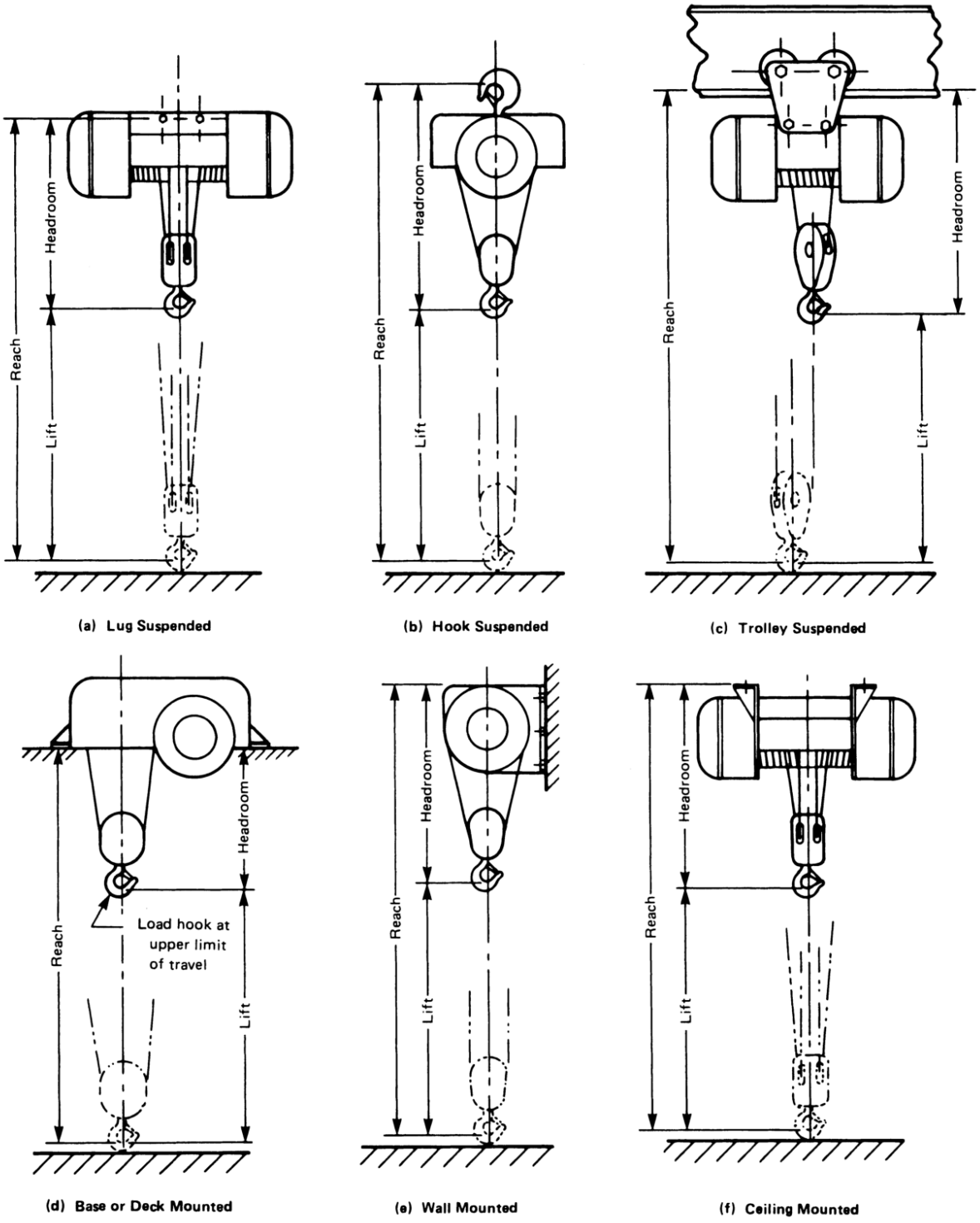
*double reeving:* reeving in which two parts of the line lead off of the drum.

*single reeving:* reeving in which one part of the line leads off of the drum.

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

NOTE: Rope properties do not conform to those shown in ASME B30.9. See ASME B30.16 for hoist rope properties.

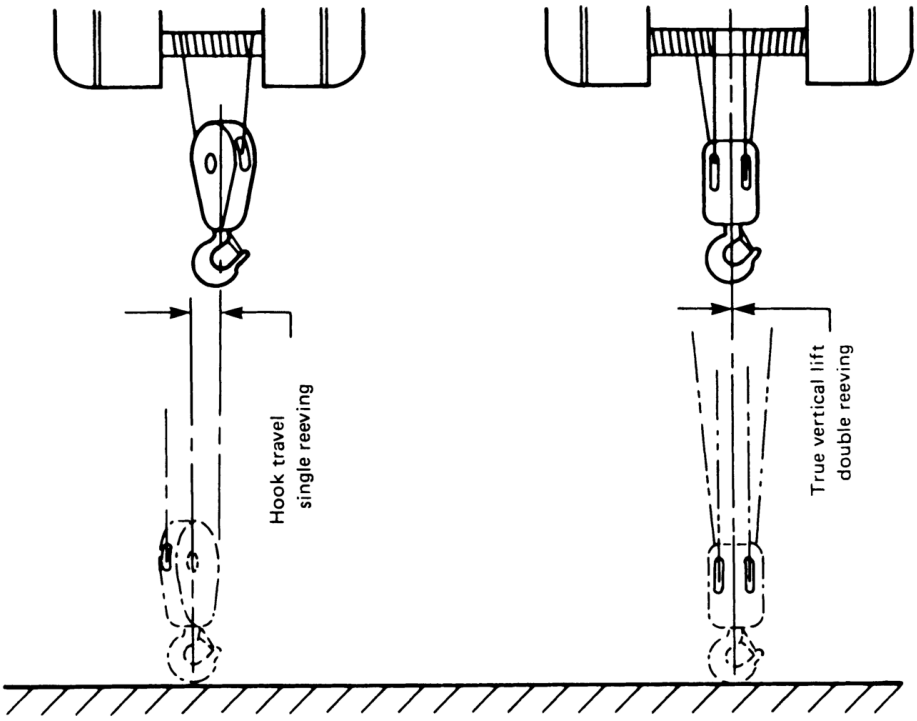
**Fig. 6-0.2-1 Hoist Mounting Headroom, Lift, and Reach**




GENERAL NOTE:

These illustrations are not intended to confine the use of single or double reeving. Each of the mountings may be used with either type of reeving.

**Fig. 6-0.2-2 Single and Double Reeving**




*rope drum:* the cylindrical member around which the rope is wound for lifting and lowering the load.

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

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

*sheave, rope:* a grooved wheel used with a rope to change direction and point of application of a pulling force.

*sheave, running:* a sheave that rotates as the hook is lifted or lowered.

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

*trolley:* a wheeled mechanism from which a hoist is suspended to provide horizontal motion of the hoist along a beam.

*trolley speed:* the rate of motion that a motor-operated trolley (and hoist) attains while traveling along a beam.

*trolley suspended:* suspension of a hoist from a trolley. The hoist can be connected to the trolley by hook, clevis, or lug suspension, or the hoist can be integral with the trolley.

*true vertical lift:* a lift in which the load hook travels in a true vertical path between the lower limit of lift and the upper limit of lift (includes no lateral hook travel) [see Fig. 6-0.2-2, illustration (b)].

*valve:* a device for starting, stopping, or changing the flow in a pneumatic circuit.

*wall mounted:* a type of mounting where the hoist is mounted to a vertical surface.

## SECTION 6-0.3 REFERENCES

The following is a list of publications referenced in this Standard. The latest edition shall apply.

ASME B30.7, Winches
ASME B30.9, Slings
ASME B30.16, Overhead Hoists (Underhung)
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

NFPA 70, National Electrical Code
Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169 (www.nfpa.org)

## SECTION 6-0.4 APPENDICES

Nonmandatory Appendix A, Performance Requirements for Air Wire Rope Hoists Used in Marine and Other Applications as Required by the U.S. Department of Defense (DOD), applies to the performance requirements for hoists used in marine and other applications. The requirements stated in Nonmandatory Appendix A are in addition to the requirements of ASME HST-6–2015 and shall be specifically invoked.

# Chapter 6-1
# Performance

## SECTION 6-1.1 GENERAL

All equipment selected in accordance with this Standard is designed to perform satisfactorily when installed, inspected, tested, operated, and maintained in accordance with ASME B30.16, Chapters 16-2 through 16-4, and used within the rated load and hoist duty service classification. All equipment shall provide speeds, lifts, and headroom in accordance with the manufacturer's specifications or specifications agreed upon by the manufacturer and user.

## SECTION 6-1.2 HOIST DUTY SERVICE CLASSIFICATION

### 6-1.2.1 General Considerations

Service conditions have an important influence on the performance of wearing parts of a hoist, such as gears, bearings, rope, sheaves, brake linings, load and lift limit devices, wheels, and pneumatic components. Careful consideration of the hoist duty service classifications described in this Section will enable the user to evaluate the application and obtain a hoist designed for optimum performance and minimum maintenance. If doubt exists regarding hoist selection, the hoist supplier should be consulted. Many factors enter into the selection of the proper hoist to perform a given function. Hoisting equipment consists of both mechanical and pneumatic components, and both must be considered when analyzing the service the hoist must perform.

The factors that influence the performance of any hoist include the following:

*(a) Load Distribution.* Load distribution is the actual distribution or proportion of full and partial loads to be handled by the equipment, including lifting devices, and has an important effect on the life of power transmission components. For example, ball bearing life varies according to the cube of the load. A 2-ton (1 814.4-kg) hoist operated at a mean effective load of 1 ton (907.2 kg) will have a ball bearing life of 8 times that of the same hoist used steadily at its rated load.

*(b) Operational Time.* Operational time is the total running time of the hoist per hour or per work period.

*(c) Repetitive Long Lowering Operations.* Such operations generate heat in control braking means.

*(d) Environmental Conditions.* Examples include high or low ambient temperatures, dust, moisture, and corrosive fumes.

**Table 6-1.2.3-1 Air Wire Rope Duty Service Classification**

| Hoist Duty Class | Description |
|---|---|
| A4 | Loads normally less than 50% of rated load with running time up to continuous; or<br>Loads normally above 50% of rated load with running time up to 50% of work period |
| A5 | Loads normally above 50% of rated load with running time above 50% of work period |

### 6-1.2.2 Hazardous Locations

When hoists are used in hazardous locations as defined by NFPA 70 or other special codes, modifications or additional precautions not covered by this Standard may be required. In these locations, only hoists designed in a manner suitable for the conditions encountered shall be used.

### 6-1.2.3 Duty Classification

While all the factors listed in para. 6-1.2.1 must be considered in selecting the proper class of hoist, most industrial applications can be generalized according to the percentage of rated load normally handled and the running time. Listed in Table 6-1.2.3-1 are the two duty classes that have been established for air wire rope hoists. The majority of hoist applications fall into the A4 category.

## SECTION 6-1.3 SPECIFICATIONS OF LIFT, HEADROOM, AND REACH

### 6-1.3.1 Lift

Lift should be specified for the application.

### 6-1.3.2 Headroom

Headroom should be specified if important to the application.

### 6-1.3.3 Reach

Reach should be specified if important to the application.

**Table 6-1.4-1 Typical Hoist and Motorized Trolley Speeds**

| Rated Load | | Hoist Speed, ft/min (m/min) [Note (3)] | Motorized Trolley Speed, ft/min (m/min) |
|---|---|---|---|
| Ton (kg) [Note (1)] | Tonne (kg) [Note (2)] | | |
| 1/8 (114) | 1/8 (125) | 16 to 100 (5 to 30) | 30 to 100 (9 to 30) |
| 1/4 (227) | 1/4 (250) | 7 to 100 (2 to 30) | |
| 1/2 (454) | 1/2 (500) | | |
| 1 (909) | 1 (1 000) | | |
| 1 1/2 (1 364) | 1 1/2 (1 500) | 4 to 40 (1 to 12) | |
| 2 (1 818) | 2 (2 000) | | |
| 3 (2 727) | 3 (3 000) | | |
| 4 (3 636) | 4 (4 000) | 4 to 24 (1 to 7) | |
| 5 (4 545) and over | 5 (5 000) and over | | |

NOTES:
(1) 2,000 lb/ton.
(2) 1 000 kg/tonne.
(3) Lifting and lowering speeds will vary depending on the percent of rated load. Inherently, lowering speeds are greater than lifting speeds. Refer to manufacturer's catalog.

## SECTION 6-1.4 SPEEDS: HOIST AND TROLLEY

Hoisting equipment is available over a wide range of hoist and trolley speeds. Table 6-1.4-1 lists typical speed ranges.

NOTE: Table 6-1.4-1 is to be used as a guide only and is not intended to restrict either the manufacturer or the buyer from offering or specifying speeds outside the ranges shown; nor should it be inferred that speeds above or below the ranges shown are not compatible with the required class of hoist.

## SECTION 6-1.5 TROLLEYS

Hoist trolleys are available in plain, hand-chain-operated, and motor-driven types. Selection of each type depends upon the application.

When a trolley is required for use with a hoist, the type and size of support beam shall be specified to ensure that the trolley is suitable for the minimum radius and the contour of the beam.

### 6-1.5.1 Plain-Type Trolleys

A plain-type trolley is recommended where trolley motion is infrequent or relatively short. Due to the force required to manually operate this type of trolley, it is also recommended that the use of plain trolleys be limited to a maximum load of 3 tons (2 727 kg), with the elevation of the beam not more than 20 ft (6 m) above the operator's floor level.

### 6-1.5.2 Hand-Chain-Operated Trolleys

For hand-chain-operated trolleys, motion is obtained by pulling on the hand chain that is connected to trolley wheels through gears or sprockets. This type is recommended where trolley motion is relatively infrequent or short, and for those capacities and beam heights where a plain-type trolley would be impractical. The hand-chain-operated trolley provides good load-spotting ability.

The hand chain shall be guarded to prevent hand chain disengagement from the hand chain wheel. The hand chain shall withstand, without permanent deformation, a force of 3 times the pull required to traverse the trolley with rated load.

### 6-1.5.3 Motor-Operated Trolleys

A motor-operated trolley is recommended where operating frequency, distance of travel, rated load, beam elevation, or the type of load being handled exceeds recommendations for the use of plain or hand-chain-operated trolleys.

The design of motor-operated trolleys shall be based on intermittent operation on a straight beam, unless otherwise specified. Where trolley travel involves a curved beam, beam switches, exceptionally long runs, or near continuous operation, special design may be required. Full particulars should be provided with the inquiry. Brakes, when specified, may be actuated by mechanical or pneumatic means, and shall have the following characteristics:

*(a)* sufficient capacity to stop the trolley within a distance in feet (meters) equal to 10% of the rated speed in feet (meters) per minute when traveling at rated speed with rated load

*(b)* heat dissipation capability for the specified frequency of operation

*(c)* provisions for adjustment where necessary to compensate for wear

### 6-1.5.4 Trolley Wheels

When a trolley is required for use with a hoist, the type and size of the support beam shall be specified to ensure the trolley wheel contour is suitable for the contour of the beam.

# Chapter 6-2
# Mechanical Requirements

## SECTION 6-2.1 ROPE SHEAVES

*(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.

## SECTION 6-2.2 DRUM

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

*(b)* No less than two wraps of rope shall remain on each anchorage of the hoist drum when the hook is at its lower limit of travel as determined by rated lift, unless a lower limit device is provided, in which case no less than one wrap shall remain on each anchorage of the hoist drum.

## SECTION 6-2.3 REEVING

Hoist reeving may be either single or double, and may be one part or multiple part.

### 6-2.3.1 Single Reeving

On single-reeved hoists, one end of the rope is attached to the drum. Continuous drum grooving runs in one direction. The load block moves laterally in the direction of the axis of the drum as the rope winds onto or off of the drum. [See Fig. 6-0.2-2, illustration (a).]

### 6-2.3.2 Double Reeving

On double-reeved hoists, both ends of the rope are attached to the drum. The drum is grooved with left- and right-hand grooves beginning at both ends of the drum, then grooving toward the center of the drum. The load block follows a true vertical lift (true vertical path) as the ropes wind toward or away from each other onto or off of the drum. [See Fig. 6-0.2-2, illustration (b).]

## SECTION 6-2.4 OVERLOAD LIMIT DEVICE

*(a)* An overload limit device, when furnished, shall be designed to permit operation of the hoist within its rated load and to limit the amount of overload that can be lifted by a properly maintained hoist, under normal operating conditions.

*(b)* The overload limit device may allow the lifting of an overload but shall be designed to prevent the lifting of an overload that could cause damage to a hoist, trolley, or supports. This does not imply that any overload is to be intentionally applied to the hoist.

*(c)* The overload limit device is an emergency device. It shall not be used to measure the maximum load to be lifted and shall not be used to sense the overload imposed by a constrained load.

## SECTION 6-2.5 CONTROL

Hoists and trolleys shall have pendant, pull cord, or rod control. Control actuators shall spring return to the "OFF" position.

### 6-2.5.1 Pendant Control

*(a)* The pendant control station shall be supported to protect the pneumatic hoses against strain.

*(b)* The pendant control station shall be clearly marked to indicate the function of each actuator.

*(c)* Unless otherwise specified, the standard pendant control shall have a length that will locate the pendant approximately 3 ft to 5 ft (0.9 m to 1.5 m) above the lower limit of lift.

### 6-2.5.2 Pull Control

Pull control shall consist of two pull chains or cords with suitable handle(s) clearly marked for direction. Unless otherwise specified, the standard pull control shall have a length that will locate the control handles approximately 3 ft to 5 ft (0.9 m to 1.5 m) above the lower limit of the lift.

### 6-2.5.3 Rod Control

Rod control shall permit control of hoist or trolley motion by linear or rotary movement of the rod handle, or a combination of both. The rod handle shall be clearly marked for direction of motion. Unless otherwise specified, the rod handle shall be located 3 ft to 5 ft (0.9 m to 1.5 m) above the lower limit of lift.

# Chapter 6-3
# Typical Air Wire Rope Hoist and Trolley Inquiry Data

## SECTION 6-3.1 INQUIRY DATA FORM

See Form 6-3.1-1. An editable digital copy of this Form is available at go.asme.org/HSTforms.

**Form 6-3.1-1 Typical Air Wire Rope Hoist and Trolley Inquiry Data Form**

**HOIST**

Quantity required _____

Rated load _____ tons ( _____ kg)

Lift [Note (1)] _____ ft ( _____ m)

Reach _____ ft ( _____ m)

Headroom _____ in. ( _____ m)

Distance from operating floor to underside of beam or to support point:

_____ ft _____ in. ( _____ m)

Hoisting speed _____ ft/min ( _____ m/min)

Type of control:

☐ Pendant ☐ Pull ☐ Rod

☐ Other _____

Air supply pressure at hoist under normal operating conditions _____ psig

Performance Requirements (see Chapter 6-1):

Average lift _____ ft ( _____ m)

Number of lifts/hr _____

Number of starts/hr _____

Work period hr/day _____

Hoist service classification ☐ A4 ☐ A5

Furnish complete information regarding any abnormal operating conditions: _____

Type of suspension:

☐ Lug ☐ Hook ☐ Clevis

☐ Plain trolley ☐ Hand-chain-operated trolley

☐ Motor-operated trolley ☐ Other _____

**TROLLEY (see Section 6-1.5)**

Travel speed _____ ft/min ( _____ m/min)

☐ Trolley brake required

Type of control:

☐ Pendant ☐ Pull ☐ Rod

☐ Other _____

Type and size of beam _____

Width of running flange _____ in. ( _____ mm)

Minimum radius of beam curves

_____ ft _____ in. ( _____ m)

Clearance dimensions of interlocks, switches, or beam splices (if used): _____

**OPTIONAL EQUIPMENT REQUIRED**

NOTE:

(1) Refer to manufacturer's catalog for standard lift that will meet the application requirement.

# NONMANDATORY APPENDIX A

# PERFORMANCE REQUIREMENTS FOR AIR WIRE ROPE HOISTS USED IN MARINE AND OTHER APPLICATIONS AS REQUIRED BY THE U.S. DEPARTMENT OF DEFENSE (DOD)

## A-1 GENERAL

### A-1.1 Scope

This Nonmandatory Appendix provides performance requirements beyond those cited in ASME HST-6–2015 for air wire rope hoists for use in marine and other applications as required by the U.S. Department of Defense (DOD).

This Nonmandatory Appendix, in conjunction with ASME HST-6–2015, replaces the requirements of MIL-H-2813 for air wire rope hoists.

### A-1.2 Classification

Air wire rope hoists shall be of the hook suspension type and be of the following classes, as specified [see para. A-5.1(b)]:

Class 1 Conventional weight
Class 2 Lightweight

### A-1.3 Definitions

*brittle material:* material showing less than 10% elongation in gauge length for the tensile test specimen.

*continuous operation:* lifting and lowering through the full hoisting range at rated load at the specified lifting and lowering speeds.

*excessive wear:* wear that is sufficient to impair safe operation of the hoist. The following conditions and items define excessive wear:

*(a)* increase in chain wheel pocket dimension in excess of 10%

*(b)* increase in clearance tolerance between shaft and bearing in excess of 15%

*(c)* life-lubricated bearings requiring lubrication

*(d)* load-brake lining reduced in excess of 50% of useful life

*(e)* reduction of bar diameter of link chain in excess of 10%

*(f)* reduction of wall thickness for rollers and pins of roller chain in excess of 10%

*(g)* reduction in gear tooth thickness of reduction gear drive in excess of 10%

*mean time to repair:* the average time it takes to fix a failed item. It is calculated by dividing the total corrective maintenance time by the total number of corrective maintenance actions during a specified measurement interval.

*recovered materials:* materials that have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials.

### A-1.4 References to Other Codes and Standards

Refer to the following publications, copies of which may be obtained from the publisher as indicated. The edition bearing the latest date of issue shall be used unless otherwise noted.

AGMA 6010-F97, Standard for Spur, Helical, Herringbone and Bevel Enclosed Drives
AGMA 6034, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors

Publisher: American Gear Manufacturers Association (AGMA), 1001 North Fairfax Street, Suite 500, Alexandria, VA 22314 (www.agma.org)

ASME B30.16, Overhead Hoists (Underhung)

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

ASTM A48, Standard Specification for Gray Iron Castings (DOD adopted)
ASTM A143, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement (DOD adopted)
ASTM B26, Standard Specification for Aluminum-Alloy Sand Castings (DOD adopted)
ASTM B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel (DOD adopted)

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

MIL-E-917, Electric Power Equipment, Basic Requirements
MIL-S-901, Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-STD-167-1, Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)
MIL-STD-740-1, Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment
Publisher: Department of Defense (DOD), Defense Logistics Agency (DLA), DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094 (http://quicksearch.dla.mil)

## A-2 PERFORMANCE REQUIREMENTS

### A-2.1 General

Performance requirements shall be in accordance with ASME HST-6–2015, and as specified in this Nonmandatory Appendix.

### A-2.2 Application

Metals susceptible to corrosion attack in a seawater environment shall be treated, plated, or painted to provide corrosion resistance. To minimize electrolytic corrosion between dissimilar metals in contact with each other, metal-to-metal contacts shall be limited to those metals that, when coupled, are in accordance with seawater corrosion of galvanic couples requirements of MIL-E-917. If a metal is coated or plated, the coating or plating metal, rather than the base metal, shall be considered in metal-to-metal contact between parts that depend upon coating or plating for corrosion resistance.

When specified [see para. A-5.1(c)], hooks shall be zinc plated. Zinc plating shall be in accordance with ASTM B633, Type II, Class Fe/Zn 12. The hook throat safety device shall be constructed of noncorrosive material or treated for corrosion resistance.

The safeguarding against and procedure for detecting embrittlement of zinc coating shall be in accordance with ASTM A143.

### A-2.3 Characteristics

**A-2.3.1 Hoist Characteristics.** For a specified rated load, the lift, weight, headroom, and lifting speed shall be in accordance with Table A-2.3.1-1 unless otherwise specified [see para. A-5.1(d)].

**A-2.3.2 Air Supply Characteristics.** The air supply line shall connect to the hoist. The hoist shall be capable of operating with an air supply having the following characteristics:

*(a)* rated air gauge pressure from 90 psi to 110 psi (0.62 MPa to 0.76 MPa)

*(b)* a maximum moisture content of 0.002 lb (0.91 g) of water per pound (gram) of dry air at 60°F (15.56°C) and 90 psi (0.62 MPa) absolute

*(c)* solid particle contamination limited to 25 μm

*(d)* a minimum of one drop of atomized lubrication for every 10 cfm (17.0 $m^3/h$) of air

**A-2.3.3 Interchangeability.** In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance, and strength.

### A-2.4 Manual Operation

When specified [see para. A-5.1(e)], means shall be provided for manual lowering and traversing of the hoist at rated load. To provide hand clearance for operator safety, the length and location of a hand crank shall provide for a minimum of 1 in. (25 mm) operational hand clearance measured vertically between the hand crank and the top of the smallest specified I-beam trolley track, track foundation, or hull structure. Force required on a crank to lower rated load shall not exceed 40 lbf (178 N). The load shall not lower unless the brakes are intentionally and manually released or the hand crank is manually cranked. Means shall be provided so that powered operation shall not be possible when the hand crank is removed from its stowage position.

### A-2.5 Lubrication

Lubricants used shall be readily available and free of ozone-depleting chemicals (ODC).

### A-2.6 Painting

Paints and coatings shall be lead and chromate free.

### A-2.7 Workmanship

The hoist shall withstand any operation specified herein without malfunction or component failure caused by faulty workmanship. Edges and surfaces exposed to operating and maintenance personnel shall be smooth and rounded so that a hazardous surface does not exist.

### A-2.8 Availability, Reliability, and Maintainability

The minimum acceptable inherent availability (Ai) of the hoist shall be 0.90. This requirement establishes threshold values for reliability, maintainability, and supportability of the hoist.

**A-2.8.1 Reliability.** The hoist shall operate for an average period of 3,000 continuous cycles without failure [this value of 3,000 mean cycles between failure (MCBF) is equivalent to 90 days of normal ship's operation without hoist failure].

**A-2.8.2 Maintainability.** Routine corrective maintenance at the organizational level shall be accomplished by replacing complete assemblies and subassemblies. Mean time to repair (MTTR) for the hoist shall be 4 hr.

**Table A-2.3.1-1 Air Wire Rope Hoist Characteristics**

| Rated Load, ton (tonne) [Note (1)] | Standard Lift, Min., ft (m) [Note (2)] | Headroom, Max., in. (mm) | Weight of Hoist, Max., lb (kg), Class 1 [Note (2)] | Lifting Speed, ft/min (m/s) [Note (2)] |
|---|---|---|---|---|
| 1/4 (0.2278) | 8 (2.44) | 14.5 (368.3) | 275 (124.7) | 40 (131.2) |
| 1/2 (0.4536) | 8 (2.44) | 15 (381.0) | 285 (129.3) | 30 (98.4) |
| 1 (0.9072) | 8 (2.44) | 18 (457.2) | 375 (170.1) | 19 (62.3) |
| 1.5 (1.3608) | 8 (2.44) | 23.51 (597.2) | 435 (197.3) | 15 (49.2) |
| 2 (1.8144) | 8 (2.44) | 15 (381.0) | 510 (231.3) | 10 (32.8) |
| 3 (2.7216) | 8 (2.44) | 32 (812.8) | 550 (249.5) | 10 (32.8) |
| 4 (3.627) | 8 (2.44) | 37 (939.8) | 720 (326.6) | 8 (26.2) |
| 5 (4.5359) | 8 (2.44) | 45 (1 143.0) | 890 (403.7) | 8 (26.2) |
| 6 (5.4431) | 8 (2.44) | 45 (1 143.0) | 1,000 (453.6) | 8 (26.2) |
| 8 (7.2575) | 8 (2.44) | 49 (1 244.6) | 1,230 (557.9) | 6 (19.7) |
| 10 (9.0719) | 8 (2.44) | 54 (1 371.6) | 1,400 (635.0) | 4 (13.1) |
| 12 (10.8862) | 8 (2.44) | 54 (1 371.6) | . . . | 4 (13.1) |
| 16 (14.5150) | 8 (2.44) | 60 (1 524.0) | . . . | 4 (13.1) |
| 20 (18.1437) | 8 (2.44) | 71 (1 803.4) | . . . | 4 (13.1) |

NOTES:
(1) 2,000 lb/ton (1 000 tonne/kg).
(2) See para. A-5.1(d).

At least 95% of all corrective maintenance actions shall require no more than 10 hr to complete.

## A-3 MECHANICAL REQUIREMENTS

### A-3.1 Design Stress

The maximum combined stress in component parts shall not exceed 35% of the tensile yield strength of the material for hoist operation at rated load under 15-deg incline and tilt conditions. The maximum combined stress in component parts shall not exceed 70% of the tensile yield strength of materials when the hoist is subjected to static or dynamic load tests.

### A-3.2 Design Load

Design load shall be 200% of the hoist rated load for static tests and 150% of the hoist rated load for dynamic tests.

### A-3.3 Frame or Housing

The housing shall be constructed of steel or aluminum alloy for maximum strength and minimum deflection. The housing shall contain the hoist mechanism, including gears, air motor, wire rope drum, brake, and air controls. These components shall be compactly and securely mounted.

### A-3.4 Hoist Lift

Hoist lifts shall be powered by a reversible air motor of enclosed construction that shall operate with air gauge pressures between 80 psi and 100 psi (0.55 MPa and 0.69 MPa). The air motor shall have adequate power and starting torque and shall operate without perceptible vibration at any of the hoist loads or speeds within the rated load and speed capacity. The hoist lift drive motor shall be coupled through a speed reducer or drive gear to the wire rope drum.

### A-3.5 Hoist Load Lifting Medium

The wire rope shall provide a safety factor of at least 5 for the rated load based on the minimum breaking strength of the wire rope. The wire rope shall be of sufficient strength to withstand the tests specified.

**A-3.5.1 Hoist Load Wire Rope Drums.** Hoist load wire rope drums shall have machined radiused grooves. Drum grooves shall have a minimum depth equal to 40% of the wire rope diameter. Drums shall be fitted on each end with recessed flanges to prevent wire rope jamming. The drum diameter shall be not less than 20 times the diameter of the wire rope except that, when extra flexible wire rope is used, the diameter of the drum may be 15 times the diameter of the wire rope. There shall be not less than 12 full turns of wire rope remaining on the drum with the hook in the lowest elevation of the rated lift. Drums shall have a rope winding guide and shall be protected on both top and sides. The wire rope shall be securely attached to the drums.

### A-3.6 Load Hooks

Hook throat openings shall be in accordance with the dimensions shown in Table A-3.6-1. The hook shall be clearly marked with manufacturer identification and allowable hook load or allowable hook load designator. Positive means shall be provided to prevent the load hook from loosening due to rotation of the load.

**Table A-3.6-1 Hook Throat Openings**

| Hoist Rated Load, lb (kg) | Minimum Hook Throat Opening, in. (mm) |
|---|---|
| 1,000 (453.6) | 0.75 (19.1) |
| 2,000 (907.2) | 0.906 (23.0) |
| 3,000 (1 360.8) | 1.0 (25.4) |
| 4,000 (1 814.4) | 1.125 (28.6) |
| 5,000 (2 268.0) | 1.125 (28.6) |
| 6,000 (2 721.6) | 1.5 (38.1) |
| 7,500 (3 402.0) | 1.375 (34.9) |
| 10,000 (4 536.0) | 1.625 (41.3) |
| 11,000 (4 989.5) | 2.0 (50.8) |
| 13,000 (5 896.7) | 2.063 (52.4) |
| 15,000 (6 803.9) | 2.063 (52.4) |
| 17,000 (7 711.1) | 2.063 (52.4) |
| 20,000 (9 071.9) | 2.25 (57.2) |
| 25,000 (11 339.9) | 2.25 (57.2) |
| 30,000 (16 607.8) | 2.75 (70.0) |
| 40,000 (18 143.7) | 3.0 (76.2) |

**A-3.6.1 Range of Load Hook.** The hoist shall pick up a load with the load hook anywhere within a radius of 2 ft (0.61 m) perpendicular to the wire rope drum centerline at the point the wire rope reeves on the wire rope drum, and 7 ft (2.13 m) below the load wire rope drum, without jamming or jumping the wire rope drum.

### A-3.7 Construction

Rotating shafts shall be supported in antifriction bearings or bushings, or both, and shall be enclosed against entry of foreign matter. Rotating and sliding surfaces shall be lubricated. Hoists shall operate through a temperature range of −40°F through 140°F (−40°C through 60°C) for a minimum of 3,000 cycles without a failure. Gears shall be totally enclosed in a readily accessible casing that will permit examination, servicing, and cleaning. Positive means shall be provided to prevent any component from working loose. Hoist parts shall be readily accessible for servicing and replacement as required. Airborne noise level shall be kept to a minimum (maximum MIL-STD-740-1, Grade D).

**A-3.7.1 Controls.** The speed of the motor shall be regulated. The controls shall vertically position a load within ±0.250 in. (±6.35 mm).

**A-3.7.2 Hoist Brake.** The hoist brake shall be spring loaded, of the automatic operating type, which shall stop hoist motion when the air pressure is reduced below the safe motor operating pressure. The hoist brake shall be self-adjusting or readily accessible for easy adjustment to compensate for wear of the brake lining. The hoist brake shall hold the test loads required from a stopped position and shall stop and hold rated loads without slipping. The brake shall be equipped with a manual release for use in the event of a loss of air pressure. Manual release mechanisms shall be arranged so that they can be operated without endangering the operator.

**A-3.7.3 Wire Rope.** Wire rope shall provide a safety factor of at least 5 for the rated load based on the minimum braking strength of the wire.

**A-3.7.4 Gears.** Gears shall be spur, helical, or worm-and-wheel type manufactured in accordance with AGMA 6010-F97 and AGMA 6034.

**A-3.7.5 Overtravel Protection.** The lift limit device specified in ASME B30.16 shall ensure that the hoist shall automatically stop in the lowering position, so as not to exceed the lower limit of travel.

**A-3.7.6 Overload Protection.** Mechanical overload limit devices shall not be permitted in naval applications unless the hoist is provided with a mechanical load brake and the mechanical overload limit device is not installed on the load side of the hoist.

### A-3.8 Materials

Materials used shall be of sufficient hardness and strength to withstand intended use and applicable tests.

**A-3.8.1 Recycled, Recovered, or Environmentally Preferable Materials.** Recycled, recovered (see para. A-1.3), or environmentally preferable materials should be used to the maximum extent possible provided that the materials meet or exceed the operational and maintenance requirements and promote economically advantageous life cycle costs.

**A-3.8.2 Prohibited Materials.** Cadmium, asbestos, beryllium, brittle materials (see para. A-1.3), and magnesium or magnesium-based alloys (except steel or aluminum alloys that contain less than 0.5% magnesium) shall not be used unless otherwise specified. Pressed steel shall not be used except as specified for a particular application. Welded aluminum 6061-T6, 2XXX, and 7XXX material shall not be used.

**A-3.8.3 Cast Iron.** Cast iron in any form shall not be used except where permitted by referenced specifications. The use of cast iron is limited to those alloys conforming to ASTM A48, Class 35, or better.

**A-3.8.4 Aluminum.** Aluminum castings, if used, shall be in accordance with ASTM B26.

## A-4 TESTING, MARKING, AND DATA

### A-4.1 Testing

**A-4.1.1 High-Impact Shock.** When specified [see para. A-5.1(f)], the hoist in the unloaded, not-operating condition shall withstand the high-impact shock test for Grade A or Grade B equipment as specified in MIL-S-901.

**A-4.1.2 Load.** Hoists with overload protection devices shall demonstrate the ability to lift and hold a load equal to 12 times their rated capacity without slippage.

**A-4.1.2.1 Static Load.** Hoists shall support a static load of twice the maximum rated capacity for a period of 10 min. This load shall be suspended with the hoist load chain extended to the limit of the hoist's rated lift height. This extension may be changed to a minimum of 1 ft provided the contractor demonstrates that the entire length of chain is capable of a 200% load. The suspended test load shall be held by the hoist brake.

**A-4.1.2.2 Dynamic Load.** Hoists shall be loaded to 150% of rated capacity and operated by hoisting and lowering the test load through the full operating range for 10 cycles. Trolley-type hoists shall be operated back and forth over a section of track 8 ft (2.43 m) or more in length, with the 150% load in suspension. This test shall be performed for 10 cycles. Hoists and trolleys shall operate satisfactorily, and brakes shall exhibit no sign of slippage.

**A-4.1.3 Operating.** Hoists shall be tested to determine that they are satisfactory for operation with the rated load as follows:

*(a) Hoisting Speed.* Hoists shall be operated for approximately 90% of lift height to verify conformance with the hoisting speed requirements.

*(b) Lowering Speed.* Hoist load hooks shall be lowered at a maximum speed to determine conformance with the speed governor requirements.

*(c) Travel Limit.* Hoists shall be operated in the up and down directions so as to engage the limit switches to demonstrate hoist ability to prevent load hook overtravel.

*(d) Load-Positioning Control.* Hoists shall demonstrate the capability of accurately positioning a load. The test shall be conducted by establishing a reference height and then jogging the load to a position ±0.250 in. (±6.35 mm) above and below the reference height. Repeat each test at least six times.

*(e) Performance.* Hoists shall be continuously operated at maximum speed through approximately 90% of lift height for a period of not less than 30 min. During this test, hoists shall operate satisfactorily without any indication of malfunction.

**A-4.1.4 Manual Operation.** Hoists shall be tested to demonstrate

*(a)* the ability to transverse, lift, and lower through the full hoisting range a rated load by means of manual operation (see para. A-2.4)

*(b)* the interlock prevents air operation

**A-4.1.5 Mechanical Vibration.** An unloaded hoist shall be tested in accordance with the vibration test requirements of MIL-STD-167-1, Type I.

**A-4.1.6 Mounting Hook Test.** The ability of the safety gate of the mounting hook to hold a load equal to the rated load of the hoist shall be tested as follows: A test load shall be attached to the closed and latched safety device in four directions. The load shall be applied to the safety device at a point measured from the hook tip along the safety device at a distance equal to one-third of the throat opening as shown in Table A-3.6-1. The load shall first be applied alternately to opposite sides of the safety device, along the sides of the safety device, at 90 deg to the safety device in a plane perpendicular to the hook plane. The test load shall be 75 lb (34.0 kg) for safety hoist hooks with safe working loads between 1,200 lb and 4,000 lb (544.3 kg and 1 814.4 kg), inclusive; 150 lb (68.0 kg) for safe working loads between 4,000 lb and 10,000 lb (1 814.4 kg and 4 535.9 kg), inclusive; and 200 lb (90.7 kg) for safe working loads greater than 10,000 lb (4 535.9 kg). The safety device shall suffer no permanent deformation due to the test load applications and shall be functional upon completion of testing.

**A-4.1.7 Endurance.** Hoists shall be subjected to 3,000 cycles of continuous operation (see para. A-1.3). After completion of the above tests, the gears, chains, bearings, chain sprockets, brakes, and other wearing parts shall be examined for excessive wear (see para. A-1.3).

### A-4.2 Marking

**A-4.2.1 Identification.** In addition to the requirements of ASME B30.16, Section 16-1.1, the hoist shall be identified with the following:

*(a)* weight and shock (grade), as applicable
*(b)* rated load and hoisting speed
*(c)* ASME HST-6–2015, Nonmandatory Appendix A
*(d)* class and type
*(e)* contract order number
*(f)* date of manufacture
*(g)* National Stock Number (NSN) (if established)

### A-4.3 Data

**A-4.3.1 Technical Manuals.** When specified [see para. A-5.1(g)] in the contract or order, the manufacturer shall prepare technical manuals in accordance with the data ordering documents and include the following:

*(a)* complete list of material
*(b)* identification of each component for replacement
*(c)* final drawings

## A-5 TYPICAL HOIST INQUIRY DATA

### A-5.1 Acquisition

In addition to the typical hoist inquiry data of ASME HST-6–2015, acquisition documents shall specify the following:

*(a)* ASME HST-6–2015, Nonmandatory Appendix A
*(b)* class of hoist required (see para. A-1.2)

*(c)* whether zinc coating of hooks is required (see para. A-2.2)

*(d)* hoist characteristics other than those specified in Table A-2.3.1-1

*(e)* whether manual operation capability is required (see para. A-2.4)

*(f)* whether high-impact shock test is required (see para. A-4.1.1)

*(g)* whether a technical manual is required (see para. A-4.3.1)

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