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AMERICAN NATIONAL STANDARD

ANSI/ASSE A10.4-2007
Personnel Hoists and
Employee Elevators on
Construction and
Demolition Sites

American National Standard
for Construction and
Demolition Operations

ANSI/ASSE A10.4-2007

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ANSI/ASSE A10.4 – 2007

American National Standard
Construction and Demolition Operations

Safety Requirements for Personnel Hoists and Employee Elevators on Construction and Demolition Sites

Secretariat

American Society of Safety Engineers
1800 East Oakton Street
Des Plaines, Illinois 60018-2187

Approved: May 3, 2007

American National Standards Institute, Inc.

American National Standard

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Foreword (This Foreword is not a part of American National Standard A10.4-2007.)

This standard is one of a series of safety standards that have been formulated by the Accredited Standards Committee on Safety in Construction and Demolition Operations, A10. It is expected that the standards in the A10 series will find a major application in industry, serving as a guide to contractors, labor, and equipment manufacturers. For the convenience of users, a list of existing and proposed standards in the A10 series for Safety Requirements in Construction and Demolition Operations follows.

A10.1 Planning for Construction Safety and Health (under development)
A10.2 Safety, Health, and Environmental Training (under development)
A10.3 Powder-Actuated Fastening Systems
A10.4 Personnel Hoists and Employee Elevators
A10.5 Material Hoists
A10.6 Demolition Operations
A10.7 Transportation, Storage, Handling, and Use of Commercial Explosives and Blasting Agents
A10.8 Scaffolding
A10.9 Concrete and Masonry Construction
A10.10 Temporary and Portable Space Heating Devices
A10.11 Personnel and Debris Nets
A10.12 Excavation
A10.13 Steel Erection
A10.15 Dredging
A10.16 Tunnels, Shafts, and Caissons
A10.17 Safe Operating Practices for Hot Mix Asphalt (HMA) Construction
A10.18 Temporary Roof and Floor Holes, Wall Openings, Stairways, and Other Unprotected Edges
A10.19 Pile Installation and Extraction Operations (under development)
A10.20 Ceramic Tile, Terrazzo, and Marble Work
A10.22 Rope-Guided and Non-Guided Workers' Hoists
A10.24 Roofing – Safety Requirements for Low-Sloped Roofs
A10.25 Sanitation in Construction (under development)
A10.26 Emergency Procedures for Construction Sites (under development)
A10.27 Hot Mix Asphalt Facilities
A10.28 Work Platforms Suspended from Cranes or Derricks
A10.29 Aerial Lifts in Construction (under development)
A10.31 Digger-Derricks
A10.32 Fall Protection Systems for Construction Industry Users
A10.33 Safety and Health Program Requirements for Multi-Employer Projects
A10.34 Public Protection
A10.36 Railroad Construction Safety (under development)
A10.37 Debris Nets
A10.38 Basic Elements of a Program to Provide a Safe and Healthful Work Environment
A10.39 Construction Safety and Health Audit Program
A10.40 Reduction of Musculoskeletal Problems in Construction (under development)
A10.41 Equipment Operator and Supervisor Qualifications and Responsibilities (under development)
A10.42 Rigging Qualifications and Responsibilities in the Construction Industry
A10.43 Confined Spaces in Construction (under development)
A10.44 Lockout/Tagout in Construction
A10.46 Hearing Loss Prevention
A10.47 Highway Construction Safety (under development)
A10.48 Communication Tower Erection (under development)

One purpose of these standards is to serve as guides to governmental authorities having jurisdiction over subjects within the scope of the A10 Committee standards. If these standards are adopted for governmental use, the reference of other national codes or standards in individual volumes may be changed to refer to the corresponding regulations.

Revisions: The A10 Committee welcomes proposals for revisions to this standard. Revisions are made to the standard periodically (usually five years from the date of the standard) to incorporate changes that appear necessary or desirable, as demonstrated by experience gained from the application of the standard. Proposals should be as specific as possible, citing the relevant paragraph number(s), the proposed wording, and the reason for the proposal. Pertinent documentation would enable the A10 Committee to process the changes in a more timely manner.

Interpretations: Upon a request in writing to the Secretariat, the A10 Committee will render an interpretation of any requirement of the standard. The request for interpretation should be clear, citing the relevant paragraph number(s) and phrased as a request for a clarification of a specific requirement. Oral interpretations are not provided.

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AMERICAN NATIONAL STANDARD A10.4
SAFETY REQUIREMENTS FOR PERSONNEL HOISTS AND EMPLOYEE ELEVATORS FOR CONSTRUCTION AND DEMOLITION OPERATIONS

1. GENERAL

1.1 Scope.

1.1.1 This standard applies to the design, construction, installation, operation, inspection, testing, maintenance, alterations and repair of hoists and elevators that (1) are not an integral part of buildings, (2) are installed inside or outside buildings or structures during construction, alteration, demolition or operations and (3) are used to raise and lower workers and other personnel connected with or related to the structure. These personnel hoists and employee elevators may also be used for transporting materials under specific circumstances defined in this standard.

1.1.2 This standard does not apply to the following:

(1) Permanent elevators that are temporarily installed in the hoistways during the construction of buildings, and which incorporate a part of the permanent elevator that will be installed later.
(2) Hoists for raising and lowering materials that have no provision for carrying personnel.
(3) Manlifts of the counterbalanced and endless-belt types.
(4) Mine hoists.
(5) Wire-rope-guided or non-guided hoists.

1.2 Purpose. The purpose of this standard is to set forth minimum requirements intended to provide for the safety of life, limb and property of those engaged in occupations requiring the use of personnel hoists or employee elevators. The requirements of this standard are the minimum for that purpose.

1.3 Exceptions. In cases of practical difficulties, unnecessary hardships or new developments, the enforcing authority may grant exceptions to literal requirements of this standard. These exceptions may permit use of other devices or methods, but only when it is clearly indicated that equivalent safety and permanent installation are thereby secured.

2. REFERENCES

2.1 Related American National Standards. The following publications or their most current issue supplement this standard:

ANSI/ASSE A10.18, *Safety Requirements for Temporary Floors, Holes, Wall Openings, Stairways, and Other Unprotected Edges in Construction and Demolition Operations*

ANSI/ASME A17.1. *Safety Code for Elevators and Escalators*

ANSI/ACI 318, *Building Code Requirements for Structural Concrete*

ANSI/AWS D1.1, *Structural Welding Code – Steel*

ANSI/NFPA 70, *National Electrical Code*

2.2 Other References.

AGMA 2004-B89, *Gear Materials and Heat Treatment Manual*

ANSI/AGMA 2001-D04, *Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth*

ANSI/AGMA 6022-C93, *Design Manual for Cylindrical Wormgearing*

ANSI/AGMA 908-B89, *Information Sheet: Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth*

2.3 Referenced Standards. When any of the following American National Standards referred to in this document is superseded by a revision by the American National Standards Institute, the revision shall apply:

ANSI/ASME A17.1, *Safety Code for Elevators and Escalators*

CAN/CSA B44.1 ANSI/ASME A17.5, *Elevator and Escalator Electrical Equipment*

ANSI/ACI 318-M-83, *Building Code Requirements for Reinforced Concrete*

ANSI/NFPA 70, *National Electrical Code*

ANSI/ASSE A10.8, *Scaffolding Safety Requirements*

ANSI/ASSE A10.18, *Safety Requirements for Temporary Floors, Holes, Wall Openings, Stairways and Other Unprotected Edges in Construction and Demolition Operations*

ANSI/ASTM A307, *Carbon Steel Externally and Internally Threaded Standard Fasteners*

ANSI/ASTM A325, *High-Strength Bolts for Structural Steel Joints*

ANSI/ASTM A283, *Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates*

ANSI/ASTM A27, *Standard Specification for Steel Castings, Carbon, for General Application*

ANSI/ASTM A490-04a, *Standard Specification for Structural Bolts, Alloy Steel, Heat Treated*

ANSI/ASTM A668, *Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use*

ANSI/ASTM A502-03, *Standard Specification for Rivets, Steel, Structural*

ANSI/ASTM A36, *Standard Specification for Carbon Structural Steel*

CSA W47.1, *Certification of Companies for Fusion Welding of Steel*

16 CFR Part 1201, *Safety Standard for Architectural Glazing Materials*

CAN/CGSB 12.1, *Tempered or Laminated Safety Glass*

CAN/CGSB 12.11, *Wired Safety Glass*

CAN/CGSB 12.12, *Plastic Safety Glazing Sheets*

3. DEFINITIONS

3.1 Alteration. Any change or addition to the equipment other than ordinary repairs or replacements.

3.2 Approved. Accepted as satisfactory by a duly constituted administrative or regulatory authority.

3.3 Authorized Personnel. Persons who have been instructed in the operation and/or maintenance of the equipment and who are designated by the owner to use or maintain the equipment.

3.4 Bridging Device. A device to span between the threshold of the car to the threshold of the landing. (See Figure 11.3.1.)

3.5 Buffer. A device designed to stop a moving car or counterweight beyond its

normal limit of travel by storing or by absorbing and dissipating the kinetic energy of the car or counterweight beyond its desired limit of travel.

3.5.1 Hydraulic Buffer. A buffer using fluid as a medium that absorbs and dissipates the kinetic energy of the moving car or counterweight.

3.5.2 Hydraulic Buffer Stroke. The fluid-displacing movement of the buffer-plunger accelerating device.

3.5.3 Spring Buffer. A contact device that stores in a spring the kinetic energy of the moving car or counterweight.

3.5.4 Spring Buffer Load Rating. The load required to compress the spring an amount equal to its stroke.

3.5.5 Spring Buffer Stroke. The distance the contact end of the spring can move under a compressive load until all coils are essentially in contact or at the limit of their travel.

3.6 Car.

3.6.1 Car Gate Contact. An electrical device whose function is to prevent the normal operating device from moving the driving-machine unless the car gate is in the closed position.

3.6.2 Car Enclosure. The top and the walls of the car resting on and attached to the car platform.

3.6.3 Car Gate Mechanical Lock. A mechanical device whose function is to lock a car gate in the closed position as the car leaves the receiving landing and to prevent the gate from being opened unless the car is within the landing zone.

3.6.4 Car Frame (Sling). The supporting frame to which are attached the car platform, upper and lower sets of guide shoes, backup guide shoe slides, car safety and hoisting ropes, hoisting rope sheaves or other lifting mechanism.

3.6.5 Car Platform. The structure that forms the floor of the car and directly supports the load.

3.6.6 Hoist Car. The load-carrying unit, including its platform, car frame, car enclosure and car door or gate.

3.7 Car Safety. See Safety, Car or Counterweight.

3.8 Cathead. See Overhead Structure.

3.9 Chicago Boom (Jib Crane). A lifting arm, (derrick) mounted on the hoistway structure or tower that is free to swing in the horizontal plane and is used for the purpose of hoisting materials and loading them into the building.

3.10 Clearance.

3.10.1 Bottom Car Clearance. The clear vertical distance from the pit floor (ground or foundation) to the lowest structural or mechanical part, equipment or device installed beneath the car platform, except guide shoes or rollers, safety-jaw assemblies and platform aprons or guards, when the car rests on its fully compressed buffers.

3.10.2 Top Car, Elevators. The shortest vertical distance within the hoistway between the horizontal plane described by the top of the car enclosure and the horizontal plane described by the lowest part of the overhead structure or other obstruction in the hoistway when the car floor is level with the top terminal landing.

3.10.3 Top Car Clearance. The shortest vertical distance between the top of the car crosshead, or the top of the car where no crosshead is provided, and the nearest part of the overhead structure, or any other obstruction, when the car floor is level with the top terminal landing.

3.10.4 Top Counterweight Clearance. The shortest vertical distance between any part of the counterweight structure and the nearest part of the overhead structure, or any other obstruction, when the car floor is level with the bottom terminal landing.

3.11 Compensating-Rope Sheave Switch. A device that automatically causes the electric power to be removed from the hoist driving-machine motor and brake when the compensating sheave approaches its upper or lower limit of travel.

3.12 Competent Person. One who as a result of specific education, training and/or expertise is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous and who has the authorization and responsibility to take prompt corrective measures to eliminate them.

3.13 Control. A system governing the starting, stopping, direction of motion, acceleration, speed and retardation of the car.

3.14 Controller. A device that serves to control in some predetermined manner the apparatus to which it is connected.

3.15 Counterweight Safety. See Safety, Car or Counterweight.

3.16 Door. The moveable portion(s) of an entrance that closes the openings on the landings. The use of the word "door" shall apply only to the landings.

3.16.1 Biparting Door. A vertically or horizontally sliding door consisting of two or more sections. The biparting door is arranged so the sections or groups of sections open away from each other and are interconnected so all sections operate simultaneously.

3.16.2 Car Gate or Hoistway Door. The sliding portion of the car or the hinged or sliding portion in the hoistway enclosure that closes the opening, giving access to the car or to the landing or pit.

3.16.3 Manually Operated Door or Gate. A door or gate that is opened and closed by hand.

3.17 Drop Plates. A loose plate that is used to bridge the threshold of the car to the threshold of the landing.

3.18 Emergency Stop Switch. A device located at the operator station, which, when manually operated, causes the power to be removed from the driving-machine motor, and thereby causes the brake to be applied.

3.19 Employee Elevator. See Personnel Hoist or Employee Elevator under the Hoist listing.

3.20 Gate. The moveable portion(s) of the car that closes the openings on the car. The use of the word "gate" shall apply only to the car.

3.21 Gate Electric Contact. See Car Contact or Gate Electric Contact under the Car listing.

3.22 Guide Members. Fixed vertical sections designed to restrict lateral movement of the car or counterweight. Guide members may be standard elevator T-rails or other suitable sections.

3.23 Guide Shoes, Backup Guide Shoes and Guide Rollers. Devices attached to the car frame or counterweight frame that cause the car or counterweight to be guided by the guide members.

3.24 Hoist.

3.24.1 Material Hoist. A hoist for raising and lowering materials only. Movement of personnel on a material hoist is prohibited.

3.24.2 Personnel Hoist or Employee Elevator. (Hereinafter referred to as Hoist or Elevator.) A mechanism and its hoistway for use in connection with the construction, alteration, ongoing maintenance or demolition of a building, structure or other work. It is used for hoisting and lowering workers or materials or both, and is equipped with a car that moves vertically on guide members.

3.25 Hoistway. A shaftway; the space traveled by the car or counterweight, and the space occupied by its support members.

3.26 Hoistway Access for Emergency and Inspection Purposes. A means or device that will unlock and permit operation of a hoistway door from a landing, regardless of the location of the stopped car in the hoistway, shall be provided at the top and bottom landing and may be provided at all landings. This device shall be designed to prevent unlocking by a common tool.

3.27 Hoistway Access Switch. A switch located at a landing, the function of which is to permit operation of the car.

3.28 Hoistway Door Interlock. A device having the following two related and interdependent functions:

(1) Preventing the operation of the driving-machine by the normal operating device unless the hoistway door is locked in the closed position.

(2) Preventing the opening of the hoistway door from the landing side unless the car is within the landing zone and is either stopped or being stopped.

3.29 Hoistway Enclosure. The structure that isolates the hoistway from all other parts of the building and at or on which the hoistway doors and the door assemblies are installed.

3.30 Hoistway Enclosure Fascia Plate. The outside surface of the hoistway enclosure.

3.31 Hoistway Landing. The portion of the parent structure, such as floor, balcony or roof, used to receive and discharge passengers or material.

3.32 Hoistway Landing Runway. A self-supported structure created to bridge between the hoistway and the parent structure.

3.33 Hoistway Unit System. A series of hoistway door or gate interlocks whose function is to prevent operation of the driving-machine by the normal operating device unless all hoistway doors or gates are in the closed position and locked.

3.34 Installation.

3.34.1 Existing Installation. A completed and approved hoist, including its hoistway, hoistway enclosures and related construction and all machinery and equipment necessary for its operation.

3.34.2 Jumping. The addition or removal of mast or tower allowing a change in the hoist service elevation.

3.34.3 New Installation. Any installation not classified as an existing installation by definition, or a hoist moved to a new location.

3.35 Landing. The stationary portion of a floor, balcony, or surface used to receive and discharge passengers or freight from the car.

3.35.1 Landing Runby. The difference of measurements between the landing floor

elevation and the car floor elevation at which the car is stopped.

3.35.2 Landing Side. A space outside of the hoistway where users would normally wait for the car.

3.35.3 Landing Zone. A zone extending from a point 12 inches (30.48cm) below a landing to a point 12 inches (30.48cm) above the landing.

3.36 Load Test (Test Load). Shall be 100 percent of the car's rated load equally distributed inside the cab, allowing the system's safeties to stop the moving car as specified elsewhere in the code.

3.37 Log. A record for each day of operation or maintenance of an installation in which the user records anything notable that has or could affect the safe operation of the equipment. The log should include a checklist for operation, maintenance, lubrication and inspections from the equipment manufacturer or from others authorized to make such lists. A record of any testing by authorities, and the results, shall also be recorded in this log. This log shall be available to the governing authorities for the duration of the installation and it shall be given to the owner of the equipment at the completion of the installation.

3.38 Machine.

3.38.1 Driving-Machine. The power unit that applies the energy necessary to raise and lower a hoist car and or counterweight, where applicable.

3.38.2 Electric Driving-Machine. A machine whose energy is applied by an electric motor.

3.38.3 Geared-Drive Machine. A direct-drive machine in which the energy is transmitted through gearing from the motor to the driving sheave, drum, pinion or shaft.

3.38.4 Gearless Machine. A machine without intermediate gearing, which has the driving sheave, pinion or shaft and the brake drum mounted directly on the motor shaft.

3.38.5 Rack-and-Pinion Machine. A machine in which the motion of a car is obtained by a power-driven rotating pinion mounted on the car and traveling on a stationary rack mounted on the supporting mast or tower.

3.38.6 Traction Machine. A machine in which the motion of a car is obtained through friction between the suspension ropes and a traction sheave.

3.38.7 Winding-Drum Machine. A geared-drive machine in which the hoisting ropes are fastened to and wind on a drum.

3.38.8 Worm-Geared Machine. A direct-drive machine in which the energy from the motor is transmitted to the driving sheave or drum through worm gearing.

3.39 Maintenance. This is the normal lubrication, adjusting, tightening, cleaning, protecting and inspecting of the hoist, hoistways, appendices and their power supplies. It is not the repair, replacement or restoration of worn, damaged or broken parts, components or accessories. (Repair is not maintenance.)

3.40 Mast. A vertical structure that supports and guides the car (and the counterweight and cathead, when used) outside of which the car travels.

3.41 May. The term "may" means permissive.

3.42 Operating Device. The car switch, push buttons, lever or other device used to actuate the motor control.

3.43 Operation. The method of actuating the control.

3.43.1 Automatic Operation. Operation wherein the starting of the hoist car is affected in response to the call or activation of operating devices at the landing and/or operating devices in the car.

3.43.2 Car-Switch Automatic Floor-Stop Operation. Operation in which the stop is initiated by the attendant from within the car with a definite reference to the landing at which stopping is desired. Then slowing down and stopping of the elevator is automatic.

3.43.3 Car Switch Operation. An operation wherein the movement and direction of travel of the car are directly and solely under the control of the operator by means of a manually operated car switch inside the car.

3.43.4 Continuous-Pressure Operation. Operation by means of buttons or switches in the car and at the landings, any one of which may be used to control the movement of the car as long as the button or switch is manually maintained in the actuating position.

3.43.5 Landing Operating Device. A device located at a landing that permits the hoist to be operated to that landing.

3.43.6 Nonselective Collective Automatic Operation. Automatic operation by means of one or more buttons in the car for each landing served and one button at each landing, wherein all stops registered by the momentary actuation of landing or car buttons are made regardless of the number of buttons actuated or of the sequence in which the buttons are actuated. With this type of operation the car stops at all landings for which buttons have been actuated, making the stops in the order in which the landings are reached after the buttons have been actuated, but irrespective of its direction of travel.

3.43.7 Pre-Register Operation. Operation in which signals to stop are registered in advance by buttons in the car and at the landings. At the proper point in the car travel, the attendant in the car is notified by a visual, audible or other signal to initiate the stop, after which the landing stop is automatic.

3.43.8 Selective Collective Automatic Operation. Automatic operation by means of one button in the car for each landing served and by up-and-down buttons at the landings, wherein all stops registered by the momentary actuation of the car buttons are made as defined under nonselective collective automatic operation, but wherein the stops registered by the momentary actuation of the landing buttons are made in the order in which the landings are reached in each direction of travel after the buttons have been actuated. With this type of operation, all "up" landing calls are answered when the car is traveling in the up direction and all "down" landing calls are answered when the car is traveling in the down direction, except in the case of the uppermost or lowermost calls which are answered as soon as they are reached regardless of the direction of travel of the car.

3.43.9 Single Automatic Operation. Automatic operation by means of one button in the car for each landing served and one button at each landing, arranged so if any car or landing button has been actuated, the actuation of any other car or landing operating will have no effect on the operation of the car until the response to the first button has been completed.

3.43.10 Single Operation. Operation by means of single buttons or switches or both in the car, and up direction buttons or down direction buttons or both at the landings, by which predetermined landing stops may be set up or registered for an elevator or for a group of elevators. The stops set up by the momentary actuation of the car buttons are made automatically in succession as the car reaches those landings, regardless of its direction of travel or the sequence in which

the buttons are actuated. The stops set up by the momentary actuation of the up and down buttons at the landing are made automatically by the first available car in the group approaching the landing in the corresponding direction, irrespective of the sequence in which the buttons are actuated. With this type of operation, the car can be started only by a starting switch or button in the car.

3.43.11 Snap Action Switch. A switch designed to snap from one position to another (i.e., opened to closed) that is caused by a linkage activated by a cam, normally related to a travel action.

3.44 Overhead Structure (Cathead). All of the structural members or platforms supporting the hoist machinery, sheaves or equipment at the top of the hoistway.

3.45 Pit. The portion of a hoistway extending from the threshold level of the lowest landing door to the floor (ground or foundation) at the bottom of the hoistway.

3.46 Qualified Person. One who by possession of a recognized degree, certificate, or professional standing and who by extensive knowledge, training and experience, has successfully demonstrated their ability to solve or resolve problems relating to the subject matter, the work, or the project.

3.47 Rated Load. The maximum load for which the hoist is designed and installed to lift at the rated speed.

3.48 Rated Speed. The maximum speed in the up direction, with a rated load in the car, at which a hoist is designed to operate.

3.49 Repair. The replacement or restoration of worn, damaged or broken parts, components or accessories. (Repair is not maintenance or alteration.)

3.50 Rise. See Travel.

3.51 Rope. Hoist(ing) wire ropes, governor wire ropes and compensating wire ropes.

3.52 Suspension Rope Equalizer. Devices installed on a hoist car or counterweight to automatically equalize the tension in the hoisting wire ropes.

3.53 Runby.

3.53.1 Bottom Hoist-Car Runby. The distance between the car buffer striker plate and the striking surface of the car buffer when the car floor is level with the bottom terminal landing.

3.53.2 Bottom Hoist-Counterweight Runby. The distance between the counterweight buffer striker plate and the striking surface of the counterweight buffer when the car floor is level with the top terminal landing.

3.54 Safety, Car or Counterweight. A mechanical device attached to the car frame or an auxiliary frame, or to the counterweight frame, that will stop and hold the car or counterweight in case of predetermined overspeed, free fall or slackening of the hoisting ropes.

3.55 Shall. The term "shall" means mandatory.

3.56 Should. The term "should" means advisory.

3.57 Slack-Rope Switch. A device that automatically causes the power to be removed from the hoist driving-machine motor and causes the brake to be applied when a hoisting or counterweight rope becomes slack.

3.58 Standard Hand Railing. A substantial railing constructed of wood or metal, which shall consist of a top rail having a smooth surface. This railing shall be located at a vertical height of approx-

imately 42 inches (106.7cm), measured between the upper surface of the top rail and the floor. An intermediate rail shall be located approximately halfway between the top rail and the floor. Posts shall be located not more than eight feet (2.44m) apart.

3.59 Stopping Device.

3.59.1 Final Terminal Stopping Device. A device that automatically causes the power to be removed from a hoist driving-machine motor and applies the brake. This occurs independently of the functioning of the normal terminal stopping device, the operating device or an emergency terminal-stopping device after the car has passed terminal landings.

3.59.2 Normal Terminal Stopping Device. A device or devices to slow down and stop a hoist car automatically at or near a terminal landing. This occurs independently of the functioning of the operating device.

3.59.3 Terminal Speed-Limiting Device. A device that automatically reduces the speed of a hoist car approaching a terminal landing. This occurs independently of the functioning of the operating device and the normal terminal stopping device, if these devices fail to slow down the car as intended.

3.60 Test Load. See Load Test.

3.61 Tower. A vertical structure that supports and guides the car (and the counterweight and overhead, when used) and within which or on which the car travels.

3.62 Travel (Rise). The vertical distance between the bottom terminal landing and the top terminal landing of a hoist or counterweight.

3.63 Traveling Cable. A cable made of electric conductors, which provides electrical connection between the hoist car and the fixed outlet in or adjacent to the hoistway.

3.64 User. The person or persons having care, custody or control of the equipment at the site.

3.65 Weatherproof. Constructed or protected so that exposure to the weather, to falling moisture or to external splashing will not impair the effectiveness of the enclosed equipment.

4. TEMPORARY USE OF PERMANENT ELEVATORS FOR CARRYING WORKERS OR MATERIALS

Permanent passenger or freight elevators installed in buildings under construction, modification or demolition may be used for carrying workers or materials or both provided the elevators are approved for such use and a temporary permit is issued for the class of service for which approval is granted by the authorities or department having jurisdiction. When elevators handle personnel during construction and operate in permanent hoistways on permanent guide rails, these elevators shall conform to the applicable requirements of ANSI/ASME A17.1, *Safety Code for Elevators and Escalators.*

5. CONSTRUCTION OF TOWERS, MASTS AND HOISTWAY ENCLOSURES

5.1 Tower or Mast Construction. The tower or mast construction forming the supports for the machinery and guide members shall be designed and installed to support the load and forces specified.

5.1.1 A personal fall arrest/protection plan shall be in place in accordance with local, state, or federal regulations. See ANSI/ASSE Z359.1, *Safety for Personal Fall Arrest Systems, Subsystems and Components* and ANSI/ASSE A10.32, *Fall Protection Systems for Construction and Demolition Operations.*

5.2 Protection of Spaces Below Hoistways Not Extending to the Lowest Floor of the Building. Where the space below the hoistway is used for a passageway or is occupied by personnel or, if unoccupied, is not secured against unauthorized access, the following requirements shall be met:

(1) Hoist counterweights shall be provided with a Type A, Type B or rack-and-pinion safety.

(2) The cars and counterweights shall be provided with spring or oil buffers conforming to the following requirements:

(a) Spring or oil buffers shall conform to Section 14.

(b) Spring buffers for hoists shall be designed and installed to not fully compress when struck by the car with its rated load or by the counterweight at governor-tripping speed where the safety is governor operated, and at 125 percent of rated speed where the safety is not governor operated.

(3) Car and counterweight buffer supports shall be of sufficient strength to withstand without permanent deformation the impact resulting from buffer engagement at governor tripping speed where the safety is governor operated and at 125 percent of rated speed where the safety is not governor operated.

5.3 Hoistway Enclosures.

5.3.1 Hoists Located Outside of Structures. For hoists located outside of structures, the enclosures, except those at the lowest landing, may be omitted on the sides where there is no floor, ladders, stairways or scaffold adjacent to the hoistway. Enclosures on the building side of the hoistway shall be full height or a minimum of eight feet (2.44m) high at each floor landing, and the enclosure shall extend not less than 30 inches (76.2cm) on either side of the moving car or counterweight. Enclosures at the pit shall not be less than eight feet (2.44m) high on all sides of the moving car or counterweight.

5.3.2 Hoists Located Inside of Structures. For hoists with conventional floors and located inside of structures, the hoistway shall be enclosed throughout its height. For hoists located inside of open structures and which in general pierce no solid floors, the full-height hoistway enclosure may be omitted, provided that where it is adjacent to areas permitting normal passage of personnel (such as passageways, stairwells and elevator landings) it shall be enclosed to a height of not less than eight feet (2.44m) above the floor stair treads. The enclosure shall extend not less than 30 inches (76.2cm) on either side of the moving car or counterweight.

5.3.3 Design. Hoistway enclosures shall be supported and braced so when they are subjected to a pressure of 100 pounds (45kg) applied horizontally at any point, the deflection will not exceed one inch (2.54cm) and will not reduce the running clearance below the minimum required in 11.1.1.

Hoistway enclosures, if of openwork, shall be provided on all sides within the building or structure with a solid kickplate extending not less than 12 inches (30.48cm) above the level of each floor above the lowest floor.

5.4 Hoist Structure.

5.4.1 Each hoist shall be supported by a firm foundation of such dimensions as will adequately distribute the transmitted load so as not to exceed the safe load-bearing

capacity of the ground upon which such hoists are erected.

5.4.2 Each hoist structure shall be anchored to the building or other structure at vertical intervals not over 30 feet (9.14m) as measured on the tower. Where the building or other structure is of such construction that tie-ins cannot be made, other means of securing the mast to the structure shall be designed by the manufacturer or by a qualified engineer. The hoist structure shall be guyed by means of a suitable number of guys. Such guys shall be fastened to adequate anchorages to ensure the stability of the hoist structure. When wire rope is used for guys, the rope shall be at least 1/2 inch (1.27cm) in diameter.

5.4.3 Tie-ins shall conform to or be equal to manufacturer specifications and shall remain in place until the tower or mast is dismantled. Where tie-ins for cantilever hoist towers are over eight feet (2.44m) in length, measured from the center of the tower to the point of attachment on the structure, the hoist installation shall be designed by a representative of the manufacturer or a qualified engineer. They shall be installed only with the written consent of the manufacturer or upon certification by a qualified engineer. This data shall be available to the enforcing authority prior to acceptance of installation.

5.4.4 The freestanding portion of the hoist structure shall be in accordance with manufacturer specifications.

5.4.5 Material or concrete hoists shall not be used together with personnel hoists in multiple hoistways or on a common tower.

5.4.6 Each hoist shall be independently operated and each personnel hoist car shall have an independent power supply run from the main servicing the site, and each shall have a separate disconnect at that main.

5.4.7 Chicago booms shall be prohibited on hoist structures or in the hoistways.

5.4.8 Personnel hoistways shall have a minimum separation of ten feet (3.05m) from any material hoistway.

5.4.9 Live loads shall not be hoisted or swung over an occupied personnel hoist.

5.5 Erection and Dismantling. Personnel and building materials connected with or related to the building projects shall not be moved by the hoist while it is being installed, jumped, dismantled or altered.

5.5.1 Installation, Jumping Alterations, Maintenance, Testing or Removal. All work shall be performed under the supervision of a competent person.

5.5.1.1 Hoist personnel are those persons performing installation, jumping, alterations, maintenance, removal, repairs, and/or testing of the equipment covered by this standard. Hoist personnel shall, by verifiable documented training and experience, be familiar with the operation and safety functions of the hoist, hoist component, or equipment to be constructed, maintained, repaired, or tested. Training and experience shall include, but not be limited to:

(1) Recognizing the safety hazards that are created during the construction, maintenance, repair, or testing procedures to which they are assigned.

(2) Ability to recognize the compatibility of replacement components, and subsystems in conformance to this standard.

(3) Performing the construction, alteration, maintenance, repair, or testing procedures to which they are assigned in conformance with the requirements of this standard.

(4) Working knowledge of mechanical principles as applied to structures, machines, and mechanisms.

(5) Working knowledge of hydraulic principles as applied to the operation of buffers or other hydraulic hoist equipment on the site.

(6) Working knowledge of the hoists covered by this standard, their uses and limitations, and any special problems or applications likely to be encountered during construction, maintenance, alteration, repair, or testing procedures.

(7) Must have field, on-the-job, classroom, guild, apprenticeship, or other exposure to and instruction from a person skilled or knowledgeable in the hoists covered by this standard or similar conveyances before working alone, performing tests in the presence of an inspector, or supervising other person(s).

(8) Identifying existing and potential hazards in the surroundings, or work conditions which are unsanitary, hazardous, or dangerous to employees and others, and taking prompt corrective measures to eliminate, mitigate, or avoid the hazard(s).

(9) The safety practices required by the employer and the authority having jurisdiction.

(10) Hoist personnel shall obtain site-specific training related to the special conditions and/or unusual hazards to be encountered prior to beginning work.

5.5.2 Operation. Personnel and building materials connected with or related to the building projects shall not be moved by the hoist while it is being installed, jumped, dismantled or altered.

5.6 Landings.

5.6.1 Design. Landing platforms that connect the hoistway or tower to a building or structure shall be designed and constructed to sustain a uniformly distributed load of not less than 100 pounds per square foot (psf) (4.788 kPa).

5.6.2 Railings. Railings and toeboards that conform to ANSI/ASSE A10.8, *Scaffolding Safety Requirements*, shall be placed on the open sides of landing platforms or runways connecting the hoistway or tower to a building or structure.

5.6.3 Overhead Protection. All landing platforms where people may be exposed to falling objects shall be provided with solid overhead protection made of two inch (5.08cm) planking or the equivalent.

5.6.4 Housekeeping. Landing platforms and runways shall be kept clear of stored material, tools, equipment and rubbish.

6. HOISTWAY DOORS AND DOOR-LOCKING DEVICES

6.1 Height, Material and Installation. Hoistway doors shall be not less than six feet six inches (1.98m) in height. Any opening in the door shall not admit a ball 3/4-inch (1.9cm) in diameter. Doors, door guides, guide shoes and locking devices shall be designed, constructed and installed so a fully closed door and its components will not deflect beyond the centerline of the car-to-landing sill clearance when subjected to a 75 pound (34kg) force applied perpendicular to the door opening and distributed over an area of one square foot ($929cm^2$) on any part of the door. Furthermore, the door or its support members and components or all shall not deflect beyond the centerline of the car-to-

landing-sill clearance nor be permanently deformed or distorted. The door shall not be displaced from its supports, guides, tracks, hinges, latches and locking devices or otherwise be made inoperative when the door is subjected to a force of 250 pounds (113kg) applied perpendicular to the door opening and distributed over the full surface of the door.

A vision panel shall be provided where solid doors are used. The vision panel shall be covered with a flame-proof material that will not admit a ball of 3/4-inch diameter (1.9cm) and that will withstand a force of 75 pounds (34kg) applied perpendicular to any part of the panel and distributed over an area of one square foot (929cm^2) with no greater deflection than any other part of the door as allowed above.

The vision panel shall be installed so it will not be in contact with any of the doorjambs.

Landing doors in closed position shall not measure more than eight inches (20.3cm) from the car threshold.

6.2 Door-Locking Devices. See 24.8.3.

6.2.1 Door-Locking Devices – Manual. Landing doors shall be provided with a means of locking the doors so they cannot be opened from the landing.

6.2.2 Door-Locking Devices – Automatic. Landing doors shall be provided with a means of locking the doors so they cannot be opened from the landing side unless the hoist is in the landing zone.

These locks shall, at landings other than the lowest landing, be of a type that can be released only by a person in the car.

If the door at the lowest terminal landing is locked automatically when it is closed with the car at the landing, it shall be provided with means to unlock it from the landing side to permit access to the car. The means provided shall be accessible only to authorized persons.

6.2.2.1 Access to Hoistways for Emergency and Inspection Purposes. A device to unlock and permit operation of the hoistway door from any landing, regardless of the location of the car in the hoistway, shall be provided at the top and bottom landing and may be provided at all landings. This device shall be designed to prevent unlocking by a common tool.

7. OVERHEAD BEAMS, FOUNDATIONS AND FLOORING OVER HOISTWAY

7.1 Overhead Beams and Foundations. Overhead beams and foundations for the direct support of the machinery or sheaves or both shall conform to the requirements given in 7.1.1 through 7.1.4.

7.1.1 Beams and Support. Machines, machinery and sheaves shall be so supported and maintained in place as to effectually prevent any part from becoming loose or displaced under the conditions imposed in service.

Supporting beams, if used, shall be of steel or reinforced concrete. Beams are not required under machines, sheaves and machinery or control equipment that are supported on floors, provided such floors are designed and installed to support the load imposed thereon.

7.1.2 Loads on Machinery and Sheave Beams, Floors or Foundations and Their Supports.

7.1.2.1 Overhead Beams and Floors and Their Supports. Overhead beams and floors and their supports shall be designed for not less than the sum of the following:

(1) The load resting on the beams and supports, which shall include the complete weight of the machine, sheaves, controller,

governor and any other equipment, together with the portion, if any, of the machine-room floor that is supported thereon. This is exclusive of the roof.

(2) Twice the sum of the tensions in all wire ropes supporting the car, passing over sheaves or drums supported by the beams, with the rated load in the car as required by 1.3.3 of *Specification for the Design, Fabrication and Erection of Structural Steel for Buildings*, AISC.

Note: These tensions are doubled to take care of impact, acceleration, stresses, etc.

7.1.2.2 Foundations, Beams and Floors for Machinery and Sheaves Not Located Directly over the Hoistway. For machines and sheaves located below or at the sides of the hoistway, the foundation for the machine and sheave beams and their supports shall be designed to withstand the loads specified in 7.1.2.2.1 through 7.1.2.2.4.

7.1.2.2.1 The foundation shall support the total weight of the machine, sheaves and other equipment, and the floor, if any.

7.1.2.2.2 The sheave beams and the foundation bolts shall withstand twice the vertical component of the tensions in all hoisting ropes passing over sheaves or drums on the foundation or beams, less the weight of the machine or sheaves.

7.1.2.2.3 The sheave beams and the foundation bolts shall withstand twice the horizontal component, if any, of the tensions in all hoisting ropes passing over sheaves or drums on the foundation or beams.

7.1.2.2.4 The foundation shall withstand twice the overturning moment, if any, developed by the tensions in all the hoisting ropes passing over sheaves or drums on the foundation or beams.

7.1.3 Securing of Machinery and Equipment to Beams, Foundations or Floors.

7.1.3.1 Overhead Beams and Floors. Machinery or equipment shall be secured to, and supported on or supported from the top of, overhead beams or floors. Exceptions are:

(1) Secondary or deflecting sheaves of traction hoists.

(2) Devices and their accessories for limiting or retarding car speed.

7.1.3.2 Beams or Foundations Supporting Machinery and Sheaves Not Located Directly over the Hoistway. Machines and sheaves located below or at one side of a hoistway:

(1) Shall be anchored to beams, foundations or floors with bolts.

(2) Shall conform to ANSI/ASTM A307, *Carbon Steel Externally and Internally Threaded Standard Fasteners*.

(3) Shall be of sufficient size and number to withstand the applicable loads specified under 7.1.2.2. Based on these initial loads, total tension in anchor bolts shall not exceed 12,000 lb_f/in^2 (59,295 kPa) for the actual area in the shear plane.

Where bolts are used through sloping flanges of structural shapes, the bolt heads shall be of the tipped or beveled-head type or shall be fitted with beveled steel washers, and nuts on sloping flanges shall seat on beveled steel washers.

Exception: Bolts made of steel having a greater strength than that specified by ANSI/ASTM A307 may be used and the maximum allowable stresses increased proportionally, based on the ratio of the ultimate strengths. Elongation of the bolts must conform to the requirements of ANSI/ASTM A307.

7.1.3.3 Overhead Hoisting-Rope.

Hitches. Where hoisting ropes are secured to the structure above a hoistway, the hitch plates and hitch plate blocking beams, where used, shall be secured to and mounted on top of overhead beams, machine beams or auxiliary beams connected to the webs of overhead beams. Hitch plates, blocking beams or auxiliary beams shall be secured by bolting, riveting or welding and shall be located so the tension in the hoisting ropes will not develop direct tensions in the bolts or rivets.

Bolts. Shall conform to ANSI/ASTM A307, *Carbon Steel Externally and Internally Threaded Standard Fasteners*, ANSI/ASTM A325; *High-Strength Bolts for Structural Steel Joints,* or ANSI/ASTM A490-04a, *Standard Specification for Structural Bolts, Alloy Steel, Heat Treated.*

Rivets. Shall conform to ANSI/ASTM A502-03, *Standard Specification for Rivets, Steel Structural.*

Welding. Shall conform to ANSI/AWS D1.1, *Structural Welding Code – Steel* or CSA W47.1, *Certification of Companies for Fusion Welding of Steel.*

Where bolts and rivets are subject to shearing stresses due to tensions in the hoist ropes, the total shear shall not exceed 8,600 lb_f/in^2 (59,295 kPa) for the actual area in the shear plane. Except where friction-type a connections are used in accordance with ANSI/ASTM A325 and ANSI/ASTM A490-04a, the allowable stresses given in 7.1.4(1) shall be used. The stresses in welds due to tensions in the hoisting ropes shall not exceed 12,000 lb_f/in^2 (82,740 kPa), based on the throat area of the weld.

The hitch plate supporting beams shall be designed to withstand twice the sum of the tensions in all hoisting ropes attached to the hitch plates.

Total stresses in tension plus bending in hitch plates and hitch plate shapes shall not exceed 12,000 lb_f/in^2 (82,740 kPa).

Exception: Bolts made of steel having a greater strength than that specified by ANSI/ASTM A307 may be used and the maximum allowable stresses increased proportionally, based on the ratio of the ultimate strengths. Elongation of the bolts must conform to the requirements of ANSI/ASTM A307.

7.1.3.4 Cast Metals in Tension or Bending. Cast metals having an elongation of less than 20 percent in a length of two inches (5.08cm), which are subject to tension or bending, shall not be used to support machinery or equipment from the underside of overhead beams or floors.

7.1.4 Allowable Stresses for Machinery and Sheave Beams, Floors and Towers or Masts. The unit stresses for all machinery and sheave beams and floors, based on the loads computed as specified in 7.1.2, shall not exceed 80 percent, and the unit stresses in the tower or mast structures shall not exceed 100 percent of those permitted for static loads by the following standards:

(1) *Structural Steel: Specification for the Design, Fabrication and Erection of Structural Steel for Buildings*, AISC.

(2) ANSI/ACI 318, *Building Code Requirements for Structural Concrete.*

7.2 Flooring Over Hoistway. Where the hoisting machine is installed at the top of the hoistway, a solid floor shall be provided for maintenance, inspection and lubrication of the top cathead and sheaves.

7.3 Overhead Protection. All personnel hoist cars shall have overhead protection equivalent to two-inch (5.08cm) plank whenever the building exceeds the height of the personnel-hoist tower. These planks shall be secured.

8. ELECTRICAL WIRING, FITTINGS AND FIXTURES

8.1 Installation of Raceways and Wiring in Hoistway and Machine Room.

8.1.1 Wiring, Raceways and Cables in Hoistways. Main feeders for supplying power to the hoist may be installed inside or outside the hoistway.

8.1.2 Method of Installing Wiring in Hoistways. Stationary electrical conductors located in hoistways shall be encased in rigid metal conduits, intermediate metal conduit or electrical metallic tubing or metal wireways.

Exception 1: Conductor cables without metal encasement may be used for the hoistway wiring provided they are securely fastened to the hoistway construction where exposed to the weather, as in open shafts outside the building. Such conductors shall be suitable for their intended use.

Exception 2: Liquid-tight flexible metal conduit may be used to and from control enclosures used between hoistway risers and limit switches, hoistway door interlocks or contacts, and signal or stop buttons and similar devices.

All conduits, electrical metallic tubing, metal wireways and flexible metal conduits carrying electrical conductors and located within hoistways shall be securely fastened to the hoistway construction, the guide members or the guide member supports.

8.1.3 Wiring Methods in Hoistways and Machine Rooms. The installation of all electrical wiring in hoistways and machine rooms, except as may be provided elsewhere in this standard, shall conform to the requirements of ANSI/NFPA 70, *National Electrical Code*.

Traveling cables, where used between the car and hoistway wiring, shall be Type EO or Type W equivalent. See ANSI/NFPA 70.

8.1.4 Enclosure of Live Parts on Cars and in Hoistways. All live parts of electrical apparatus located in or on hoist cars or in their hoistways shall be suitably enclosed or guarded to protect against accidental contact.

The maximum circuit voltage of control or operating circuits permitted in or on hoist cars and their hoistways shall not exceed that specified in 24.3.1.

8.2 Fittings, Fixtures and Switches. Where the hoistway is exposed to the weather, as in open shafts outside the structure, the electrical fittings, fixtures and switches shall be weatherproof.

Slack-rope switches, where required, and lower normal terminal and lower final terminal hoistway limit switches, slowdown switches and pit-stop switches shall be located as far above the bottom of the pit as practicable.

9. PROTECTION OF AND ACCESS TO MACHINERY AND CONTROL EQUIPMENT, AND LIGHTING OF MACHINERY SPACES

9.1 Access for authorized personnel shall be provided to the machinery and control spaces to permit proper lubrication and maintenance of the equipment.

9.2 Machinery and control equipment shall be protected from the weather and from access by unauthorized personnel.

9.3 Spaces containing driving-machines and control equipment shall be provided with adequate lighting.

10. BOTTOM AND TOP CLEARANCES AND RUNBYS FOR PERSONNEL HOIST CARS AND COUNTERWEIGHTS

10.1 Bottom Car Clearances. When the car rests on its fully compressed buffer, there shall be a vertical clearance of not less than two feet (0.61m) between the pit area (ground or foundation) and the lowest structural or mechanical part, equipment or device installed beneath the car platform, except guide shoes or rollers, safety-jaw assemblies and platform aprons, guards or other equipment located within 12 inches (0.30m) horizontally from the sides of the car platform (see Figure 10.1).

When the car rests on its fully compressed buffer, no part of the car or any equipment attached thereto shall strike any part of the pit or any part of the equipment located therein.

The bottom clearance should be determined as shown in Figure 10.1 and should be not less than the following:

(1) Where no equipment under the car platform, except as noted in Figure 10.1, projects below the bottom of the car frame plank channel, c = two feet (0.61m).

(2) Where any equipment under the car platform, except as noted in Figure 10.1, projects a distance (d) below the bottom of the car frame plank channel, c = d + two feet (0.61m).

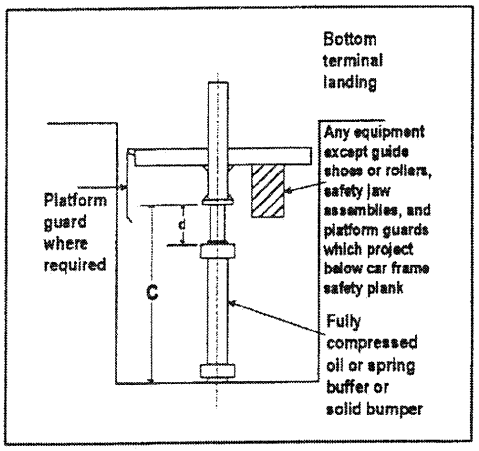


Figure 10.1 - Bottom Car Clearance

10.2 Bottom Runby for Counterweighted Hoists. The bottom runby of cars and counterweights shall be not less than six inches (15.24cm).

Exception 1: Where practical difficulties prevent a sufficient pit depth, or where a top clearance cannot be provided to obtain the runby specified, it may be reduced. Where spring-return-type oil buffers are used, the runby may be eliminated so that the buffers are compressed by amounts not exceeding those permitted by 14.3.1 through 14.3.3, when the car floor is level with the terminal landings.

Exception 2: Where spring buffers are used, a minimum of six inches (15.24cm) shall be required where generator-field control is used. Where rheostatic control is used, the minimum runbys shown in Table 1 shall apply.

10.3 Bottom Runby for Uncounterweighted Hoists. The bottom runby of uncounterweighted elevators shall be not less than six inches (15.24cm).

10.4 Maximum Bottom Runby. The maximum bottom runby may be increased providing the top runby requirements of 10.5, 10.6 and 10.7 are met.

RATED SPEED		RUNBY	
ft/minute	m/s	inches	cm
51-200	.26-1.0	9	22.86
201-600	1.0-3.0	12	30.48

Table 1. Minimum Runbys Where Rheostatic Control Is Used

10.5 Top Car Clearances for Counterweighted Hoists. The top clearance shall be not less than the sum of the following:

(1) The bottom counterweight runby.

(2) The stroke of the counterweight buffer used.

(3) Two feet (0.61m) or the distance that any sheave or any other equipment mounted in or on the car crosshead projects above the top of the car crosshead, whichever is greater.

(4) Where an oil buffer is used for the counterweight and no provision is made to prevent the sudden movement of the counterweight at car buffer engagement, add: (a) 1/2 the gravity stopping distance (see 10.10), based on 115 percent of rated speed or (b) 1/2 the counter-weight buffer stroke if a reduced-stroke buffer conforming to 14.3 is used. Where counterweight spring buffers are used, add 1/2 the gravity stopping distance (see 10.10), based on governor-tripping speed.

10.6 Top Car Clearance.

10.6.1 Uncounterweighted Hoists. The top car clearance shall be not less than two feet six inches (0.76m).

10.6.2 Rack and Pinion. This shall mean the highest point on the car to the closest striking point of the top of the tower.

10.7 Top Counterweight Clearances. The top counterweight clearance shall be not less than the sum of the following:

(1) The bottom car runby.

(2) The stroke of the car buffer used.

(3) Six inches (15.24cm).

(4) Where an oil buffer is used for the car and no provision is made to prevent the sudden movement of the counterweight at car buffer engagement, add: (a) 1/2 the gravity stopping distance (see 10.10), based on 115 percent of rated speed or (b) 1/2 the car buffer stroke if a reduced-stroke buffer conforming to 14.3 is used. Where car spring buffers are used, add 1/2 the gravity stopping distance (see 10.10), based on governor-tripping speed. (See Figure 10.10)

10.8 Overhead Clearances Where Overhead Beams Are Not Over Car Crosshead. Where overhead beams or other overhead hoistway construction except sheaves are located vertically over the car but not over the crosshead, the clearance from the car top to such beams or construction, when the car is level with the top landing, shall be not less than the amount specified in 10.5 and 10.6.

10.9 Equipment on Top of Car Striking Overhead Structure. When the car cross-head, or car top where no crosshead is provided, is at a distance of two feet (0.61m) from the nearest

obstruction above it, no equipment on top of the car shall strike any part of the overhead structure or the equipment located in the hoistway.

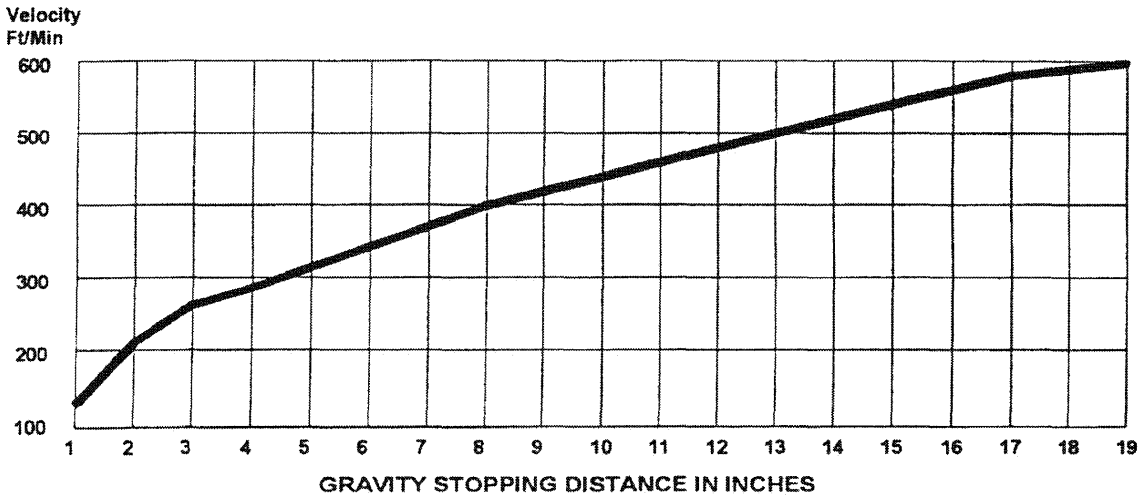
10.10 Gravity Stopping Distances. The following formula gives the value of the stopping distance based on gravity retardation from any initial velocity:

$$S = \frac{(V)(V)}{19{,}320}$$

where

S = free fall, in inches (gravity stopping distance)

V = initial velocity, in feet per minute (fpm)



General note: 1 in = 25.4 mm; 1 ft = 0.305 m; 1 Fpm = 5.08E-03 m/s

Figure 10.10 - Gravity Stopping Distances

11. HORIZONTAL CAR AND COUNTERWEIGHT CLEARANCES FOR PERSONNEL HOISTS

The clearances specified in 11.1 through 11.4 shall be measured with no load on the car platform.

11.1 Clearance Between Car and Hoistway Enclosures. The clearance between the car and the hoistway enclosure shall be not less than 3/4 inch (1.9cm) except on the sides used for loading and unloading and there shall not exceed eight inches or (20.3cm).

11.2 Clearance Between Car and Counterweight and Between Counterweight and Counterweight Screen. The clearance between the car and the counterweight shall be not less than one inch (2.54cm). The clearance between the counterweight and the counterweight screen, and between the counterweight and the hoistway enclosure, shall be not less than 3/4 inch (1.9cm).

11.3 Clearance Between Cars and Landing Sills. The clearance between the car platform sill and the hoistway edge of any landing sill, or the hoistway side of any vertically sliding counterweighted hoistway door or any vertically sliding counterweighted hoistway door, shall be not less than 1/2 inch (1.27cm) where side guides are used. This clearance shall be not less than 3/4 inch (1.9cm) where corner guides are used. The maximum clearance shall be not more than 2-1/2 inches (6.35cm). Drop plates shall be prohibited except at the base landing.

11.3.1 The bridging device, if provided, shall be designed and constructed to support the load. This device shall be securely attached to the car at the threshold and shall be no longer than 12 inches (30.5cm). The bridging device, if hinged, shall have a stop so as to prevent the device from falling into the car when in the retracted position. The car shall be prevented from operating with the bridging device extended. Clearances required by Sections 11.3 and 11.4 shall not be exceeded. See Figure 11.3.1.

11.4 Clearance Between Loading Side of Car Platforms and Hoistway Enclosures. Clearance between the edge of the car platform sill and the hoistway enclosure fascia plate for the full width of the clear hoistway door opening shall be not more than eight inches (20.32cm).

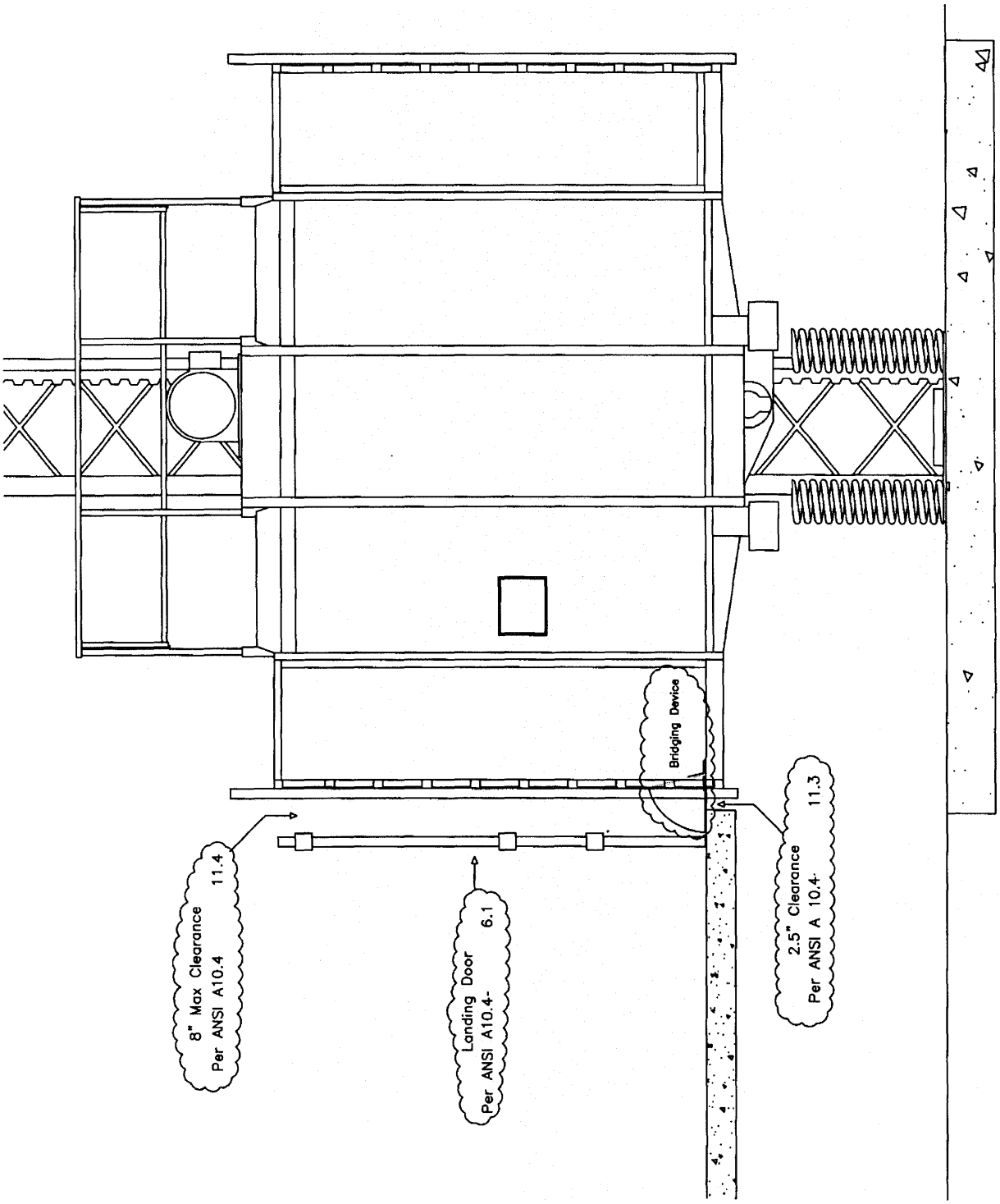


Figure 11.3.1 – Bridging Device

12. LOCATION AND GUARDING OF COUNTERWEIGHTS FOR HOISTS

12.1 Location of Counterweights. Counterweights shall be located either in or on the hoist structure they serve.

12.2 Design, Construction and Location of Counterweight Pit Guards. Guards shall extend from a point not more than 12 inches (30.48cm) above the pit floor to a point not less than six feet (1.83m) or more than eight feet (2.44m) above the pit floor and shall be fastened by its frame and properly reinforced or braced to be at least equal in strength and stiffness* to No. 14 U.S. Gauge Sheet Steel.

* - Required in 5.3.3.

12.3 Enclosure of Counterweight by the Hoisting Enclosure.

12.3.1 Hoists Located Outside of Structures. For hoists located outside of structures, the enclosures, except those at the lowest landing, may be omitted on the sides where there is no floor, scaffold, stairway or platform within 30 inches (76.2cm) adjacent to the counterweight-way. Enclosures on the building side of the counterweight way shall be full height or a minimum of eight feet (2.44m) at each floor landing.

12.3.2 Hoists Located Inside of Structures. For hoists located inside of structures, the counterweight-way shall be enclosed to its full height. For hoists located inside of open structures and which in general pierce no solid floors, the full-height hoistway enclosure may be omitted, provided that where it is adjacent to areas permitting normal passage of people (passageways, stairwells, elevator landings) it shall be enclosed to a height of not less than eight feet (2.44m) above the floor or stair treads. The enclosure shall extend not less than 30 inches (76.2cm) on either side of the counterweight.

13. CAR AND COUNTERWEIGHT GUIDE MEMBERS, GUIDE MEMBER SUPPORTS AND FASTENINGS

13.1 Guide Members. Personnel hoists shall be provided with car and counterweight guide members.

13.2 Material. The guide members, guide member brackets, rail clips, fishplates and their fasteners shall be of steel or other metals conforming to the requirements given in 13.2.1 and 13.2.2.

13.2.1 Steel. Steel, where used, shall conform to the requirements given in 13.2.1.1 through 13.2.1.3.

13.2.1.1 Members, Brackets, Fish-plates and Rail Clips. Members, brackets, fishplates and rail clips shall be made of steel, or its equivalent, having a tensile strength of not less than 55,000 lb_f/in^2 (379.210 kPa) and having an elongation of not less than 22 percent in a length of two inches (5.08 cm).

13.2.1.2 Bolts. Bolts shall conform to ANSI/ASTM A307, ANSI/ASTM A325 or ANSI/ASTM A490-04a.

13.2.1.3 Rivets. Rivets shall conform to ANSI/ASTM A502-03.

13.2.2 Metals Other than Steel. Metals other than steel may be used, provided the factor of safety is not less than, and the deflections not more than, the values specified in 13.2.1, and metals other than steel may be used provided that cast iron is not used.

13.3 Stresses and Deflections.

13.3.1 Guide Members. The stresses in a guide member, or in the member and its reinforcement, due to the horizontal forces imposed on the member during loading, unloading or running, calculated without impact, shall not exceed 15,000 lb_f/in^2 (103.420 kPa) based upon the class of

loading, and deflection shall not exceed 1/4 inch (6.35mm).

Exception: Where materials of greater strength than those specified under 13.2.1 are used, the stresses specified may be increased proportionately, based on the ratio of the ultimate strengths.

13.3.2 Fastenings and Support. The guide member fastenings and supports shall be capable of resisting the horizontal forces imposed by the loading with a total deflection at the point of support not in excess of 1/8 inch (3.17mm).

13.4 Overall Length of Guide Members. The top and bottom ends of each run of guide members shall be so located in relation to the extreme positions of travel of the car and counterweight that the car and counterweight guide shoes or rollers cannot travel beyond the ends of the guide members.

13.5 Guide Member Fastenings and Supports.

13.5.1 Design and Strength of Fastenings and Supports. The supports and fastenings of the guide members shall be of such design as to (1) safely withstand the application of the car or counterweight safety to the car and its rated load or the counterweight and (2) withstand the forces specified in 13.3.2 within the deflection limits specified.

13.5.2 Fastenings. Guide member fastenings, when used, shall be secured to their supporting structure by means of structural bolts, clips or rivets, or by welding. Fastening bolts and bolt holes in fastenings and their supporting beams shall conform to the requirements of 13.6. Welding shall conform to ANSI/AWS D1.1.

13.6 Attachment of Guide Members.

Guide Members shall be secured by clips, rivets, bolts or welds.

Bolts used for fastening shall be of such strength as to withstand the forces specified in Section 13.3.

Welding, where used, shall conform to ANSI/AWS D1.1.

14. CAR AND COUNTERWEIGHT BUFFERS

14.1 Type and Location.

14.1.1 Spring or Oil Buffers. Buffers of the spring or oil type shall be installed under the cars and counterweights of personnel hoists.

Note: In hoistways above accessible spaces, 5.2(2) requires buffers under all cars and counterweights.

Spring buffers or their equivalent may be used where the rated speed is not in excess of 200 fpm (1.0m/s). For units manufactured, one year after the effective date of this code, the maximum speed for which spring buffers can be used is 200 fpm (1.0m/s). Current units in service do not have to be changed.

14.1.2 Location. Buffers shall be located symmetrically with reference to the vertical centerline of the car frame or the counterweight frame within a tolerance of two inches (5.08cm).

14.2 Spring Buffers.

14.2.1 Buffer Stroke. The stroke of the buffer spring, as marked on its marking plate, shall be greater than or equal to those listed in Table 2.

14.2.2 Buffers for Cars and Counterweights. Buffers for cars and counterweights shall be:

(1) Capable of supporting, without being compressed solid, a static load having a minimum of

twice the total weight of the car and its rated load, for car buffers, or the counterweight, for counterweight buffers.

RATED CAR SPEED		STROKE	
ft/minute	m/s	inches	cm
100-less	.51-less	1-1/2	3.81
101-150	.51-.76	2-1/2	6.35
151-200	.77-1.0	4	10.16
201-250	1.0-1.3	6	15.24
251-300	1.3-1.5	9	22.86

Table 2. Minimum Buffer Stroke

(2) Compressed solid with a static load of three times the total weight of the car and its rated load, for car buffers, or the counterweight, for counterweight buffers.

(3) For rack-and-pinion elevators, spring buffers, where used, shall be so designed and installed that they will not be fully compressed when struck by the car with its rated load at governor tripping speed where the safety is governor operated, or at 125 percent of rated speed where the safety is not governor operated. Kinetic energy from the drive unit shall be taken into account in the design calculations. The effect of the counterweight, where used, may also be taken into account in the design calculations.

Exception: When requirements of 5.2(2)(b) necessitate a greater load rating, the requirements in this subsection do not apply.

14.2.3 Marking Plate. Each spring buffer shall have permanently attached a metal plate marked legibly and permanently with its stroke and load rating.

14.3 Oil Buffers.

14.3.1 When oil buffers are used they shall comply with Requirement 2.22.4 of ANSI/ASME A17.1.

14.3.2 When oil buffers are used at an installation there shall be means to keep the oil above its pour point.

14.3.3 Terminal speed-limiting devices installed in connection with reduced-stroke oil buffers shall conform to the requirements of 23.4.

15. COUNTERWEIGHTS

15.1 General.

15.1.1 Sectional Counterweights. Sectional counterweights and frames shall be designed to retain the weights securely in place.

15.1.2 Horizontal Clearances Between Car and Counterweight and Between Counterweight and Counterweight Screen. The clearance between the car and the counterweight shall be not less than one inch (2.54cm). The clearance between the counterweight and counterweight screen and between the counterweight and hoistway enclosure shall be not less than 3/4-inch (1.9 cm).

15.2 Design. The weight of the counterweight shall be as specified by the hoist manufacturer or a registered professional engineer.

15.3 Cars Counterbalancing One Another. A hoist car shall not be used to counterbalance another hoist car.

15.4 Compensating Chain or Rope Fastenings. Compensating chains or ropes, when used, shall be fastened to the counterweight or to the counterweight frame and shall not be fastened to tie rods.

15.5 In the event rollers or guide shoes are used for guiding the counterweight, they shall have a securely connected backup guide shoe that will maintain the safe guiding or holding of the counterweight. The backup guide shoes shall be used only when a roller or guide shoe has broken away or has come off of its guide members by overtraveling the end of its tower or mast.

16. CAR FRAMES AND PLATFORMS

16.1 Car Frames. Every hoist car shall have a frame. The car frame and platform may be an integral part of the car construction.

16.2 Guiding of Car Frames. Car frames shall be guided on each guide member by upper and lower guide shoes or rollers attached to the frame.

16.3 Design of Car Frames and Guide Shoes or Rollers. The frame and its guide shoes or rollers shall be designed to withstand the forces resulting under the loading conditions for which the hoist is designed (see Section 21). In the event rollers or guide shoes are used for guiding the car, they shall have a securely connected backup guide shoe that will maintain the safe guiding or holding of the car. The backup guide shoes shall be used only when a roller or guide shoe has broken away or has come off of its guide members by overtraveling the end of its tower or mast.

16.4 Underslung or Subpost Car Frames. The vertical distance between the top and bottom guide shoes of a hoist having a sub-post car frame, or having an underslung car frame located entirely below the car platform, shall be not less than 40 percent of the distance between guide rails.

16.5 Car Platforms. Every car shall have a platform consisting of a fire-retardant non-perforated floor attached to a platform frame supported by the car frame and extending over the entire area within the car enclosure. The platform-frame members and the floor shall be designed to withstand the forces developed under the loading conditions for which the hoist is designed and installed.

16.6 Materials for Car Frames and Platform Frames.

16.6.1 Materials Permitted. Materials used in the construction of car frames and platforms shall conform to the following:

(1) Car frames and outside members of platform frames shall be made of steel or other materials of equal strength.

(2) Cast iron shall not be used for any part subject to tension, torsion or bending.

Exception: Steels of greater strength than those specified may be used, provided they have elongation of not less than 22 percent in a length of two inches (5.08cm) and provided the stresses and deflections conform to the requirements of 16.8 and 16.9, respectively.

16.6.2.1 Car Frame and Platform-Frame Members. Steel shall be rolled, forged or cast, conforming to the requirements of the following American National Standards:

(1) Rolled and Formed Steel: Grade D as described in ANSI/ ASTM A36, *Standard Specification for Carbon Structural Steel*, or ANSI/ASTM A283, *Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates*.

(2) Forged Steel: Class C as described in ANSI/ASTM A668, *Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.*

(3) Cast Steel: Grade 60/30 as described in ANSI/ASTM A27, *Standard Specification for Steel Castings, Carbon, for General Application.*

16.6.2.2 Rivets, Bolts and Rods. Steel used for rivets, bolts and rods shall conform to the following American National Standards:

(1) Rivets: ANSI/ASTM A502-03

(2) Bolts and Rods: ANSI/ASTM A307

16.6.3 Metals Other Than Steel. Metals other than steel may be used in the construction of car frames and platforms, provided the materials used have the essential properties to meet all the requirements for the purpose in accordance with good engineering practice, and provided the stresses and deflections conform to the requirements of 16.8 and 16.9 respectively.

16.6.4 Wood for Platform Floors and Stringers. Wood used for platform stringers and for platform floors and subfloors shall be of clear-structural-quality, fire-retardant lumber, conforming to the requirements of ASTM D245-74, *Methods for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber*, and ANSI/ASTM D198-05a, *Standard Test Methods of Static Tests of Lumber in Structural Sizes.*

16.7 Car Frame and Platform Connections. Connections between members of car frames and platforms shall be riveted, bolted or welded, and shall conform to the requirements given in 16.7.1 through 16.7.3.

16.7.1 Bolts. Bolts, where used through sloping flanges of structural members, shall have bolt heads of the tipped-head type or shall be fitted with beveled washers.

16.7.2 Nuts. Nuts, where used on sloping flanges of structural members, shall seat on beveled washers.

16.7.3 Welding. Welding of parts on which safe operation depends shall be performed in accordance with ANSI/AWS D1.1.

All welding of such parts shall be performed by welders qualified in accordance with the requirements of the American Welding Society. At the option of the manufacturer, the welders may be qualified by one of the following:

(1) The manufacturer.

(2) A qualified engineer.

(3) A recognized testing laboratory.

Exception: Tack welds not later incorporated into finished welds carrying calculated loads are not subject to this requirement.

16.8 Maximum Allowable Stresses in Car Frame and Platform Members and Connections. The stresses in car frame and platform members and their connections, based on the static load imposed on them, shall be as follows:

(1) For steels meeting the requirements of 16.6.2.1 and 16.6.2.2, stresses shall not exceed the stresses listed in Table 3.

(2) For steels of greater strength, as permitted by the exception of 16.6.2, the stresses

listed in Table 3 may be increased proportionately, based on the ratio of the ultimate strengths.

(3) For metals other than steel, as permitted by 16.6.3, the factor of safety shall be not less than that required for steel as given in 16.6.2.1 and 16.6.2.2, based on the allowable stress specified in Table 3.

16.9 Maximum Allowable Deflections of Car Frame and Platform Members. The deflections of car frame and platform members, based on the static load imposed on them, shall be not more than the following:

(1) For crosshead, 1/960 of the span.

(2) For plank, 1/960 of the span.

(3) For platform-frame members, 1/960 of the span.

For uprights (stiles), the moment of inertia shall be not less than determined by the following formula:

$$I = \frac{KL^3}{18\,EH}$$

where

I = moment of inertia of member, gross section, in in^4

K = turning moment, in inch-pounds

L = free length of uprights, in inches

E = modules of elasticity

H = vertical center distance between upper and lower guide shoes

Note: The aforementioned deflection limits apply irrespective of the type of steel or other metal used.

16.10 Car Frames with Crosshead Sheaves. Where a hoisting-rope sheave is mounted on the car frame, the construction shall conform to the requirements given in 16.10.1 through 16.10.3.

16.10.1 Where multiple sheaves mounted on separate sheave shafts are used, provision shall be made to take the compressive forces, developed by tension in the hoist ropes between the sheaves, on a strut or struts between the sheave shaft supports, or by providing additional compressive strength in the car frame or car frame members supporting the sheave shafts.

16.10.2 Where the sheave shaft extends through the web of a car frame member, the reduction in area of the member shall not reduce the strength of the member below that required. Where necessary, reinforcing plates shall be welded or riveted to the member to provide the required strength. For bolts in clearance holes, the bearing pressure shall in no case be more than permitted in Table 3.

16.10.3 Where the sheave is attached to the car crosshead by means of a single threaded rod or a specially designed member or members in tension, the requirements given in 16.10.3.1 and 16.10.3.2 shall be met.

16.10.3.1 The single rod, member or members in tension shall have a factor of safety 50 percent higher than the factor of safety required for the suspension wire ropes, but in no case less than 15.

16.10.3.2 The means for fastening the single threaded rod, member or members in tension to the car frame shall conform to the requirements of 16.11.

16.11 Rope Hitch Plates or Shapes. Where cars are suspended by ropes attached to the frame by means of rope shackles, the shackles shall be attached to steel hitch plates or to structural or formed steel shapes. Such plates or shapes shall be secured to the underside or to the webs of the car frame member with bolts, rivets or welds located so the tensions in the ropes will not develop direct tension in the bolts or rivets. The stresses shall not exceed those permitted in 7.1.3.3.

16.12 Platform Side Braces. Where side braces and similar members are attached to car frame uprights, the reduction in the area of the upright shall not reduce its strength below that required by Section 16.

Table 3
Maximum Allowable Stress* in Car-Frame
And Platform Members and Connections
For Steels Specified in 16.6.2.1 and 16.6.2.2

MEMBER	TYPES OF STRESS	MAXIMUM STRESS (psi)	AREA BASIS
Car Crosshead	Bending	12,500	Gross section
Car-frame plank, normal loading	Bending	12,500	Gross section
Car-frame plank, buffer reaction	Bending	25,000	Gross section
Car-frame uprights (stiles)	Bending plus tension	15,000 18,000	Gross section Net section
Hoisting-rope hitch shapes or plates	Bending plus tension	8,000	Net section
Platform framing	Bending	12,500	Gross section
Platform stringers	Bending	15,000	Gross section
Threaded brace rods and other tension members except bolts	Tension	8,000	Net section
Bolts	Tension	7,000	Net section
Bolts in clearance holes	Shear	7,000	Actual area in shear plane
Bolts in clearance holes	Bearing	16,000	Gross section
Rivets or tight body-fit bolts	Shear	10,000	Actual area in shear plane
Rivets or tight body-fit bolts	Bearing	18,000	Gross section
Any framing member, normal loading	Compression	14,000 – (59L/R)	Gross section

* Stresses shall be determined on the basis of a uniformly distributed load over the entire area of the car platform or a single concentrated load placed at the center of the car platform.

17. CAR ENCLOSURES

17.1 Material for Enclosures and Enclosure Linings. Materials for car enclosures and car enclosure linings shall be made of metal or fire-retardant material.

17.2 Extent of Enclosures. Personnel-hoist cars shall be permanently enclosed on the top and on all sides, except for the entrance and exit.

17.3 Securing of Enclosures. The enclosure shall be securely fastened to the car platform and supported so it cannot loosen or become displaced in ordinary service, when the car safety is applied, or the buffer is engaged.

17.4 Deflection of Enclosure Walls. The enclosure walls shall be of such strength and design and supported so that, when subjected to a pressure of 100 pounds (45kg), applied horizontally on any four square inch (25.8cm^2) area of the walls of the enclosure, the deflection will not reduce the running clearance below 3/4 inch (1.9cm).

17.5 Number of Compartments in Cars. Cars shall have not more than one compartment.

17.6 Car Top Emergency Access. An emergency access with a cover shall be provided in the top of all cars and shall conform to the requirements given in 17.6.1 through 17.6.4.

17.6.1 The access opening shall have an area of not less than 400 square inches (2580.6cm^2) and shall measure not less than 16 inches (40.64cm) on any one side and shall be electrically interlocked.

17.6.2 The access cover shall be located to provide a clear passageway unobstructed by fixed hoist equipment located in or on top of the car.

17.6.3 The access cover shall be hinged and open outward.

17.6.4 The access cover shall remain closed during operation, shall be electrically interlocked and shall stop the car when open. (Except in emergencies or while servicing, inspecting or maintaining the equipment.)

17.7 Car Enclosure Tops. Tops of car enclosures shall be so designed and installed to be capable of sustaining a load of 300 pounds (136kg) on any square area two feet (0.6m) on a side and 100 pounds (45kg) applied at any point. Simultaneous application of these loads is not required.

17.8 Equipment on Top of Cars. A working platform or any equipment that is not required for the operation of the hoist or its appliances, except where specifically provided in this standard, shall not be located on the top of a hoist car.

17.9 Car Lighting. The car shall have minimum lighting of five foot candles measured at the threshold.

17.10 Heater Requirements. Open flame heaters shall not be used on the car. Where other types of heaters are used they shall be properly vented. When provided heating systems shall be installed in compliance with ANSI/ASSE A10.10, *Safety Requirements for Temporary and Portable Space Heating Devices and Equipment*. Combustible fuels shall not be used.

18. CAR GATES AND ELECTRICAL CONTACTS

18.1 Car Gates.

18.1.1 Location. A gate shall be provided at each entrance to the car.

18.1.2 Type of Gates. Gates shall be of either the horizontally or the vertically sliding type, subject to the requirements given in

18.1.5 and 18.1.9. Scissor-type gates shall be prohibited.

18.1.3 Strength of Gates and Their Guides, Guide Shoes, Tracks and Hangers. Gates and their guides, guide shoes, tracks and hangers shall be designed, constructed and installed so when the fully closed gate is subjected to a force of 75 pounds (34kg), applied on an area of one foot squared (929cm^2) at right angles to and approximately at the center of the gate, it will not deflect beyond the line of the car sill. When subjected to a force of 250 pounds (113kg) similarly applied, vertically sliding gates shall not break or be permanently deformed and shall not be displaced from their guides or tracks. Where multisection gates are used, each panel shall withstand the forces specified.

18.1.4 Sliding Gates. Sliding gates shall conform to the requirements given in 18.1.5.1 through 18.1.5.4.

18.1.4.1 Vertically sliding gates shall be of the balanced counterweighted type or the biparting counterbalanced type.

18.1.4.2 Gates be constructed of metal or fire-retardant reinforced material and shall be designed to reject a ball 1-1/2 inch (3.81cm) in diameter.

18.1.4.3 Gates shall guard the full width and height of the car entrance opening.

18.1.4.4 Balanced counterweighted gates may be either single section or multisection and may slide either up or down to open.

18.1.5 Weights for Closing or Balancing Gates. Weights used to close or balance gates shall be located outside the car enclosure and shall run in guides or be boxed in. Guides shall be of metal, and the bottom of the guides or boxes shall be so constructed as to retain the weight if the suspension member fails.

18.1.6 Suspension Members. Suspension members of vertically sliding car gates, and of weights used with car gates, shall have a factor of safety of not less than five.

18.1.7 Manual Opening of Car Doors. Car gates shall be arranged so when the car is stopped they may be opened by hand from inside the car, subject to the requirements of 18.2.3.

18.1.8 Entrances Permitted. Cars may have multiple entrances. Car gates not being used shall be secured in the closed position.

18.2 Car Gate Electric Contacts. Car gates shall be provided with car gate electric contacts.

18.2.1 Location of Car Gate Electric Contacts. Car gate electric contacts shall be located so they are not readily accessible from the inside of the car.

18.2.2 General Design. Car gate electric contacts shall conform to the requirements given in 18.2.2.1 and 18.2.2.2.

18.2.2.1 Car gate switches shall be positively actuated by a lever or other device attached to, and operated by, the gate.

18.2.2.2 Car gate electrical switches may be a snap action contact switch maintained in the open position by the action of gravity, a cam or by positive mechanical means.

18.2.3 Mechanical Locks of Car Gates on Side Opposite Landing Being Serviced. A mechanical lock shall be provided to prevent the opening of the car gates on the side opposite the landing or structure, unless the car is at the ground-level landing or equivalent.

18.2.4 Closed Position of Car Gates. Car gates shall be considered to be in the closed position under the conditions given in 18.2.4.1 through 18.2.4.3.

18.2.4.1 Horizontally sliding gates shall be considered to be in the closed position when the clear open space between the leading edge of the gate and the nearest face of the jamb does not exceed two inches (5.08cm).

18.2.4.2 Vertically sliding counterweighted gates shall be considered to be in the closed position when the clear open space between the leading edge of the gate and the sill of the car platform does not exceed two inches (5.08cm).

18.2.4.3 Horizontally sliding biparting gates or vertically sliding biparting counter-balanced gates shall be considered to be in the closed position when the gate panels are within two inches (5.08cm) of contact with each other.

18.3 Solid Gates. A vision panel shall be provided where solid gates are used. The vision panel shall be covered with a flameproof material that will not admit a ball 3/4 inch (1.9cm) in diameter. The panel shall withstand a force of 75 pounds (34.02kg) applied perpendicular to the center of the panel without deflection of the gate or panel beyond the centerline of the clearance between the car and the landing sill.

The vision panel shall be installed so it cannot make contact with any of the jambs.

19. CAR AND COUNTERWEIGHT SAFETIES

19.1 Location. The car of every personnel hoist shall be provided with one or more car safeties of one of the types identified in 19.4. The safeties shall be attached to the car frame or supporting structure.

All car safeties shall be mounted on a single car frame and shall operate either on one pair of guide members or on one vertical rack.

19.2 Function and Stopping Distance of Safeties. The safety or, where furnished, the combined safeties shall be capable of stopping and sustaining the entire car with its rated load from governor-tripping speed.

Type B safeties (see 19.4.2) shall stop the car with its rated load from governor-tripping speed within the range of the maximum and minimum stopping distances as determined by the following formulas:

$$S = \frac{(V)^2}{81{,}144} + 0.84$$

and

$$S' = \frac{(V)^2}{231{,}840}$$

where

S = minimum stopping distance, in feet

S' = maximum stopping distance, in feet

V = governor-tripping speed, in feet per minute

In metric units:

$$S = \frac{(V)^2}{6.870} + 0.2560$$

and

$$S' = \frac{(V)^2}{19.63}$$

where

S = maximum stopping distance, in meters

S' = maximum stopping distance, in meters

V = governor-tripping speed, in meters/second

Table 4 shows the maximum and minimum stopping distances for various governor-tripping speeds when the safety is tested in conformance with 26.2.1.

19.3 Counterweight Safeties. Counterweight safeties shall conform to the requirements for car safeties found in section 5.2(1) of this standard.

19.4 Identification and Classification of Types of Safeties. Car safeties are identified and classified on the basis of performance characteristics. In general, there are three types of safeties that operate to apply pressure on the guide rails and one type that uses a separately mounted rack and accompanying pinion gear. The former are classified as Types A, B and C, based on how the safety begins to apply pressure on the guide members.

19.4.1 Type A Safeties. Type A safeties develop a rapidly increasing pressure on the guide members during the stopping interval, the stopping distance being very short due to the inherent design of the safety. The operating force is derived entirely from the mass and the motion of the car or the counterweight being stopped. These safeties apply pressure on the guide members through eccentrics, rollers or similar devices without any flexible medium purposely introduced to limit the retarding force and increase the stopping distance.

19.4.2 Type B Safeties. Type B safeties apply limited pressure on the guide members during the stopping interval and provide stopping distances that are related to the mass being stopped and the speed at which application of the safety is initiated. Retarding forces are reasonably uniform after the safety is fully applied. Continuous tension in the governor rope may or may not be required to operate the safety during the entire stopping interval. Minimum and maximum distances are specified on the basis of governor-tripping speed (see 19.2).

19.4.3 Type C Safeties (Type A with Oil Buffers). Type C safeties develop retarding forces during the compression stroke of one or more oil buffers interposed between the lower members of the car frame and a governor-operated Type A auxiliary safety plank applied on the guide or tension members. The stopping distance is equal to the effective stroke of the buffers.

19.4.4 Rack-and-Pinion Safeties. In rack-and-pinion safeties, a freely rotating safety pinion and governor and a safety device may form an integral unit mounted on the car. The freely rotating pinion travels on a stationary rack mounted vertically on the hoist structure and drives the governor. When the speed of the car reaches the tripping value, the rotating governor actuates the safety device, which, in turn, removes power to the drive motor(s) and brings the car to a gradual stop.

19.5 Safeties to Stop Ascending Cars or Counterweights. Safeties may be used to stop an ascending car or counterweight providing it operates independent of the car's regular safety device.

Exception: Safeties may be provided to stop ascending rack-and-pinion cars. Such safeties shall be of one of the types described in 19.4 and shall be located in accordance with 19.1.

19.6 Governor-Actuated Safeties and Car-Safety-Mechanism Switches. Separate speed governors shall actuate car safeties and counterweight safeties, where both are provided.

Exception: Speed governors are not required for the operation of counterweight safeties of hoists whose rated speed is not more than 150 fpm (.8m/s).

Each car safety shall be provided with a switch operated by the car safety mechanism. This switch shall conform to the requirements given in 20.4.

19.7 Limits of Use of Various Types of Safeties.

19.7.1 Type A (Instantaneous) Safeties. Type A safeties may be used on hoists having a rated speed of not more than 200 fpm (1.0m/s).

When overspeed occurs for any reason, the governor shall actuate such safeties.

19.7.2 Type C Safeties. Spring buffers may be substituted for oil buffers on Type C car safeties for rated speeds up to and including 300 fpm (1.5m/s), provided that:

(1) the springs do not fully compress during the operation of the car safety with rated load in the car and;

(2) the rate of retardation conforms to the requirements of 14.3.1.

19.8 Application and Release of Safeties.

19.8.1 Means of Application. Safeties shall be applied mechanically. Electric, hydraulic or pneumatic devices shall not be used to apply the safeties required by Section 19 or to hold such safeties in the retracted position.

19.8.2 Level of Car on Safety Application. The application of the safety to stop the car, with one-fourth of its rated load distributed on each quarter of the platform symmetrically with relation to the centerlines of the platform, shall not cause the platform to be out of level more than 3/8-inch per foot (3.125cm/m) in any direction.

19.8.3 Release. When car safeties are applied, no decrease in tension in the governor rope or downward motion of the car shall release the safeties, but such safeties may be released by upward motion of the car.

19.8.4 Force Providing Stopping Action. Safeties shall be so designed that on their application, the forces that provide the stopping action will be compressive forces on either side of the guide member section.

Exception: For rack-and-pinion safeties, the stopping action may be obtained by the engagement of the teeth of the safety pinion on the car and the stationary vertical rack.

19.9 Minimum Permissible Clearance Between Guide Member Gripping Faces of Safety Pads. In the normally retracted position of the safety, the distance between the member-gripping faces of the safety parts shall be not less than the thickness of the guide member plus 0.14 (9/64) inch (0.36cm), and the clearance on any side between the gripping face and the guide member shall be not less than 0.0625 (1/16) inch (0.159cm), as measured on the side of the rail toward which the car frame is pressed, when sufficient force is exerted on the car to take up all clearances in the guide-shoe assembly. Safety jaws, while in the retracted position, shall be restrained to prevent a reduction of this minimum clearance.

19.10 Maximum Permissible Movement of Governor Rope or Car to Operate the Safety Mechanism.

19.10.1 Type B and Type C Safeties. For all Type B and Type C safeties, the movement of the governor rope relative to the car or to the counterweights, respectively, required to operate the safety mechanism so that the safety jaws move from their fully retracted position to a position where they begin to exert pressure

against the guide members shall not exceed the following values, based on rated speed:

(1) For car safeties: At 200 fpm (1.0m/s) or less, 42 inches (106.7cm); at 201 to 375 fpm (1.0-1.9m/s), 36 inches (91.44cm); at over 375 fpm (1.9m/s), 30 inches (76.2cm).

(2) For counterweight safeties: At all speeds, 42 inches (106.7cm).

Drum-operated car and counterweight safeties, requiring continual unwinding of the safety drum rope to fully apply the safety, shall be so designed that not less than three turns of the safety rope will remain on the drum after the overspeed test of the safety has been made with rated load in the car (see 26.2.3 and 26.4.6).

19.10.2 Rack-and-Pinion Safeties. For rack-and-pinion safeties, the travel of the car measured from the governor-tripping time to the full-stop time shall not exceed, based on rated speed, the values in Table 5.

19.11 Minimum Factors for Safety and Stresses of Safety Parts and Rope Connections. Parts of safeties, except springs shall have a factor of safety of not less than 3.5 (based on ultimate strength), and the materials used shall have an elongation of not less than 15 percent of two inches (5.08cm). Forged, cast or welded parts shall be stress-relieved.

Exception: Safety rope drums, leading sheaves and their supporting brackets and safety-jaw gibs shall be made of metal and shall have a factor of safety of not less than 10.

Rope used as a connection from the safety to the governor rope, including rope wound on the safety rope drum, shall be not less than 3/8-inch (0.95cm) in diameter and shall be made of a corrosion-resistant metal. Tiller-rope construction shall not be used. The factor of safety of the rope shall be not less than 5.

The factors of safety shall be based on the maximum stresses developed in the parts during the operation of the safety when it stops rated load from governor-tripping speed.

Springs may be used in the operation of car or counterweight safeties. Where they are used and are partially loaded prior to safety operation, the loading on the spring shall not produce a fiber stress exceeding one-half the elastic limit of the material. During operation of the safety, the fiber stress shall not exceed 85 percent of the elastic limit of the material. Helical springs, where used, shall be in compression.

Safety rope loading-sheave brackets and other safety operating parts shall not be attached to or supported by wood platform members.

All gears shall meet the following standards: ANSI/AGMA 908, *Information Sheet: Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth*, ANSI/AGMA 2001-D04, *Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth,* AGMA 2004.B89, *Gear Materials and Heat Treatment Manual.*

Table 4
Maximum and Minimum Stopping Distances
for Other Than Instantaneous Safeties

RATED SPEED feet per minute / (m/s)	MAXIMUM GOVERNOR-TRIP SPEED feet per minute / (m/s)	STOPPING DISTANCES feet-inches / (m-cm)	
		Minimum	Maximum
0 to 125 / (0 to .6)	175 / (.9)	0-1 / (0-2.54)	1-3 / (0-38.1)
150 / (.8)	210 / (1.0)	0-2 / (0-5.08)	1-4 / (0-40.64)
175 / (.9)	250 / (1.3)	0-3 / (0-7.62)	1-7 / (0-48.26)
200 / (1.0)	280 / (1.4)	0-4 / (0-10.16)	1-10 / (0-55.88)
225 / (1.1)	308 / (1.6)	0-5 / (0-12.7)	2-0 / (0-60.96)
250 / (1.3)	337 / (1.7)	0-6 / (0-15.24)	2-3 / (0-68.58)
300 / (1.5)	395 / (2.0)	0-8 / (0-20.32)	2-9 / (0-83.82)
350 / (1.8)	452 / (2.3)	0-10 / (0-25.4)	3-4 / (1-1.6)
400 / (2.0)	510 / (2.6)	1-1 / (0-33.02)	4-0 / (1-21.92)
450 / (2.3)	568 / (2.9)	1-5 / (0-43.18)	4-10 / (1-47.32)
500 / (2.5)	625 / (3.2)	1-8 / (0-50.8)	5-8 / (1-72.72)
600 / (3.0)	740 / (3.8)	2-4 / (0-71.12)	7-7 / (2-31.14)

19.12 Corrosion-Resistant Bearing in Safeties and Safety-Operation Mechanisms. Bearings in safeties and in the safety-operation mechanism shall be of corrosion-resistant construction, with one or both members of a bearing made of, or electroplated with, a corrosion-resistant material.

19.13 Marking Plates for Safeties. A metal plate shall be securely attached to each safety so as to be readily visible and shall be marked in a legible and permanent manner with letters and figures not less than 1/4-inch (0.64cm) in height, indicating the following:

(1) The maximum tripping speed in fpm (m/s) for which the safety may be used.

(2) The maximum weight in pounds (kg) that the safety, as installed, is designed to stop and sustain.

(3) The replacement date of the device if any.

19.14 Governor Rope Releasing Carriers. The governor rope releasing carrier on the car (or on the counterweight) shall be set so that the tension required in the governor rope to pull the rope from the carrier is not more than 60 percent of the pull-through tension developed by the governor. The carrier shall be designed so that the pullout tension cannot be adjusted in a normal manner to exceed the amount specified.

19.15 Rail Lubricants. Rail lubricants or coatings that will reduce the holding power of the safety or prevent its functioning as required in 19.2 shall not be used. Graphite shall not be used for lubrication.

19.16 Application of Safeties on Suspended Tension Members. Safeties that apply on tension members suspended from the top of the hoistway and anchored in the pit in lieu of guide members shall be in conformity with 19.16.1 and 19.16.2.

19.16.1 The tension members shall have a minimum factor of safety of 10 when the car and its rated load are being stopped with an average retardation of 32.2 feet per second (9.8m/s).

19.16.2 Steel-wire rope tension members shall be inspected in accordance with 25.10 and 25.11.

20. SPEED GOVERNORS

20.1 Location. Car safeties and, where furnished, counterweight safeties shall be actuated by a speed governor.

The governor shall be located where it cannot be struck by the car or the counterweight in case of overtravel and where there is adequate space for full movement of governor parts.

20.2 Tripping Speeds for Speed Governors.

20.2.1 Car Speed Governors. Speed governors for car safeties shall be set to trip at overspeeds as follows:

(1) At not less than 115 percent of rated speed.

(2) At not more than the tripping speed listed opposite the applicable rated speed in Table 5. Maximum tripping speeds for intermediate rated speeds shall be determined from Figure 20.2.2.

20.2.2 Counterweight Speed Governors. Speed governors for counterweight safeties, where provided, shall be set to trip at an overspeed greater than, but not more than ten percent above, that at which the car speed governor is set to trip.

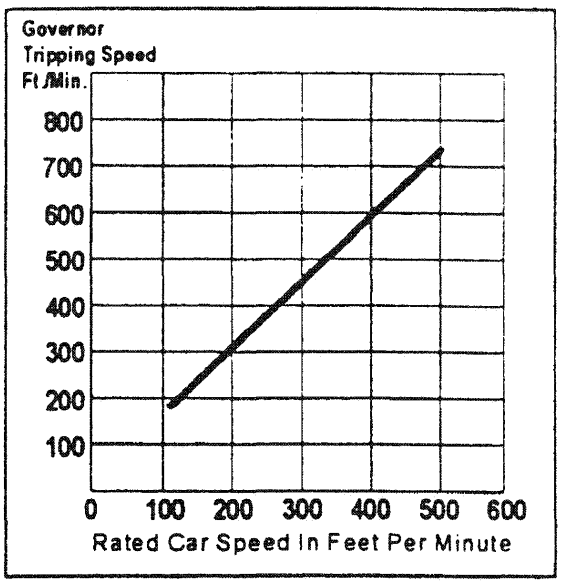


Figure 20.2.2 - Maximum Governor-Tripping Speeds

20.3 Sealing and Painting of Speed Governors. Speed governors shall have their means of speed adjustment sealed after test (see 26.2). If speed governors are painted after sealing, all bearing and rubbing surfaces shall be freed of or kept free of paint and a hand test shall be made to determine that all parts operate freely as intended. Seals shall be of a type that will prevent readjustment of the governor-tripping speed without breaking the seal.

20.4 Speed Governor Overspeed and Car-Safety-Mechanism Switches.

20.4.1 A switch shall be provided on the speed governor and operated by the overspeed action of the governor.

Every car safety shall be provided with a switch that is operated by the car safety mechanism when the safety is applied. The switch shall, when operated, remove power from the driving-machine motor and brake before or at the time of application of the safety.

20.4.2 Setting of Speed Governor Overspeed Switches. The setting of the car's speed governor overspeed switch shall conform to the requirements given in 20.4.2.1 and 20.4.2.2.

RATED SPEED (feet per minute)	MAXIMUM GOVERNOR-TRIP SPEED (feet per minute)	MAXIMUM SPEED AT WHICH GOVERNOR OVERSPEED SWITCH OPERATES DOWN
0 to 125	175	175*
150	210	210*
175	250	250
200	280	280
225	308	308
250	337	337
300	395	395
350	452	452
400	510	510
450	568	568
500	625	625
600	740	740
* Governor overspeed switch not required on car governors		

Table 5
Maximum Speeds, In Feet Per Minute, At Which Speed Governor Trips and Governor Overspeed Switch Operates

20.4.2.1 The car's speed governor over-speed switch shall activate when the car is traveling downward at not more than 100

percent of the speed at which the governor is set to trip in the down direction.

20.4.2.2 The switch, when set as specified in 20.4.2.1 shall activate when the car is traveling upward at not more than 100 percent of the speed at which the governor is set to trip in the down direction.

20.4.3 Type of Over-Speed, Speed Governor Switches and Car Safety Mechanism Switches Required. Switches used to perform the functions specified shall be positively opened and shall remain in the open position until manually reset. Switches operated by the car safety mechanism shall be of a type that will not reset unless the car safety mechanism has been returned to the off position.

20.4.4 Speed Governor Switch. A switch may function as both overspeed and safety switch if the governor and safety function as one unit.

20.5 Governor Ropes and Tripping Mechanisms.

20.5.1 Materials and Factor of Safety. Governor ropes shall be of iron, steel, nickel-copper alloys, phosphor bronze or stainless steel, shall be of regular-lay construction, and shall be not less than 3/8-inch (0.95cm) in diameter. Tiller-rope construction shall not be used. The factor of safety of governor ropes or governor-tripping mechanisms shall be not less than five.

20.5.2 Replacement of Governor Ropes. Replacement governor ropes shall be of the same size, material and construction as the rope originally furnished by the hoist manufacturer, except that a rope of the same size but of either different material or different construction or both may be employed provided there is conformance with the requirements of 20.7, and a test is made of the car or counterweight safety and speed governor with the new rope to demonstrate that the safety will function as required by 19.2.

20.5.3 Clearance of the Speed Governor Rope. During normal operation of the hoist, the governor rope shall run free and clear of the governor jaws, rope guards or other stationary parts.

20.5.4 Splicing of Governor Ropes. Governor ropes shall not be lengthened or repaired by splicing.

20.5.5 Lubrication of Governor Wire Ropes. Governor wire ropes shall not be lubricated after installation. If lubricants have been applied to governor ropes, the ropes must be replaced, or the lubricant removed, and the governor and safety shall be tested as specified in this document. The application of lubricants to the governor rope impedes the proper operation of the breaking system used to stop the hoist.

20.6 Design of Governor Rope-Grip Jaws for Type B and C Safeties. Type B and C car and counterweight safeties shall be actuated by a speed governor equipped with rope-grip jaws that will permit the governor rope to pull through the jaws. The maximum tension in the governor rope that will cause it to slip through the governor jaws shall not exceed 1/5 of the rated ultimate strength of the rope.

Governor jaws shall be of such a shape and such minimum length that no appreciable damage to or deformation of the rope will result from the stopping action of the jaws in operating the car or counterweight safety.

20.7 Design of Speed Governor Sheaves and Traction Between Speed Governor Rope and Sheave. The arc of contact between the governor rope and the governor sheave shall, in conjunction with a governor rope tension device, provide sufficient traction to cause proper functioning of the governor.

Governor sheave grooves shall have machine-finished surfaces and a diameter of not more than 1-1/8 times the diameter of the governor rope. Governor tension sheaves shall have machine-finished grooves for rated car speeds of more than 200 fpm (1.0m/s).

The pitch diameter of governor sheaves and governor tension sheaves shall be not less than the product of the rope diameter and the applicable multiplier in Table 6, based on rated speed and number of rope strands.

RATED SPEED		# of Strands	Multi-plier
ft/minute	m/s		
200-less	1.0-less	6	42
200-less	1.0-less	8	30
Over 200	Over 1.0	6	46
Over 200	Over 1.0	8	32

Table 6. Pitch Diameters

20.8 Speed Governor Marking Plate. A metal plate shall be securely attached to each speed governor and shall be marked in a legible and permanent manner with letters and figures not less than 1/4-inch (0.64cm) in height, indicating the following:

(1) The speed, in fpm (m/s), at which the governor is set and sealed to trip the governor rope-grip jaws.

(2) The size, material and construction of the governor rope on which the governor jaws were designed to operate.

20.9 Permanently Enclosed Governors. Speed governors that cannot be internally inspected through an inspection plate shall be replaced by the owner in accordance with instructions on the manufacturer's data plate. The plate shall state:

REPLACE UNIT BY (Month, Day, Year)

20.10 Non-Rope Friction Operated Speed Governors. Speed governors may be operated by means other than ropes and associated grip jaws. The speed of the elevator car with a safety device may be sensed by friction driven rollers or similar devices that bear against rigid tower components such as guide rails or racks. These units shall be capable of accurately monitoring car speed under all normal operating conditions within five percent.

21. CAPACITY AND LOADING

21.1 Inside Net Platform Area. The inside net platform area (see Figure 21.1) of the hoist car shall be determined by the rated capacity of the hoist and shall be no greater than that given in Table 7. The rated capacity shall not be increased without written approval of the manufacturer or a registered professional engineer.

21.2 Capacity and Data Plate. Every hoist car shall be provided with a capacity and data plate securely fastened in a conspicuous place inside the car.

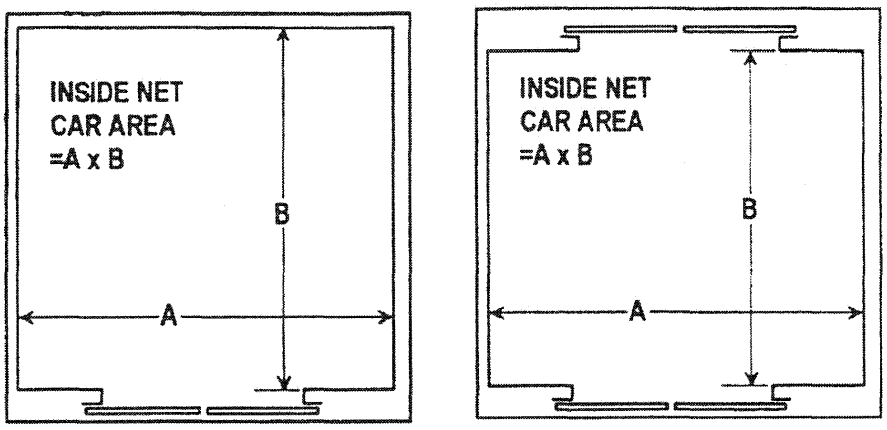


Figure 21.1 - Inside Net Platform Areas for Personnel Hoist Cars

RATED LOAD (pounds)	INSIDE NET PLATFORM AREA (square feet)
2,000	24.2
2,500	29.1
3,000	33.7
3,500	38.0
4,000	42.2
4,500	46.2
5,000	50.0
6,000	57.7
7,000	65.3
8,000	72.9
9,000	80.5
10,000	88.0

Table 7

Relationship Of Hoist Rated Capacity to Inside Net Platform Area

21.3 Information on Plates. Capacity and data plates shall indicate the following:

(1) The rated capacity of the car in pounds and the number of persons (200 pounds {90.7kg} per person).

(2) The weight of the car, including safety and all auxiliary equipment attached thereto.

(3) The rated maximum speed.

(4) The wire rope data required in Section 25.2.

21.4 Material and Marking of Plates. Letters and figures shall be stamped or printed on the surface of a durable plate in such a manner as to be legible at all times. The height of the letters and figures shall be not less than

(1) One inch (2.54cm) for the information required by 21.3(1).

(2) One-eighth inch (0.31cm) for information required by 21.3(2), (3) and (4).

21.5 Overload Devices. Overload devices, when provided, shall be sealed.

22. DRIVING-MACHINES, SHEAVES AND DRUMS

22.1 Type of Driving-Machine. Driving-machines shall be powered by electric or hydraulic motors. Hydraulic units, where used, shall be electrically driven.

22.1.1 Use of Hydraulic Motors. The hydraulic drive shall consist of an oil storage tank, a hydraulic pump and a hydraulic brake motor, and shall conform to the following requirements:

22.1.1.1 Working Pressure Valves. Piping and fittings shall not be subjected to working pressures exceeding those recommended by the manufacturer for the type of service in which they are used.

22.1.1.2 Pipe Supports. Piping shall be supported so as to eliminate undue stresses at joints and fittings, particularly at any section of the line subject to vibration.

22.1.1.3 Flexible Connections. Flexible connections installed in high-pressure lines shall have a busting strength of not less than four times the working pressure. Flexible joints may be used in hydraulic lines connecting control or check valves to the motor provided the failure of the flexible sealing element will not result in separation of the parts connected.

22.1.1.4 Pump Relief. Each pump or group of pumps shall be equipped with a relief valve conforming to the following requirements:

(1) Type and Location: The relief valve shall be of such a type and so installed in a bypass connection that the valve cannot be shut off from the hydraulic system.

(2) Setting: The relief valve shall be preset to open at a pressure not greater than 125 percent of the working pressure at the pump.

(3) Size: The size of the relief valve and bypass shall be sufficient to pass the maximum rated capacity of the pump without raising the pressure more than 20 percent above that at which the valve opens. Two or more relief valves may be used to obtain the required capacity.

(4) Sealing: Relief valves having exposed pressure adjustments, if used, shall have their means of adjustment sealed after being set to the correct pressure.

22.1.1.5 Interlock. An electric interlock shall be provided to prevent the start or movement of the hoist car unless the pump operates at the normal operating pressure.

22.1.1.6 Brake. The brake shall remain in the applied position until the pump operates at the normal operating pressure and the movement of the hoist car is initiated. The brake is to be spring applied, hydraulic released and will apply automatically in the event of loss of electric power or hydraulic pressure.

22.2 Use of Winding-Drum Machines. Winding-drum machines may be used irrespective of car travel provided that the drums are grooved for hoisting wire rope. Grooves shall be machine-finished and shall be of the helical or parallel type.

If drums are equipped with helical grooving, only one layer of rope shall be permitted on the drum. If drums are equipped with parallel grooving, more than one layer but not more than four layers of rope shall be permitted on the drum.

22.3 Car Speed. The car speed for all drives shall not exceed 600 fpm (3.0m/s).

22.4 Diameter of Drums and Sheaves. Driving sheaves and drums shall have a pitch diameter of not less than 40 times the diameter of the hoisting wire rope. Overhead and deflector sheaves shall have a diameter of not less than 30 times the rope diameter.

22.5 Gear Drives.

22.5.1 Worms and worm gears, where used in the drive machine, shall be of steel and of bronze, respectively.

22.5.2 All gear drives must run in oil.

22.6 Friction Gearing and Clutches. Friction gearing or clutch mechanisms shall be prohibited.

22.6.1 Rack-and-Pinion Hoist. Means may be provided for disengaging the rack at the point where the car first contacts the buffers. Such means shall not affect the action of the overspeed safety device or allow a counterweighted car to run away in the up direction.

22.7 Driving-Machine Brakes. The driving-machine shall be equipped with a friction brake applied by a spring or by gravity and released electrically or hydraulically. The brake shall be designed to have a capacity sufficient to stop and hold the car at rest at 125 percent of its rated load.

22.8 Use of Rack-and-Pinion Drive. The rack-and-pinion drive shall consist of one or more power-driven rotating pinions mounted on the car and arranged to travel on a stationary vertical rack mounted on the hoist structure. The drive shall have at least one pinion, one rack and two backup rollers. The pinions and rack shall be of steel and shall comply with the accepted industry standards. Driving-machines located within the car shall be fully enclosed with solid or open metal, which shall be locked.

22.9 Factor of Safety for Driving-Machines and Sheaves. The factor of safety to be used in the design of driving-machines and in the design of sheaves used with hoisting and compensating ropes shall be in accordance with the following:

(1) Not less than 8 for steel, bronze or other metals having elongation of at least 14 percent in a length of two inches (5.08cm).

(2) Not less than 10 for cast iron or other metals having an elongation of less than 14 percent in a length of two inches (5.08cm).

The load to be used in determining the factor of safety shall be the result of the maximum tensions in the ropes leading from the sheave or drum with the car at rest and with a rated load in the car.

22.10 Use of Couplings. A positive-engagement type of coupling may be used between the motor and the drive gearing. An elastomeric type of coupling, if used, shall be so constructed that it will not allow disengagement of the motor if the elastic portion should fail.

22.11 Use of Chain Drives. The use of chain drives shall be prohibited.

23. TERMINAL STOPPING DEVICES

23.1 General. Switches for normal and final terminal stopping devices shall conform to the requirements given in 23.1.1 through 23.1.3.

23.1.1 When they are located on the car or on the hoist structure, switches for normal and final terminal stopping device shall be of the enclosed type and securely mounted in such a manner that the movement of the switch lever or roller to open the contacts will be as nearly as possible in a direction at right angles to a vertical plane through the face of the car guide members.

23.1.2 Operating cams shall be of metal and shall be rigid.

23.1.3 The switch contacts shall be directly opened mechanically. Arrangements that depend on a spring or gravity, or both, to open the contact shall not be used.

23.2 Normal Terminal Stopping Devices.

23.2.1 Location and Function. Upper and lower normal terminal stopping devices shall be provided to stop the car automatically, at or near the top and bottom terminal landings, with any load up to and including rated load in the car and from any speed attained in normal operation. Such devices shall function independently of the normal stopping means and of the final terminal stopping device. The device shall be so designed and installed that it will continue to function until the final terminal stopping device operates.

Note: The normal terminal stopping device may be used as the normal stopping means.

23.2.2 Location of Stopping Switches. Stopping switches for normal terminal stopping devices shall be located as described in 23.2.2.1 through 23.2.2.3.

23.2.2.1 Stopping switches for traction machines shall be located on the car, on the hoist structure or in the machine room and shall be operated by the movement of the car or the counterweight.

23.2.2.2 Stopping switches for winding-drum machines shall be located on the car or on the hoist structure and shall be operated by the movement of the car.

23.2.2.3 Rack-and-pinion hoists shall have normal terminal stopping switches located on the car and operated by cams attached to the hoist structure.

23.2.3 Stopping Switches in Machine Rooms. Stopping switches located in a machine room shall conform to the requirements given in 23.2.3.1 through 23.2.3.3.

23.2.3.1 The stopping switch contacts shall be mounted on and operated by a stopping device mechanically connected to and driven by the car. Stopping switches dependent on friction or traction shall not be used.

23.2.3.2 Tapes, chains, ropes and similar devices mechanically connecting the stopping device to the car and used as a driving means shall be provided with a device that will cause the electric power to be removed from the elevator driving-machine motor and brake if the driving means fails.

23.2.3.3 Only one set of floor-stopping contacts is necessary for each terminal landing on floor controllers and similar devices used to stop the car automatically at the landings (such as automatic operation and signal operation), provided these contacts and the means for operating them conform to the requirements of 23.2.3.1 and 23.2.3.2. These contacts may then serve also as normal terminal stopping devices.

23.3 Final Terminal Stopping Devices.

23.3.1 Location and Function. Final terminal stopping devices shall be provided and arranged to cause the electric power to be removed automatically from the hoist driving-machine motor and brake after the car has passed a terminal landing. The device shall be set so it will function as close to the terminal landing as practicable but, under normal operating conditions, will not function when the car is stopped by the normal terminal-stopping device. Where spring buffers are provided, the device shall function before the buffer is engaged.

The device shall be so designed and installed that it will continue to function.

(1) At the top terminal landing, until the car has traveled above this landing a distance equal to the counterweight runby plus 1-1/2 times the buffer stroke, but in no case less than two feet (0.61m).

(2) At the bottom terminal landing, until the car rests on its fully compressed buffer. The operation of final terminal stopping devices shall prevent movement of the car by the normal operating devices in both directions of travel. Such devices shall be reset manually.

23.3.2 Location. Final terminal stopping devices shall be located in accordance with 23.3.2.1 through 23.3.2.3.

23.3.2.1 Hoists having traction machines shall have final terminal stopping switches located on the hoist structure and operated by cams attached to the car or counterweight.

23.3.2.2 Hoists having winding-drum machines shall have final terminal stopping switches located on and operated by the driving-machine. In addition, they shall have stopping switches located on the hoist structure and operated by cams attached to the car (see also 23.3.4.2).

23.3.2.3 Rack-and-pinion hoists shall have final terminal stopping devices located on the car and operated by cams attached to the hoist structure.

23.3.3 Controller Switches Controlled by the Final Terminal Stopping Device. The normal and final terminal stopping devices shall not control the same controller switches unless two or more separate and independent switches are provided, two of which shall be closed to complete the driving-machine motor and brake circuit in either direction of travel. Where a two- or three-phase a.c. driving-machine motor is used, these switches shall be of the multiple type.

The control shall be designed and installed so a single ground or short circuit will permit either the normal or the final terminal stopping device circuit to stop the car but will not prevent both from doing so.

23.3.4 Drum-Type Personnel Hoists. Final terminal stopping devices for drum machines shall conform to the requirements given in 23.3.4.1 and 23.3.4.2.

23.3.4.1 Stopping switches located on and operated by the driving-machine shall not be driven by chains, ropes or belts.

23.3.4.2 Where a two- or three-phase a.c. driving-machine motor is used, the main circuit to the driving-machine motor and the circuit of the driving-machine brake coil shall be opened either by the contacts of the machine stop switch or by stopping switches mounted in the hoistway and operated by a cam attached to the car. The opening of these contacts shall occur before, or coincident with, the opening of the final terminal stopping switch as provided in 23.3.1.

Exception: Not subject to this requirement are driving-machines equipped with a d.c. brake and having a d.c. main-line control switch in the driving-machine motor circuit controlled by a final terminal stopping switch located in the hoistway and operated by a cam attached to the car.

23.4 Terminal Speed-Limiting Devices. Terminal speed-limiting devices shall be installed when (1) reduced-stroke oil buffers are used or (2) the car's rated speed exceeds 300 fpm (1.5m/s). These devices shall conform to the requirements given in 23.4.1 through 23.4.4.

23.4.1 Terminal speed-limiting devices shall operate independently of the normal

terminal stopping device should the latter fail to slow the car at the terminal as intended.

23.4.2 Terminal speed-limiting devices shall provide a retardation of not more than 32.2 feet per second (9.8m/s).

23.4.3 Terminal speed-limiting devices shall not apply to the car safety.

23.4.4 Terminal speed-limiting devices shall be designed and installed so a single short circuit caused by a combination of grounds or by other conditions will not prevent their functioning.

24. OPERATING AND OPERATION DEVICES AND CONTROL EQUIPMENT

24.1 Operation and Operating Devices.

24.1.1 Types of Operating Devices. All operating devices shall be of the enclosed electric type. Rope or rod operated devices actuated directly by hand, or rope-operating devices actuated by wheels, levers or cranks shall not be used. For hydraulic drives, dead-man lever (self-centering) controls may be used. Users shall satisfy themselves each day that the hoist is in a safe operating condition before operation of the hoist is permitted on that day.

24.1.2 Manual Operating Devices for Inside the Hoist Car. Handles of lever-type operating devices for car switch operation shall be recessed or protected and arranged so they will return to the stop position automatically when the operator's hand is removed. Car switch or push buttons should be of the continuous type so when the operator's hand is removed from the button, the car will come to a stop.

24.1.2.1 Automatic Operating Devices. The following types of operation are permitted:

(1) Continuous-pressure operation.

(2) Momentary-pressure operation with up-down buttons or switches in the car and up-down buttons or switches, or call buttons, at each landing. It is not required that the operation be selective.

(3) Single-automatic operation.

(4) Non-selective, collective and selective.

24.1.3 Top-of-Car Operation During Inspection. When an inspector is stationed on top of a car in performance of normal duties, the car shall be operated, when required, by an operator inside the car and by means of the normal operating devices. In addition, the car shall be operated in response to the voice commands of the inspector and only at its slowest speed. An emergency stop button located on top of the car shall be provided for use by the inspector to stop the car at any point of travel. A guardrail shall be provided on top of cantilever-type cars. The guardrail shall be approximately 42 inches (1.07m) in height and shall have an intermediate rail and a four-inch toe board.

24.1.4 Wireless Control:

(1) The operator control shall have one constant pressure-actuating device for each direction plus a separate emergency stop button.

(2) The completion or maintenance of an electric contact circuit

(a) Shall not be used to interrupt the power to the driving machine motor or brake at the terminal stops, i.e., power loss will stop car.

(b) Shall not be used to stop the car when the emergency stop button is activated, or any of the electrical protective devices operated.

Exception: The requirements of this clause do not apply to dynamic braking and speed control switches.

(3) The failure of any single magnetically operated switch contactor, or relay to release in the intended manner, or the occurrence of a single accidental ground, shall not permit the car to run if any hoistway door interlock, car gate or contact interlock is in the open position.

24.1.5 Design Principle for Wireless Control:

(1) All wireless systems shall be designed to prevent movement of the car except in response to actuation of the control devices, and only then when all safety circuits are closed.

(2) In any wireless system, there shall be a provision to maintain a minimum signal to noise ratio of 5:1, except when a single system is employed connecting each operating device the ratio of signal strength to noise shall be not less than 10:1. A minimum of two independently transmitted signals at different frequencies is required to move the car.

(3) Multiple signals codes shall be used to connect each operating device; in which case, the signal to noise ratio may be less than 10:1, but not less than 5:1.

(4) Multiple signals shall be generated by two channels and two signals. The two signals from two channels shall control a single function (move the car), which shall be required for safety, but neither signal shall be easily generated from ambient signals. A further information bit is also required to distinguish each signal. Where two or more units may be operated in radio contact with each other, a further code signal is required to identify each unit and prevent response by other than the instructed unit.

(5) Antennae, either of individual or continuous wire type, shall be securely fastened to withstand the elements and prevent accidental grounding.

24.2 Electrical Protective Devices. Electrical protective devices shall be provided in accordance with the requirements given in 24.2.1 through 24.2.15.

24.2.1 Slack-Rope Electric Switch. Hoists having winding-drum machines and counterweighted rack-and-pinion hoists shall be provided with a slack-rope device equipped with a slack-rope electric switch of the enclosed, manually reset type that will cause the electric power to be removed from the hoist driving-machine motor and brake if the ropes become slack.

24.2.2 Motor-Generator Running Switch. Where generator-field control is used, means shall be provided to prevent the application of power to the hoist driving-machine motor and brake unless the motor-generator-set connections are properly switched for the running condition of the hoist. It is not required that the electrical connections between the hoist driving-machine motor and the generator be opened in order to remove power from the hoist motor.

24.2.3 Motor-Field Excitation Switch. Where generator-field control is used, a

motor-field excitation switch shall be provided that will cause the electric power to be removed from the hoist driving-machine motor and brake unless current is flowing in the shunt-field circuit of the hoist driving-machine motor.

24.2.4 Emergency Stop Switch. An emergency stop switch shall be provided in the car and located in or adjacent to the car operating panel. When opened, this switch shall cause the electric power to be removed from the hoist driving-machine motor and brake. Emergency stop switches shall have the following characteristics:

(1) They shall be of the manually opened and closed type.

(2) They shall have red operating handles or buttons.

(3) They shall be conspicuously and permanently marked "stop."

(4) They shall be positively opened mechanically and their opening shall not be solely dependent on springs.

24.2.5 Broken-Rope, Tape or Chain Switches Used in Connection with Machine Room Normal Terminal Stopping Switches. Broken-rope, tape or chain switches conforming to 23.2.3.2 shall be provided in connection with normal terminal stopping devices located in the machine rooms of traction hoists. Such switches shall be opened by a failure of the rope, tape or chain.

24.2.6 Stop Switch on Top of Car. A stop switch conforming to the requirements of 24.2.4 shall be provided on top of every hoist car.

24.2.7 Car-Safety-Mechanism Switch. A switch conforming to the requirements of 19.6, 20.4.1 and 20.4.3 shall be required where a car safety is provided.

24.2.8 Speed Governor Overspeed Switch. A speed governor overspeed switch shall be provided when required by 20.4.1 and shall conform to the requirements given in 20.4.2 and 20.4.3.

24.2.9 Final Terminal Stopping Devices. Final terminal stopping devices conforming to the requirements given in 23.3 shall be provided.

24.2.10 Terminal Speed-Limiting Devices. Where reduced-stroke oil buffers are provided or where the car's rated speed exceeds 300 fpm (1.5m/s), emergency terminal stopping devices conforming to the requirements given in 23.4 shall be provided.

24.2.11 Compensating-Rope Sheave Switch. Compensating-rope sheaves, when used, shall be provided with compensating-rope sheave switch or switches mechanically opened by the compensating-rope sheave before the sheave reaches its upper or lower limit of travel, to cause the electric power to be removed from the elevator driving-machine motor and brake.

24.2.12 Primary Magnetic Contactor. A primary magnetic contactor shall be provided for main power disconnect, in addition to the normal service disconnect switch required by 24.4. The primary magnetic contactor shall perform its power disconnect function upon any interruption of the final terminal stopping devices or any other electrical safety devices.

24.2.13 Landing Door or Car Gate Electric Contacts. Landing door or car gate electric contacts conforming to the requirements given in 18.2 shall be provided for all hoists.

24.2.14 Normal Terminal Stopping Devices. Normal terminal stopping devices conforming to the requirements given in 23.2 shall be provided for every hoist car.

24.2.15 Motor-Generator Overspeed Protection. Means shall be provided to cause the electric power to be removed automatically from the hoist driving-machine motor and brake if a motor-generator set driven by a d.c. motor overspeeds.

24.3 Voltages Permitted in Control and Operating Circuits.

24.3.1 Voltages Permitted in the Hoistway or on the Car. The maximum system or circuit potential permitted on any equipment in the hoistway or on the car shall be not more than 600 volts (nominal). Where the potential exceeds 120 volts (nominal), either a grounding conductor shall be incorporated in the traveling cable or a separate grounding conductor shall be installed. The type and size of the grounding conductor and the grounding fastening means shall conform to the requirements of ANSI/NFPA 70.

24.3.2 Voltages Permitted in Other Locations. The nominal rated system or circuit potential for all circuits in locations other than those specified in 24.3.1 shall not exceed 600 volts, except for driving motors of motor-generator sets.

24.4 Power-Supply-Line Disconnecting Means. A fused-disconnect switch or a circuit breaker shall be installed and connected into the power-supply line to each elevator motor or to the motor of the motor-generator set. Disconnect switches or circuit breakers shall be of the manually closed multipole type, and their location shall conform to the requirements of ANSI/NFPA 70.

Disconnecting means for hoists having a d.c. primary power supply and a rheostatic control shall have the disconnect switch arranged so that its opening will directly open the driving-machine brake circuit.

Where circuit breakers are used as a disconnecting means, they shall not be of the instantaneous type and shall not be opened automatically by a fire alarm system.

24.5 Phase-Reversal and Failure Protection. Hoists having polyphase a.c. power supply shall be provided with means to prevent the starting of the hoist motor if (1) the phase rotation is in the wrong direction or (2) there is a failure of any phase.

This protection shall be considered to be adequately provided by a generator-field control having a.c. motor-generator driving motors, provided a reversal of phase will not cause the hoist driving-machine motor to operate in the wrong direction. Controllers whose switches are operated by polyphase torque motors provide inherent protection against phase reversal or failure.

24.6 Installation of Condensers or Devices That Make Electrical Protective Devices Inoperative. The installation of condensers whose operation or failure will cause an unsafe operation of the hoist is prohibited. No permanent device shall be installed, except as provided in this standard, that will make any required electrical protective device inoperative (see 27.2).

24.7 Release and Application of Driving-Machine Brakes. A driving-machine brake shall not be electrically released until power has been applied to the driving-machine motor.

Power feed lines to the brake shall be opened, and the brake shall be applied automatically when the following conditions prevail:

(1) The operating device of a car or continuous-pressure switch is in the stop position.

(2) A floor stop device functions.

(3) Any of the electrical protective devices functions.

Under conditions (1) and (2), the application of the brake may occur on or before the completion of the slowdown and/or leveling operations.

The brake shall not be permanently connected across the armature or field of a d.c. hoist driving-machine motor.

24.8 Control- and Operating-Circuit Requirements. In the design and installation of the control and operating circuits, the requirements given in 24.8.1 through 24.8.4 shall be met.

24.8.1 Springs shall not be used to actuate contactors, or relays to break the circuit to stop the hoist.

24.8.2 The completion or maintenance of an electric circuit shall not be used to interrupt the power to the hoist driving-machine motor or brake at the terminal landings, nor to stop the car when the emergency stop switch is opened or when any of the electrical protective devices operates.

Exception: The requirements of 24.8.2 do not apply to dynamic braking or to speed-control switches.

24.8.3 The failure of any single magnetically operated switch, contactor or relay to release in the intended manner, or the occurrence of a single accidental ground, shall not permit the car to start or run if any hoistway door interlock is unlocked or if any hoistway door or car gate contact is open.

24.8.4 Where generator-field control is used, means shall be provided to prevent the generator from building up and applying to the hoist driving-machine motor sufficient current to move the car when the hoist-motor control switches are in the off position. The means used shall not interfere with the maintenance of an effective dynamic-braking circuit during stopping and standstill conditions.

24.9 Absorption of Regenerated Power. Where a power source is used that, in itself, is incapable of absorbing the energy generated by the overhauling load, means of absorbing sufficient energy shall be provided on the load side of the disconnecting means for each hoist power-supply line to prevent the hoist from attaining governor-tripping speed or a speed in excess of 125 percent of rated speed, whichever is less.

25. HOISTING AND COUNTERWEIGHT ROPES, AND ROPE CONNECTIONS

25.1 Suspension Means. Hoist cars shall be suspended by steel wire ropes attached to the car frame or passing around sheaves attached to the car frame as specified in Section 16.

Exception: Hoists with rack-and-pinion machines are not subject to this requirement.

Only steel wire ropes having the commercial classification "elevator wire rope" or specifications recommended by wire rope manufacturers for hoist use shall be used to suspend hoist cars and counterweights.

25.2 Wire Rope Data.

25.2.1 Wire Rope Data on Crosshead Data Plate. The capacity and data plate required by 21.2 shall bear the following wire rope data:

(1) Number of ropes.

(2) Diameter in inches (cm).

(3) Manufacturer's rated breaking strength per rope, in pounds (kg).

25.2.2 Wire Rope Data on Rope Data Tag. The rope data tag shall bear the following wire rope data:

(1) Diameter in inches (cm).

(2) Manufacturer's rated breaking strength per rope, in pounds (kg).

(3) Grade of material used.

(4) Whether non-preformed or preformed.

(5) Construction classification.

(6) Name of the manufacturer of the rope.

A new tag shall be installed at the time each rope is replaced if any of the above specifications or information is changed.

ROPE SPEED (feet per minute)	MAXIMUM FACTOR OF SAFETY
50	7.60
75	7.75
100	7.95
125	8.10
150	8.25
175	8.40
200	8.60
225	8.75
250	8.90
300	9.20
350	9.50
400	9.75
450	10.00
500	10.25
550	10.45
600	10.70

Table 8
Minimum Factors of Safety for Suspension Wire Ropes

25.3 Factor of Safety. The factors of safety of the wire ropes used for suspension shall be not less than those given in Table 8. Figure 25.3 shows the minimum factors of safety for intermediate rope speeds. The factor of safety shall be based on the actual rope speed corresponding to the rated speed of the car.

The factor of safety, *f*, shall be calculated with the following formula:

$$f = \frac{SxN}{W}$$

where

S = manufacturer's rated breaking strength of one rope

N = number of runs of rope under load (see Note)

W = maximum static load imposed on all car ropes, with the car and its rated load at any position in the hoistway

Note: When multiple ropes are used, the number of runs of rope under load N shall be twice the number of ropes used, for 2:1 roping; three times the number of ropes used, for 3:1 roping; etc.

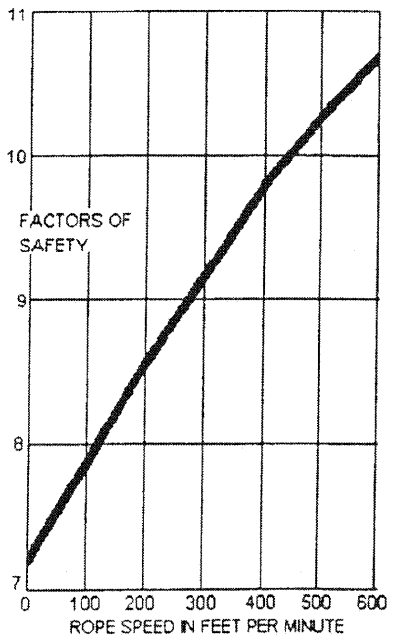


Figure 25.3 - Minimum Factors of Safety of Suspension Wire Rope of Personnel Hoists

25.4 Minimum Number and Diameter of Hoisting Ropes. The minimum number of hoisting ropes used shall be three for traction hoists and two for drum-type hoists.

Where a car counterweight is used, the number of counterweight ropes used shall be not less than two.

The term "diameter" as used in Section 25 refers to the nominal diameter as given by the rope manufacturer.

The minimum diameter of hoisting and counterweight ropes shall be 1/2 inch (1.27cm).

25.5 Suspension-Rope Equalizers. Suspension-rope equalizers must be used.

25.6 Securing of Wire Suspension Ropes to Winding Drums. Car suspension ropes of winding-drum machines shall have the ends of the rope secured to the drum or drum flange by means of clamps or tapered sockets or by other means approved by the enforcing authorities.

25.7 Spare Rope Turns on Winding Drums. Wire suspension ropes on drum-type machines shall have not less than three wraps of rope on the drum when the car is resting on the fully compressed buffers.

25.8 Splicing and Replacement of Suspension Rope. Suspension wire ropes shall not be lengthened or repaired by splicing.

25.9 Wire Rope Fastenings.

25.9.1 Type of Rope Fastening. Hoisting and counterweight wire ropes shall be attached to cars and counterweights by means of zinc-coated or galvanized drop-forged fist grips (or the equivalent) and wire rope thimbles or by approved special fastening devices. When fist grips are used, the minimum number, spacing and tightening torque shall be in accordance with the instructions of the grip manufacturer. Grips shall be periodically checked and retightened to the recommended torque (in accordance with the manufacturer's instructions).

When extra wire rope is carried on top of the frame of the hoisting platform, a drum-and-clamp tie-down or an equivalent anchor device that will not damage or deform the wire rope shall be used.

25.9.2 Babbitted Rope Sockets. Babbitted rope sockets shall not be used.

25.10 Inspection of Wire Ropes.

25.10.1 Inspector. The user responsible for the personnel hoist operation shall appoint a qualified individual to conduct the required hoist inspections and keep written records of rope condition on file at the worksite in a Hoist Operations Log (See 26.8 Hoist Operations Log).

25.10.2 Periods of Inspection. Inspection periods shall be established for each hoist, with the frequency of inspection determined by the type of installation, operating conditions and the manufacturer's recommendations. A visual inspection shall be made daily and a complete inspection of all ropes be made at least once each 30 days.

25.10.3 Method of Inspection. If ropes are dirty or over lubricated so that a proper inspection is not possible, the dirt or excess lubricant shall be removed before the ropes are inspected.

Examination of traction-machine ropes and counterweight ropes of drum-type hoists should preferably start with the car located at the top of the hoistway and be made from the top of the car, with the ropes examined on the counterweight side.

The hoist ropes of overhead drum-type machines must be examined from the overhead machinery space.

Where the traction or drum machine is located below the hoist, the portions of the ropes leading from the driving-machine drum or sheave and from the counterweight to the overhead sheaves may be examined from the top of the ear as it descends, except for a small portion that must be examined from the pit.

The ropes should be marked with chalk to indicate the locations of unexamined sections that must be inspected from other locations such as the pit or the overhead machinery space.

25.10.4 Used Wire Rope. Wire rope may be used on more than one job, provided that the rope is free of all the defects listed in Section 25.11.

25.10.5 Surfaces Contacted by Wire Rope. Sheaves, guards, guides, drums, flanges and other surfaces contacted by wire rope during operation should be examined at the time of inspection. Any condition harmful to the rope shall be corrected.

25.11 Removal and Replacement of Wire Ropes. Wire ropes with one or more of the following defects shall be removed or replaced immediately. If one wire rope of a set requires replacement, the entire set of ropes should be replaced.

(1) Corrosion: Severe corrosion, as defined by the manufacturer of the wire rope. (Any development of slight corrosion should be noted and watched closely.)

(2) Broken Wires:

(a) One or more valley breaks. A valley break is a wire break occurring in the valley between two adjacent strands.

(b) Six randomly distributed broken wires in one rope lay or three broken wires in one strand in one rope lay. (A rope lay is the length along the rope in which one strand makes a complete revolution around the rope).

(3) Abrasion: Abrasion, scrubbing, flattening or peening causing loss of more than one-third of the original diameter of the outside wires.

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

(5) Heat: Evidence of any heat damage resulting from a torch or from contact with electrical wires.

(6) Reduction of Rope Diameter: Reduction from nominal diameter of more than 3/64 inch (1.19mm)

for diameters up to and including 3/4 inch (19.05mm); 1/16 inch (1.59mm) for diameters of 7/8 to 1-1/8 inch (22.23 to 28.58mm); and 3/32 inch (2.38mm) for diameters of 1-1/4 to 1-1/2 inch (31.75 to 38.10mm). A marked reduction in diameter indicates deterioration of the core.

Governor ropes shall be replaced on the same basis as hoisting ropes. (These ropes are lightly loaded and may show little or no wear. Inspectors should check for fatigued wires in strand valleys by bending the ropes over a small radius.)

26. INSPECTIONS AND TESTS OF PERSONNEL HOISTS

26.1 Acceptance Inspections and Tests.

26.1.1 Load Requirements for Inspections and Tests. In order to ensure the safe operation of new hoists, new installations or following alterations, all hoist devices, before being placed in service, shall be subjected to an acceptance inspection and a full load test in the field. This inspection and test is to determine that all parts of the installation conform to the applicable requirements of this standard, and that all safety equipment functions as required. A jump of the tower is not considered an alteration.

26.1.2 Persons Authorized to Witness Installation and Annual Acceptance Inspections and Load Tests. Inspections and load tests as defined in 26.1.1 shall be witnessed by an inspector employed by the enforcing authority. If such a person is not available, a qualified inspector shall conduct or witness the inspection.

The following tests shall be performed by or in the presence of an inspector employed by the enforcing authority:

(1) Tests specified in 26.2 and 26.3.

(2) Any tests which require the following:

(a) Rendering of any safety devices or equipment temporarily inoperative.

(b) Removal or resetting of devices or equipment.

26.1.3 Acceptance Inspections. All parts of the installation shall be inspected for conformity with the applicable requirements of this standard.

26.1.4 Acceptance Tests. Acceptance tests shall be performed on all safety devices and equipment to determine that they function in accordance with the applicable requirements of this standard.

Acceptance tests of car and counterweight safeties, governors and buffers shall conform to the requirements given in 26.2 and 26.3.

All tests that require the hoist to carry its full rated load shall be performed by remote control methods; no person shall be in or on top of the car. Remote controls that will run and stop the car shall be temporarily installed. They shall disengage or re-apply the brake when gravity is used to overspeed the car so that it reaches tripping speed.

If the controls are to be installed at ground level, the length of the control cables must be the sum of a length sufficient to allow the operator to be in a position to view the descent of the car plus the distance the car travels to set the safety or apply the brake. All car safety devices shall be actuated by a governor and tripped by gravity overspeed.

The following checks shall be performed on all electrical switches and their activators. They shall be tested and visually inspected to make sure they function as intended. This

includes as a minimum, checks of the car gate, slack rope, directional travel limit, terminal speed, terminal limit and runbys.

26.1.5 Riding During Tests. No personnel shall be allowed to ride in or on the hoist while an overspeed test is performed.

26.2 Schedule for Acceptance Tests of Car and Counterweight Safeties and Governors.

26.2.1 General Requirements for Safeties.

26.2.1.1 Test Load. Car safeties shall be tested with rated load in the car. In performing tests of car safeties, one-fourth of the rated load shall be distributed on each quarter of the platform symmetrically in relation to the centerlines of the platform.

Counterweight safeties, where provided, shall be tested with no load in the car.

26.2.1.2 Governor-Tripping Speed. The tripping speed of the governor shall be measured by means of a tachometer and, if necessary, adjusted to conform to the requirements given in 20.2.

26.2.1.3 Sealing of Governors. Governors shall be sealed either before or at the time of the safety test, as required by 20.3. If any change is made in a governor setting during the field test in order to make it conform to the requirements given in 20.2, governors previously sealed shall be resealed immediately following the test.

26.2.1.4 Governor Overspeed Switch and Car-Safety-Mechanism Switch. The operation of the governor overspeed switch and the car-safety-mechanism switch shall be checked for conformity with the requirements given in 20.4.

26.2.1.5 Level of Car Platform. After the safety has stopped the car, the level of the car platform shall be checked and shall conform to 19.8.2.

26.2.2 Tests of Type B, Type C and Rack-and-Pinion Safeties.

26.2.2.1 Test Procedures. Safeties shall be subjected to overspeed testing, with the hoisting ropes attached, by gradually increasing the speed of the car until the governor causes application of the safety.

Exception: Safeties of hoists equipped with a.c. driving-machine motors, in which the car with its rated load does not cause sufficient overspeed when the machine brake is released to trip the governor jaws, shall be tested by operating the car at its normal speed in the down direction and tripping the governors jaws manually (see 26.2.1.2 for test of governor-tripping speed).

26.2.2.2 Operation of Governor Overspeed Switch and Car-Safety-Mechanism Switch During Test. The overspeed switch on the governor shall be inoperative during the overspeed test. In order to ensure that the safety will retard the car with minimum assistance from the hoist driving-machine, and to minimize the development of slack in the rope and fullback of the counterweight, the switch on the car operated by the car safety mechanism shall, for the duration of the test, be temporarily adjusted to open at a position as close as possible to the position at which the car safety mechanism is fully applied.

26.2.2.3 Stopping Distances for Type B, Type C and Rack-and-Pinion Safeties. The stopping distance shall conform to the requirements of 19.2.

26.2.2.4 Movement of Governor Rope to Operate Type B and Type C Safeties. The movement of the governor rope to operate the safety mechanism shall be tested for conformity with 19.10.1.

26.2.2.5 Movement of Car for Rack-and-Pinion Safeties. The movement of a car

with rack-and-pinion safeties from the governor-tripping time to full-stop time shall be determined in conformity with 19.10.2.

26.3 Acceptance Tests of Buffers for Car and Counterweight. No acceptance test shall be required for spring-type buffers.

Oil buffers shall be tested in the field in accordance with Requirement 8.10.2.2.5(c) of ANSI/ASME A17.1.

26.4 Periodic Inspections and Tests of All Installations.

26.4.1 Requirement for Periodic Inspections and Tests. All operating installations shall be subjected to regular inspections and tests as defined by this standard and in conformance with manufacturer's recommendations. The object of these inspections is to determine that the equipment is in safe operating condition.

26.4.2 Persons Authorized to Make Periodic Inspections and Tests. Periodic inspections and tests shall be made by a qualified inspector.

26.4.3 Inspection and Test Periods. Periodic inspections and tests of hoists shall be made at intervals not to exceed three months.

26.4.4 Periodic Inspections and Tests. All parts of the equipment shall be inspected and, where necessary, tested to determine they are in safe operating condition and that parts subject to wear, such as ropes, bearings, gears, car safety and governor parts and buffers, have not worn to such an extent as to affect the safe operation of the installation. Any such worn parts shall be adjusted or replaced.

26.4.5 Car and Counterweight Safety, Governor and Oil Buffer Periodic Inspections and Tests. Safeties, governors and oil buffers shall be inspected to insure the conformity with the requirements given in 26.4.6 through 26.4.9 at intervals not to exceed three months.

26.4.6 Inspection of Safety Parts. All working parts of car and counterweight safeties shall be inspected to determine that they are in satisfactory operating condition and that the distance between the guide member gripping faces of the safety parts is not less than the following:

(1) For new hoists having Type A, B or C safeties, the distance specified in 19.9.

(2) For existing hoists having steel-guide safeties, not less than the thickness of the guide members plus 3/32 inch (2.4mm).

Type B safeties shall be operated by hand until the safety jaws contact the guide members, after which the inspection specified in 26.4.6.1 and 26.4.6.2 shall be made.

26.4.6.1 For Type B drum-operated safeties that require continual unwinding of the safety drum to fully apply the safety, the number of turns remaining on the car safety drum shall he checked and shall be sufficient to ensure proper operation of the safety on the maintenance test or in the event the safety operates on overspeed. The requirements given under 19.10 specify that three turns shall remain on the drum after application of the safety at overspeed with rated load in the car.

26.4.6.2 For all Type B safeties, the movement of the governor rope necessary to bring the safety jaws into contact with the guide member surfaces shall be measured and shall not exceed the distance specified in 19.10.1.

Note: When resetting drum-operated safeties with the wrench in the car, sufficient tension shall be kept in the drum rope to prevent the rope from kinking and to ensure that it is wound evenly and uniformly in the

drum grooves. The drum must be rewound until no slack remains in the safety rope between the drum and the car-releasing carrier.

26.4.7 Inspection of Governor. Governors shall be inspected at intervals not to exceed three months. They shall be operated by hand to determine that all parts, including the rope-grip jaws, operate freely. All bearings, governor rope-grip jaws and rubbing surfaces shall be checked to make sure they are not worn excessively and are free of paint.

A test of the governor-tripping speed is not required unless the seal on the governor has been disturbed or the inspection indicates that a retest is necessary for other reasons. If a retest is performed, the governor shall be resealed after the test.

In lieu of an inspection, an overspeed test may be performed to determine proper governor operation.

26.4.8 Test of Safeties. Safeties shall be subjected to a running test with no load in the car, as specified in 26.4.8.1 and 26.4.8.2.

26.4.8.1 Governor-Operated Safeties. All governor-operated safeties shall be periodically tested without any person in or on the car.

Exception. The person performing the test may activate a hand-operable governor from within the car with the car running at the slowest operating speed.

In this test, the safety shall bring the car to rest promptly. In the case of Type B and rack-and-pinion safeties, the stopping distance is not required to conform to 19.2. In the case of Type A and Type C safeties employing rollers or dogs for application of the safety, the rollers or dogs are not required to operate over their full travel (see note to 26.4.6.2).

26.4.9 Periodic Tests of Car Oil Buffers. Periodic tests of oil buffers shall be performed as specified in 26.3.

26.5 Re-Inspection of Installation When Travel is Increased. When the height of the hoist is changed, the installation shall be re-inspected and tested in accordance with the requirements given in 26.1 and witnessed, if required, by the enforcing authority before the hoist is placed in normal service. A full load safety test is not required when the height has changed.

26.6 Product Specific Testing. If a device on a hoist cannot be tested by means available at the site, the person or firm installing and/or maintaining the hoist shall provide a written check-out procedure that demonstrates that the device complies with the requirements of this standard, or provide documentation from the manufacturer that the device complies with the requirements of this standard, including expiration date of the documentation, if applicable.

26.7 Inspection of Tower Structure Components. Prior to each tower erection, the owner or installer of the hoist tower shall have the tower structural components inspected for excessive corrosion, bent or dented components, broken welds, rewelding beyond original factory weld locations or other defects.

26.8 Hoist Operations Log. An inspection and maintenance activity log shall be maintained by the hoist operator or designated competent person. The log shall document acceptance, daily, and periodic inspections in accordance with the manufacturers specifications. It shall also contain a record of all maintenance activities, a list of component replacements and associated test results. The log shall be available to hoist personnel and the authority having jurisdiction.

The log shall include at a minimum, records concerning the following activities:

(1) All records shall include the date, and work or test done, the name of the person who performed the inspection, test, and/or work, the serial number or other identifier of the hoist.

(2) Description of erection and jumping activities.

(3) Description of maintenance tasks performed

(4) Description of examinations, tests, adjustments, repairs, and replacements.

(5) Description of all trouble calls or incidences that are reported to hoist personnel by any means, including corrective action taken.

No elevator shall be in operation without a current log on site. The log shall be available for inspection by the governing authority.

27. MAINTENANCE

Hoists, hoistways, enclosures and power supplies shall be maintained by the user in accordance with manufacturer recommendations and this standard.

27.1 Lubrication. All parts of the machinery and equipment that require lubrication shall be lubricated by the user at regular intervals as recommended by manufacturer. A log shall be maintained at the installation site of the dates lubrication is performed and have it available for inspection.

27.2 Making Safety Devices Inoperative. No person shall at any time make any required safety device or electrical protective device inoperative except when necessary during tests, inspections and maintenance.

Immediately upon completion of the tests, inspections and maintenance, such devices shall be restored to their normal operating condition in conformance with the applicable requirements of this standard (see 24.6).

27.3 Replacements. Where a listed/certified device or component is replaced, it shall be subject to the applicable engineering or type test as specified in the requirements of CAN/CSA B44.1 ANSI/ASME A17.5. The device or replacement component shall be labeled by the certifying organization. For a replacement device or component to be used it must be included in the original manufacturer's directions or specifications listed as an acceptable replacement part or equivalent.

28. USE OF HOISTS FOR CARRYING MATERIALS

Personnel hoists may be used for carrying personnel and materials provided the hoists are designed to accommodate the type of load to be carried.

28.1 Carrying Rolling Equipment. When wheelbarrows or other rolling equipment is transported, it shall be held securely in place on the hoist platform. The platform shall be level with the landing when rolling equipment is loaded or unloaded. Power-operated equipment shall not be driven onto the platform at any floor. Power-operated equipment may be loaded at any floor if it is manually pushed onto and off of the platform with the power shut off. The wheels must be adequately blocked in front and in back of at least two wheels.

28.2 Hoisting of Passengers and Materials. Materials and passengers shall not be transported together, except two workers may be transported with the material they are assigned to load and unload. The operator of the hoist is responsible for ensuring that material

carried in the hoist is appropriately secured to prevent it from shifting and the maximum load rating is not exceeded.

29. POSTING OF OPERATING PERMITS

Permits, or duplicates, shall be posted in a conspicuous location in the car.

30. OPERATION.

Hoists shall be operated in compliance with the manufacturing specifications, rules and recommendations, and the same of the governing authority. This shall consist of items, functions and criteria pertaining to the hoist use and shall be a part of an operational maintenance and inspection log.

30.1 Hoists shall be operated by automatic controls located inside the car and at each landing or operated by a competent and authorized operator either in the car or authorized personnel using an operator station in the car or on the floors.

30.2 During adverse weather conditions, when winds reach such a point as to make operation hazardous to persons or equipment, the hoist shall be shut down. No hoist shall be operated during any winds of 35 mph or more unless use in higher wind speeds is permitted and specified by the manufacturer.

30.3 The user shall be responsible for insuring that the operators are knowledgeable and capable of performing the duties outlined in the maintenance, operating and inspection manuals and are capable of recording such activity in their log.

30.4 Communication. A voice communication system shall be maintained at all times on the hoist when the height exceeds 50 feet (15.24m). *A cell phone or radio may be a means to comply with this section.*

Appendix A This Appendix is not a part of American National Standard Safety Requirements for Personnel Hoists and Employee Elevators for Construction and Demolition Operations, ANSI/ASSE A10.4, but is included for information purposes only.

SURVEY OF JOB SITE

Construction and demolition workers are subject to certain hazards that cannot be eliminated by mechanical means and must be controlled by care, common sense and intelligence. The A10 Committee realizes the importance of safety and strongly recommends that prior to commencing any operation, the employer make a survey of the conditions of the site to determine the hazards and the kind and number of safeguards that the employer will install. The survey should include, but not be limited to, the following:

(1) Safe access and movement
- (a) Work areas
- (b) Walkways, runways and passageways
- (c) Ladders, stairways and elevators
- (d) Protection for floor and roof openings
- (e) Illumination

(2) Vehicles
- (a) Roads
  - (i) Turn space
  - (ii) Parking area
  - (iii) Mud areas
- (b) Materials storage areas and dump areas
- (c) Signs and signals to route vehicles on the job
- (d) Maintenance and repair of vehicles

(3) Utilities and service
- (a) Location of temporary buildings
- (b) Location and identification of high-voltage lines (identify by signs; move, de-energize or erect barrier to prevent contact)
- (c) Location of sanitary facilities and drinking water

(4) Scheduling work for safety
- (a) Providing for items such as hard hats, life belts, goggles and work vests on the job
- (b) Establishing liaison among contractors to prevent congestion among trades
- (c) Providing temporary flooring, safety nets and scaffolding where required

(5) Work procedures
  (a) Space
  (b) Equipment such as cranes, hoists, elevators and trucks
  (c) Rigging procedures
(6) Tools and equipment
  (a) Repair, maintenance and care
  (b) Inspection
  (c) Supplies of tools for each job
(7) Workers and foremen
  (a) Job assignment
  (b) Training and supervision
  (c) Number of workers
  (d) Plans for maintaining interest in safety:
    (i) Safety bulletins, record charts and posters
    (ii) Recognition for groups or individuals
    (iii) Investigation and reporting on reportable accidents
    (iv) Knowledge of safety orders
    (v) Safety meetings
    (vi) Specific safety instructions for new employees
  (e) Establishment of provisions to take immediate action to correct unsafe conditions or acts
  (f) First aid and medical treatment of injuries
(8) Safety meetings
  (a) Establishment of provisions to take immediate action to correct unsafe conditions or acts
  (b) First aid and medical treatment of injuries

Appendix B This Appendix is not a part of American National Standard Safety Requirements for Personnel Hoists and Employee Elevators for Construction and Demolition Operations, ANSI/ASSE A10.4, but is included for information purposes only.

CHECKLIST FOR INSPECTION OF HOISTS

This is a discretionary guide.

Address: _____

_____

Hoist ID No: _____

Rated load: _____

Speed: _____

□ Periodic inspection and test

□ Acceptance inspection and test

Code Edition: _____

Inspected by: _____
Print

Signature: _____ Date: _____

QEI No: _____ Certifying organization: _____

GENERAL NOTES:
(a) OK = meets requirements; NG = insert number to identify comment on back of this Checklist; NA = not applicable. Number is A10.4 code section requirement.

OK NG NA

1. HOIST — INSIDE OF CAR

1.1 Stop switch - 24.2.4 □ □ □

1.2 Car floor and sill – 11.3 □ □ □

1.3 Car lighting – 17.9 □ □ □

1.4 Car gate - 18 □ □ □

1.5 Car enclosure - 17 □ □ □

1.6 Emergency exit – 17.6 □ □ □

1.7 Signs and data plate 21.2 □ □ □

1.7 21.3 and 21.4 □ □ □

1.8 Rated load, platform area 21 □ □ □

OK NG NA

1.9 Operating devices and controls 24 □ □ □

1.10 Inspection operation 24.1.3 □ □ □

1.19 Car ride 26.1.5 □ □ □

2. HOIST — MACHINE ROOM and MACHINERY SPACE

2.1 Access to area 7.2 - 9 □ □ □

2.2 Lighting – 9.3 □ □ □

2.3 Housekeeping – 5.6.4 □ □ □

2.4 Hoist and CWT. Ropes 25 □ □ □

2.5 Disconnect means 5.4.6, 24.4 □ □ □
2.6 Wiring, fuses, grounding 8.1, 24.3.1 □ □ □
2.7 Driving machine brake - □ □ □
22.1.1.6 and 22.7
2.8 Winding drum – slack cable device □ □ □
22, 22.2, 24.2.1
2.9 Drums - 22.2 □ □ □
2.10 Sheaves – 22.4, 16.10, 20.7 □ □ □
2.11 Phase reversal – 24.5 □ □ □
2.12 Absorption of regenerated power □ □ □
24.9

3. HOIST — TOP OF CAR

3.1 Stop switch - 24.1.3 □ □ □
3.2 Normal stopping device 23.2, 8.2 □ □ □
3.3 Final stopping device 23.3, 8.2 □ □ □
3.4 Suspension ropes – 25.10 □ □ □
3.5 Car and CWT safeties – 19 □ □ □
3.6 Speed governors 20, 20.8, 20.9 □ □ □
3.7 Wire rope fastening - 25.9 □ □ □
3.8 Car gate and locks - 18 □ □ □
3.9 Hoistway door locks □ □ □
6.2 mechanical
24.8.3 electrical
3.10 Top of car guardrail 24.1.3 □ □ □
3.11 Top clearance and runby □ □ □
10.5, 106, 10.7, 10.8 and 10.9
3.12 Inspection operation 24.1.3 □ □ □

4. TOWER – STRUCTURE

4.1 Space under hoist 5.2 □ □ □
4.2 Hoistway enclosure – 5.3 □ □ □
4.3 Tie-ins – 5.4.2, 5.4.3 □ □ □
4.4 Hoistway doors – 6 □ □ □
4.5 Guide members and supports 13 □ □ □
4.6 Overhead beams and support 7 □ □ □
4.7 Wiring - 8.1 □ □ □
4.8 Landings – 5.6 □ □ □
4.9 Overhead protection – 7.3 □ □ □
4.10 Tower or mast – 5 □ □ □
4.11 Counterweights – 15 □ □ □
4.12 Counterweight guarding 12 □ □ □
4.13 Car frames and platforms 16 □ □ □

5. HOIST PIT AREA

5.1 Pit access – 6.2 □ □ □
5.2 Bottom clearance and runby □ □ □
10.1, 10.2, 10.3 and 10.4
5.3 Final stopping – 23.3 □ □ □
5.4 Normal stopping – 23.2 □ □ □
5.5 Traveling cables – 8.1.3, 24.3.1 □ □ □
5.6 Car and CWT safeties – 19 □ □ □
5.7 Buffers - 14 □ □ □

6. HOIST – GENERAL REQUIREMENTS

6.1 Permit posting – 29 □ □ □
6.2 Welding - 16.7.3 □ □ □
6.3 Replacement of certified devices □ □ □
27.3
6.4 Hoist operations log – 26.8, 27.1 □ □ □
6.5 Operator qualifications □ □ □
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6.6 Tower structure components 26.7 □ □ □
6.7 Signs and data plates □ □ □
25.2.1, 25.2.2, 19.13 and 14.2.3