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Standard Specification for Elevators, Shipboard, Electromechanical Passenger, and Stores[1]

This standard is issued under the fixed designation F 916; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

ϵ^1 NOTE—Keywords were added editorially in March 1993.

1. Scope

1.1 This specification covers the general design, construction, installation, operation, and testing of shipboard elevators. The requirements contained in this specification apply to automatic, pushbutton, self-service passenger, and store elevators of the winding drum and traction type driven by electric motors. Elevators primarily used for the transportation of personnel shall also be classified as passenger elevators.

1.2 This specification may be issued to obtain any of the following as specified by the ordering information (see 5.1.1).

1.2.1 A preassembled system in a frame structure of adequate strength that will permit installation in an elevator trunk.

1.2.2 A system consisting of all elevator components that can be assembled and installed in an elevator trunk.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

A 27/A27M Specification for Steel Castings, Carbon, for General Application[2]

A 36/A36M Specification for Structural Steel[3]

A 283/A283M Specification for Low and Intermediate Tensile Strength Carbon Steel Plates[3]

A 307 Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength[4]

A 502 Specification for Steel Structural Rivets[4]

A 563 Specification for Carbon and Alloy Steel Nuts[4]

A 668 Specification for Steel Forgings, Carbon and Alloy, For General Industrial Use[5]

2.2 *ANSI Standards:*

A 10.4 Safety Requirement for Personnel Hoists[6]

A 17.1 Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks[6]

2.3 *American Bureau of Shipbuilding Standard:*

Rules for Building and Classing Steel Vessels, Sections 35, 41, 43, and 44[7]

2.4 *Underwriters' Laboratories Standards:*

UL 595 Marine-Type Electric Lighting Fixtures[8]

UL 844 Electric Lighting Fixtures for Use in Hazardous Locations[8]

2.5 *SOLAS Standard: International Conventions for the Safety of Life at Sea,* 1974[9]

2.6 *U.S. Coast Guard (USCG) Standard:*

CFR 46 Shipping[10]

2.7 *Institute of Electrical and Electronics Engineers Standard:*

IEEE 45 Recommended Practice for Electric Installations on Shipboard[11]

2.8 *National Electrical Manufacturers Standard:*

LD 3.1 Application, Fabrication, and Installation of High-Pressure Decorative Laminates[12]

3. Terminology

3.1 Definitions shall be in accordance with ANSI A 17.1 .

4. Classification

4.1 *Type*—The electro-mechanical elevators covered by this specification shall be of the following types (see 5.1.2):

4.1.1 *Type I*—Winding Drum Machines.

4.1.2 *Type II*—Traction Machines.

[1] This specification is under the jurisdiction of ASTM Committee F-25 on Shipbuilding and is the direct responsibility of Subcommittee F25.08 on Deck Machinery.

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[2] *Annual Book of ASTM Standards,* Vol 01.02.

[3] *Annual Book of ASTM Standards,* Vol 01.04.

[4] *Annual Book of ASTM Standards,* Vol 15.08.

[5] *Annual Book of ASTM Standards,* Vol 01.05.

[6] Available from American National Standard Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

[7] Available from American Bureau of Shipbuilding, 65 Broadway, New York, NY 10006.

[8] Available from Underwriters' Laboratories, 207 E. Ohio, Chicago, IL 60611.

[9] Available from American Bureau of Shipbuilding, 101-104 Picadilly, London, WIVDAE.

[10] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

[11] Available from Institute of Electrical and Electronics Engineers, 345 East 47th St., New York, NY 10017.

[12] Available from National Electrical Manufacturers Assoc., 155 East 44th St., New York, NY 10017.

4.2 *Grade*—The elevators shall be of the following grades (see 5.1.2):

4.2.1 *Grade 1*—1200 lb (544.3 kg) capacity.

4.2.2 *Grade 2*—2500 lb (1134 kg) capacity.

4.2.3 *Grade 3*—4000 lb (1814.4 kg) capacity.

5. Ordering Information

5.1 Orders for elevator systems to be furnished in accordance with this specification shall include the following:

5.1.1 Type of system installation (see 1.2).

5.1.2 Type and grade (see 4.1 and 4.2).

5.1.3 Speed (if other than specified), (see 6.2).

5.1.4 Quantity of drawings and design data (see 6.4).

5.1.5 Special Ship's Motion Conditions (optional) (see 6.1).

5.1.6 Types of hoistway and elevator doors (see 7.2 and 9.3).

5.1.7 Clear plumb hoistway dimensions.

5.1.8 Machine room location and space available (see 8.1).

5.1.9 Location of access to machine room (see 8.1.2).

5.1.10 Pit depth available (see 7.4.6).

5.1.11 Total clear height above top landing to machine or sheave beam supports, or both.

5.1.12 Number of stops and openings required.

5.1.13 Total travel (rise).

5.1.14 Deck heights.

5.1.15 Location of supports for car and counterweight-guide rails (see 8.5 and 8.7).

5.1.16 Openings in elevator car (such as, front only, front and rear, and adjacent (front and side)).

5.1.17 Type of actuating control system (see 10.1.2).

5.1.18 Requirement for protective mat (see 9.1.12).

5.1.19 Electrical power supply data.

5.1.20 Material for enclosure linings (see 9.1.10).

5.1.21 Requirement for sound powered telephone system (see 11.8).

5.1.22 Special requirements.

5.1.23 Elevator car and counterweight clearance and overtravel (see 8.7).

5.1.24 Responsibility for providing component interconnect cabling (see 11.9).

6. General Design Requirements

6.1 *Ship's Motion Conditions* (see 5.1.5)—Control systems shall be designed to operate satisfactorily under conditions of vibration, voltage regulation, and frequency variation present in the vessel (see Section 41 of the American Bureau of Shipping). Elevators together with ancillary equipment and controls shall be capable of satisfactory operation with the vessel in motion under conditions of roll of at least ± 15° and of pitching of at least ± 5°. In the "out of service condition," the loaded elevator and ancillary equipment shall be capable of sustaining the following vessel's motions without damage:

6.1.1 *Roll*—± 30° period of 10 s.

6.1.2 *Pitching*—± 10° period of 7 s.

NOTE 1—The ordering activity may specify other ship's roll and pitch parameters (or vertical and horizontal *G* loadings in lieu of ship's motion data) to provide for the standardization of elevators on a specific ship or class of ships.

6.2 *Capacity, Speed and Size*—The rated load, maximum speed (unless otherwise specified by ordering information, see 5.1.3), and size shall be in accordance with Fig. 1. For each rated load, a net inside platform area is given that is the maximum area acceptable for that load.

6.3 *Materials*:

6.3.1 Structural materials intended for use in the construction of elevators shall be manufactured from tested materials of American Bureau of Shipbuilding (ABS) quality or equal. Stresses for all materials when subjected to maximum loads shall not exceed 75 % of the yield strength of the material.

6.3.2 *Gray Cast Iron*—Gray cast iron shall not be used for parts subject to tension or shear including machinery or equipment supports, worms, gears, shifts, or any parts of the machinery that are in motion. Gray cast iron shall not be used in the construction of car frames, platforms, or safeties. Nodular iron conforming to the requirements of Section 44 of the American Bureau of Shipping may, in general, be used without limitation.

6.3.3 *Non-combustible Materials*—All materials used in the construction of the car frame, car (including decorative trim), and machine room shall be non-combustible. The hoistway shall be constructed of steel.

6.4 *Design Data*:

6.4.1 The ordering activity shall provide the elevator vendor with the ordering information listed in Section 5.

6.4.2 The elevator vendor shall submit drawings or data, or both, for ordering activity approval and shall include the following as applicable for a safe elevator installation:

6.4.2.1 Machine or sheave beam size, or both.

6.4.2.2 Machine or sheave beam reactions, or both.

6.4.2.3 Reactions on car rails (vertical and horizontal) due to running, loading, and safety application.

6.4.2.4 Reactions on counterweight rails due to safety application.

6.4.2.5 Guide rail bracket spacing.

6.4.2.6 Size and weight per foot of rail reinforcements where used.

6.4.2.7 Car and counterweight buffer reactions on pit floor.

6.4.2.8 Maximum vertical distance between car and counterweight brackets.

6.4.2.9 Horizontal distance between car and counterweight rails.

6.4.2.10 Location of hoisting machine, controller, etc. in machine room.

6.4.2.11 Total weight of car and counterweight.

6.4.2.12 Loads on car safety and counterweight safety.

6.4.2.13 Number, size, and type of hoist ropes.

6.4.2.14 Rated load and rated speed.

6.4.2.15 Control system and interlocks.

6.4.2.16 Safety devices.

6.4.2.17 Lighting, ventilation, and communications system.

6.4.2.18 Electrical data covering traction or hoisting motors, motor generator sets, controls, wiring, and protective devices.

7. Hoistway

7.1 *General Construction*:

7.1.1 Each elevator shall operate in a hoistway (trunk). Hoistway scantlings shall be adequate to withstand all loads imposed by operation of the elevator or motion of the vessel.

NOTE 1—An increase in the maximum net inside platform area not to exceed 5 % and shall be permitted to allow for variations in cab designs.

Inch-pound Units

Grade	Rated Load	Maximum Speed, FPM	A_2, ft	B^A ft - in.	C^A ft - in.	D ft - in.	E ft - in.	F ft - in.
1	1200	100	15.6	5 - 0	4 - 0	6 - 8	5 - 8	3 - 0
2	2500	100	29.1	7 - 0	5 - 0	8 - 4	6 - 8	3 - 6
3	4000	100	42.1	8 - 0	6 - 2	9 - 4	7 - 10	4 - 0

SI Units

Grade	Rated Load, kg	Maximum Speed, h/min	A_2, m	B^A m	C^A m	D, m	E, m	F, m
1	544.3	30.8	1.45	1.52	1.20	2.03	1.73	0.91
2	1134	30.8	2.70	2.13	1.52	2.54	2.03	1.07
3	1814.4	30.8	3.91	2.44	1.89	2.85	2.39	1.22

[A] *B* and *C* dimensions are shown for reference only. These dimensions should be determined by the manufacturer and the way in which the manufacturer designs the elevator car sling and platform.

FIG. 1 Elevator Capacity, Speed, and Size

The hoistway shall be of steel construction so arranged as to prevent the passage of flame or smoke from one level to another. The enclosing structure shall be of Class A fire resisting construction in accordance with SOLAS (International Convention for the Safety of Life at Sea).

7.1.2 Hoistways for elevators that serve one or more grating levels and which pierce no solid decks (as for engine rooms, cargo holds, or pump rooms) may be of the open type (such as, suitable enclosed with wire mesh or expanded metal).

7.2 *Hoistway Doors* (see 5.1.6):

7.2.1 All elevator hoistway-landing openings shall be provided with entrances, as required by the ordering information, which shall guard the full height and width of the openings. The door shall be steel and of Class "A" fire-resistant construction. Hoistway doors shall be power operated (except for emergency feature) and shall be one of the following types:

7.2.1.1 Horizontal slide.

7.2.1.2 Vertical slide which slide up to open.

7.2.1.3 Hinged.

7.2.2 *Closing of Hoistway Doors*—Hoistway doors shall be provided with door-closers arranged to close an open door automatically if the car for any reason leaves the landing zone. Hoistway doors will remain closed except when passengers or stores are entering or exiting the elevator car.

7.2.3 *Opening of Hoistway Doors from Hoistway Side*—Hoistway doors shall be so arranged that they may be opened by hand (under emergency conditions) from the hoistway side when the car is within the interlock unlocking zone except when locked "out of service" by use of an emergency key.

7.2.4 *Hoistway Door Counterweight Guides and Enclosures*—Hoistway door counterweights, where used, shall run in metal guides or shall be boxed in. The bottom of the guides or boxes shall be so constructed as to retain the counterweight if the counterweight suspension means breaks.

7.3 *Hoistway Escape Door*—A hoistway escape door shall be provided (where there is no other access to the hoistway) at every third deck, but not more than 36 ft (11 m) apart.

7.4 An elevator pit shall be provided for every elevator.

7.4.1 Safe and convenient access shall be provided to all pits, and shall conform to the following:

7.4.1.1 Access may be by means of the lowest hoistway door or by means of a separate pit access door.

7.4.1.2 Access to pit shall be provided by the hoistway ladder (see 7.6).

7.4.2 *Pit Access Door*—Where a separate pit access door is provided, it shall be self-closing and provided with a spring-type lock arranged to permit the door to be opened from inside the pit without a key. Such doors shall be kept locked.

7.4.3 *Pit Lighting*—A permanent lighting fixture shall be provided in all pits, and shall provide an illumination of not less than 5 footcandles at the pit floor. A light switch shall be provided and shall be so located as to be accessible from the pit

access door (or lowest hoistway door if used for pit access).

7.4.4 *Stop Switch in Pit*—This switch shall be so located as to be accessible from the pit access door. Where access to the pits of elevators in a multiple hoistway is by means of a single access door, the stop switch for each elevator shall be located adjacent to the nearest point of access to its pit from the access door.

7.4.5 *Pit Receptacle*—A 115 VAC, 3-pole, 2-wire watertight duplex receptacle shall be installed in the pit area.

7.4.6 *Minimum Depth of Pit* (see 5.1.20)—The pit depth as required by ordering information shall be not less than is required for the installation of the buffers, compensating sheaves if any, and all other elevator equipment located therein, and to provide the minimum bottom clearance and overtravel as required.

7.4.7 *Pit Drain*—Means shall be provided for draining the elevator pit.

7.5 *Venting of Hoistway*—A mechanical hoistway ventilation system shall provide at least 5 air changes/h. Supply air shall be taken from an adjacent passageway at the highest level. The supply air duct shall be fitted with a manual fire damper. Air shall be mechanically exhausted at the lowest deck level in the superstructure. The exhaust duct shall also be fitted with a manual fire damper.

7.6 *Hoistway Ladder*—A fixed vertical ladder constructed of noncombustible material shall run the entire length of the hoistway.

8. Machinery

8.1 *Machine Room* (see 5.1.8)*:*

8.1.1 Spaces containing machines, control equipment, sheaves, and other machinery shall be enclosed in steel. Enclosures and access doors thereto shall have a fire-resistance rating at least equal to that required for the hoistway enclosure.

8.1.2 A permanent, safe, and convenient means of access to elevator machine rooms and overhead machinery spaces shall be provided for authorized persons (see 5.1.9).

8.1.3 Access doors shall be self-closing and provided with a spring-type lock arranged to permit the door to be opened from inside the machine room without a key. The door shall be kept closed and locked.

8.1.4 Permanent electric lighting shall be provided in all machine rooms and spaces. Illumination shall be not less than 10 footcandles at the floor level. Lighting control switch shall be located within easy reach. Lighting fixtures shall be in accordance with Underwriters' Laboratories Bulletin UL 595.

8.1.5 *Machine Room Receptacle*—A 115 VAC, 3-pole, 2-wire watertight duplex receptacle shall be installed in the machine room.

8.1.6 *Ventilation*—Machine rooms, if independent of hoistway, shall be ventilated with natural air supply and mechanical exhaust based on 10 air changes/h.

8.2 *Driving Machines and Sheaves*—Driving machines shall be of the winding drum or traction type.

8.2.1 *Material and Grooving for Sheaves and Drums*—Sheaves and drums used with suspension and compensating ropes shall have metal finished grooves, and have a pitch diameter of not less than 40 times the diameter of the rope, where used with suspension ropes, or 32 times the diameter of the rope, when used with compensating ropes.

8.2.2 *Shaft Fillets and Keys*—A fillet shall be provided at any point of change in the diameter of driving-machine shafts and sheave shafts to reduce stress concentrations in the shafts. Shafts that support drums, sheaves, gears, couplings, and other members, and that transmit torque, shall be provided with tight-fitting keys.

8.2.3 *Cast-Iron Worms and Worm Gears*—Worms and worm gears made of cast-iron shall not be used in elevator driving machines.

8.2.4 *Friction Gearing and Clutching*—Friction gearing or a clutch mechanism shall not be used to connect a drive-machine drum or sheave to a main driving mechanism.

8.2.5 *Driving Machine Brakes*—The elevator driving machine shall be equipped with a spring-applied friction brake that shall be capable of holding the maximum load weight (rated load plus weight of car) plus 50 % of the rated load. The brake shall be released by application of electric power to the driving machine. Brake release shall be timed so that the brake is not released prior to the development of sufficient torque in the drive motor to support the loaded elevator car's weight.

8.3 *Hoisting Ropes*—Elevator cars shall be suspended by steel wire ropes attached to the car frame or passing around sheaves attached to the car frame. Hoisting ropes shall be made up of 8 strands for longer life and certified by the manufacturer as suitable for elevator service. The minimum number of hoisting ropes to be used shall be 3 for traction type elevators and 2 for winding drum type. The minimum hoisting rope diameter shall be 0.5 in. (12.7 mm). The minimum factor of safety for each hoisting rope shall be 8 based on the maximum operating load and nominal breaking strength of the cable.

8.4 *Counterweights*:

8.4.1 The counterweight weight sections shall be mounted in structural or formed metal frames so designed as to retain the weights securely in place. Individual weights shall be restrained so as to prevent movement when the ship is rolling in a heavy sea. The counterweight may be of fabricated welded construction in lieu of individual sections. This type of construction does not require frames and rods.

8.4.2 Counterweight frames shall be guided on each guide rail by upper and lower guiding members attached to the frame. Counterweight frames shall run in separate guide rails and shall be of sufficient weight to prevent slackening of the hoisting ropes during acceleration or retardation of the elevator car. The counterweight guide rails shall be guarded by removable wire mesh enclosures in the pit area.

8.4.3 *Design Requirements for Frames and Rods*—Frames and rods shall be made of steel conforming to 9.1.2. Where steels of greater strength than those specified, the factor of safety in design shall be not less than five (based on the ultimate strength of the material) with the elevator at rest and the counterweight at the top of its travel.

8.4.4 *Sheaves*—Where a hoisting sheave or sheaves are mounted in the frame, the requirements of 9.1.6 shall apply.

8.4.5 *Compensating Rope Fastening*—Compensating ropes shall be fastened to the counterweight frame directly or to a bracket fastened to the frame and shall not be fastened to the tie rods. When compensating ropes are used with a tension sheave,

one end of each rope shall be provided with a shackle-rod, or other means that provide for individual adjustment of rope length.

8.5 *Car and Counterweight Guides* (see 5.1.15)*:*

8.5.1 Guide rails, guide rail brackets, rail clips, fishplates, and their fasteners shall be of steel and other metals conforming to the requirements of this section.

8.5.2 Steel where used, shall conform to the following:

8.5.2.1 Rails, brackets, fishplates, and rail clips shall be made of steel or its equivalent having an ultimate tensile strength of not less than 55 000 lb/in. (380 MPa) and having an elongation of not less than 22 % in a length of 2 in. (5.08 cm). Maximum stress shall not exceed 75 % of the yield strength of the material.

8.5.3 Metals other than steel may be used provided the maximum stress specified in 6.3.1 is not exceeded. Cast iron shall not be used.

8.5.4 *Rail Section*—Guide rails for cars and counterweights shall be T-section conforming to the nominal weights and dimensions shown in Fig. 2.

8.5.5 *Overall Length of Guide Rails*—The top and bottom ends of each run of guide rail shall be so located in relation to the extreme positions of travel of the car. The car counterweight and counterweight guiding members cannot travel beyond the ends of the guide rails, including overtravel to elevator pit buffers, and to two-block point of hoisting wire rig in trunk overhead.

8.5.6 *Guide Rail Brackets*—Guide rail brackets and their supports shall be designed to safely withstand the application of the car or counterweight safety when stopping the car at its rated load or the counterweight. Guide rails shall be secured to their brackets by clips, by welding, or by bolts.

8.6 *Car and Counterweight Buffers*—Buffers of the spring, oil, or equivalent self recovering type shall be installed under the cars and counterweights of all elevators. Buffers shall be located symmetrically with reference to the vertical center line of the car frame or the counterweight frame.

8.7 *Bottom and Top Clearance and Runbys for Elevator Cars and Counterweights*—Elevator car and counterweight runbys shall be calculated as follows or as provided by the ordering activity (see 5.1.15 and 5.1.23).

8.7.1 *Bottom Car Clearance*—When the car rests on its fully compressed buffer, there shall be a maximum vertical clearance of not less than 2 ft (0.61 m) (or as specified by the ordering information) between the pit floor 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-in. (0.305 m) horizontally from the sides of the car platform.

8.7.2 *Top Car Clearances for Counterweighted Elevators*—The top car clearance shall be no less than the sum of the following:

8.7.2.1 The bottom counterweight overtravel,

8.7.2.2 The stroke of the counterweight buffer, plus 50 %, and

8.7.2.3 A distance of 2 ft 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.

8.7.3 *Top Overtravel Clearances for Uncounterweighted Elevators*—The top car clearance shall be no less than 2½ ft (0.77 m) or 6 in. (152.4 mm) plus the amount which any equipment mounted on the car crosshead, or above the car top

Guide Rail Dimensions (Inch-pound Units)

Nominal Weight/ft, in lb	Nominal Dimensions in Inches				
	A	*B*	*C*	*D*	*E*
8	2 7/16	3 ½	⅝	1 ¼	5/16
15	3 ½	5	⅝	1 31/32	½

Guide Rail Dimensions (SI Units)

Nominal Weight/305 mm, in kg	Nominal Dimensions in Millimetres				
	A	*B*	*C*	*D*	*E*
3.6	61.9	88.9	15.9	31.7	7.9
6.8	88.9	127.0	15.9	50.0	12.7

FIG. 2 Guide Rail

when no crosshead is provided, exceeds 2 ft.

8.7.4 *Top Counterweight Clearances*—The top counterweight clearance shall be no less than the sum of the following:

8.7.4.1 The bottom car overtravel,

8.7.4.2 The stroke of the counterweight buffer, plus 50 %, plus 6 in. (152.9 mm).

8.7.5 *Refuge Space on Top of Car Enclosure*—An unobstructed area of not less than 6 ft shall be provided on top of the car enclosure for refuge space. The minimum vertical distance in the refuge area between the top of the car enclosure and the overhead structure or other obstruction shall be not less than 42 in. (1.07 m) when the car has reached its maximum upward movement.

8.8 *Horizontal Clearances*:

8.8.1 *Horizontal Clearance Between Car and Hoistway*—The clearance between the car and the hoistway enclosure shall be not less than¾ in. (19 mm) except on the sides used for loading and unloading.

8.8.2 *Horizontal Clearance Between Car and Counterweight and Counterweight Screen*—The clearance between the car and the counterweight shall be not less than 1 in. The clearance between counterweight and the counterweight screen and between the counterweight and the hoistway enclosure shall be not less than¾in. (19 mm).

8.8.3 *Horizontal Clearance Between Car and Landing Sill*—The clearance between the car-platform sill and the hoistway edge of any landing sill shall be not less than ½ in. (12.7 mm) where side guides are used, and not less than¾ in. (19 mm) where corner guides are used. The maximum clearance shall be not more than 1¾-in. (38 mm).

8.8.4 *Horizontal Clearance Between Loading Side of Car Platforms and Hoistway Enclosures*—The clearance between the edge of the car platform sill and the hoistway enclosure or fascia plate for the full width of the clear hoistway door opening shall be not more than 5 in. (12.7 cm).

8.8.5 *Measurement of Clearances*—The clearances specified in this rule shall be measured with no load on the car platform.

9. Elevator Car

9.1 *Car Frame and Enclosures*:

9.1.1 Car frames, platforms, and enclosures (as required by ordering information) shall be of steel construction designed to withstand forces resulting from rated loads and from motion of the vessel. Car frames shall be guided on each guide rail by upper and lower guide shoes or rollers attached to the frame. Guide shoes or rollers shall be proven design modified and reinforced as necessary to provide for loading resulting from motion of the vessel. Car platforms and enclosures shall be of non-perforated material properly stiffened and attached to car frame.

9.1.2 Steel used in the construction of car frames and platforms shall be rolled, formed, forged, or cast conforming to the requirements of the following ASTM specifications:

9.1.2.1 Rolled and formed steel, Specification A 36 or A 283, Grade D.

9.1.2.2 Forged steel, Specification A 668, Class C.

9.1.2.3 Cast steel, Specification A 27/A 27M, Grade 60/30.

9.1.3 Rivets, bolts, and rods shall conform to the following ASTM specifications:

9.1.3.1 Rivets, Specification A 502.

9.1.3.2 Bolts and rods, Specification A 307.

9.1.3.3 Nuts, Specification A 563.

9.1.4 *Passenger Elevator Cars*—Car enclosures shall be permanently enclosed on all sides except sides used for entrance and exit. The car enclosure shall be securely fastened to the car platform and so supported that it cannot loosen or become displaced in ordinary service or on application of the car safety or on buffer engagement.

9.1.5 *Car Frame and Platform Connections*—Connections between members of car frames and platforms shall be riveted, bolted, or welded. Where used through greater than 5° sloping flanges of structural members, bolts shall have bolt-heads of the tripped-head type or shall be fitted with beveled washers.

9.1.6 *Car Frames and Crosshead Sheaves*—Where a hoist ing-rope sheave is mounted on the car frame, the construction shall conform to the following:

9.1.6.1 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.

9.1.6.2 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.

9.1.6.3 Where the sheave is attached to the car crosshead by means of a single threaded rod or specially designed member or members in tension, the single rod, member or members, in tension shall have a factor of safety of at least 15.

9.1.7 *Car Enclosure Tops*—Tops of car enclosures shall be so designed and installed as to be capable of sustaining a load of 300 lb (136 kg) on any 2 ftarea (0.61 m) on a side and 100 lb (45.4 kg) applied at any point. Simultaneous application of these loads is not required. A working platform or equipment that is not required for the operation of the elevator or its appliances, except where specifically provided herein, shall not be located above the top of an elevator car.

9.1.8 *Car Enclosure Walls*—The car enclosure walls shall be of such strength and so designed and supported that when subjected to a pressure of 75 lb (34.0 kg) applied horizontally at any point on the walls of the enclosure, the deflection shall not reduce the running clearance below the minimum specified nor to exceed 1 in. (25.4 mm).

9.1.9 *Equipment Prohibited Inside Cars*—Apparatus or equipment, other than that used in connection with the operation of the elevator shall not be installed inside any elevator car.

9.1.10 *Material for Enclosures and Enclosure Linings*—Materials for car enclosures and enclosure linings shall be metal or USCG approved bulkhead panels in accordance with 46 CFR 164.008. No slow-burning combustible materials for insulating, sound deadening, or decorative purposes may be used for lining enclosures. The interior of the car shall be a melamine laminate in accordance with NEMA-LD-3 and the