ECNY

NYC ELEVATOR CODE UPDATE SEMINAR "OVERVIEW OF RECENT CHANGES"

Presented by:

The ECNY Team

Wednesday, March 12, 2014

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AGENDA

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1. **Introduction – R. Cuzzi**
2. **Overview of NYC Elevator Division – H. Vyas**
3. **Licensing Requirements – A. Norflett**
4. **Building Special Investigations Unit – M. Assa**
5. **Overview of Recent Code Changes:**
   - **Article 304 - R. Cuzzi**
   - **Chapter 30 - R. Cuzzi**
   - **Chapter K1 - J. Duffy**
   - **Chapter K2 - P. McPartland**
   - **Chapter K3 - J. Duffy**
   - **Chapter K4 - W. Locker**
6. **Questions/Answers - All**

   N. Montesano - Moderator

ARTICLE 304
PERIODIC INSPECTION OF ELEVATORS AND CONVEYING SYSTEMS

§28-304.1 General. Elevators and conveying systems shall be maintained in a safe condition and in accordance with ASME A17.1, as modified by Appendix K of the New York city building code. Every new and existing elevator or conveying system shall be inspected and tested in accordance with the schedule set forth in this article.

Note: Table N1, as used herein, shall mean Table N1 of Appendix K, Chapter K1 of New York City.

§28-304.2 Elevators, escalators, moving walkways, material lifts, man lifts and dumbwaiters. Elevators, escalators, moving walkways, material lifts, VRC's and dumbwaiters shall be inspected and tested in accordance with the schedule set forth in Table N1 of ASME 17.1 as referenced in chapter 35 and as may be modified in chapter 30 and appendix K of the New York city building code.

> **Exception:** Elevators located in one-family, two-family or multiple-family dwellings that service only a single owner-occupied dwelling unit which is not occupied by boarders, roomers or lodgers, and elevators located within convents and rectories that are not open to non-occupants on a regular basis are not subject to periodic inspection requirement of such reference standard. Inspections and tests shall be performed in accordance with Table N1.

§28-304.3 Chair lifts and stairway chair lifts and vertical reciprocating conveyors (VRCs). Chair lifts, stairway chair lifts and VRCs shall be inspected and tested at intervals not exceeding one year. Inspections and tests shall be performed in accordance with Table N1.

§28-304.4 Amusement devices. Amusement devices shall be inspected and tested in accordance with department rules.

§28-304.5 Frequency of inspection and testing. Elevators and other conveying systems may be subject to more frequent inspection and testing as the commissioner finds necessary to protect public safety.

§28-304.6 Inspection and testing process. All devices shall be inspected and tested in accordance with sections 28-304.6.1 through 28-304.6.6. Inspections and tests shall be performed in accordance with Table N1.

> **§28-304.6.1 Inspection and testing entities.**
> The required periodic inspections in Table N1 shall be made by the department. The other tests and inspections in Table N1 shall be performed on behalf of the owner by an approved agency in accordance with this code and department rules. Where indicated in Table N1, tests and inspections shall be witnessed by an approved agency not affiliated with the agency performing the test. Not affiliated, as used in this section, shall mean the approved agency owners, directors and inspectors shall be independent of all relative approved agencies, maintenance firms or other entities providing any associated services to the device owner. Such other tests and inspections shall comply with the timeframes established as follows:
> 1. Category 1 tests shall be performed between January 1st and December 31st of each year at a minimal time interval of six (6) months from the date of the previous Category One testing. Category 1 tests are required on new installations the calendar year following the final acceptance test.
> 2. Category 3 tests for water hydraulics shall be performed every three (3) years on or before the anniversary month of the last Category 3 testing.
> 3. Category 5 tests shall be performed every five years on or before the month of the final acceptance test for new elevators or the anniversary month of the last Category 5 testing.
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> **§28-304.6.1.1 Department notification.** The department shall be notified by the performing agency at least seven days prior to the Category 1 testing

of escalators, Category 3 testing of water hydraulic elevators and Category 5 testing of elevators pursuant to the rules of the department.

§28-304.6.2 Scope. During periodic inspection and testing, in addition to any other requirements prescribed by this code, all parts of the equipment shall be inspected to determine that they are in safe operating condition and that parts subject to wear have not worn to such an extent as to affect the safe and reliable operation of the installation.

§28-304.6.3 Reporting an unsafe or hazardous condition. If an inspection or test reveals that any elevator or other conveying system is unsafe or hazardous to life and safety, the device is to be taken out of service immediately by the agency performing the inspection or test and the building owner notified immediately. The performing agency shall notify the department by telephone, electronically or in writing within 24 hours.

§28-304.6.4 Field Inspection Report and Notation on the Inspection Certificate.
Field inspection reports and notations on the inspection certificate shall comply with the requirements of Sections 28-304.6.4.1 and 28-304.6.4.2.

28-304.6.4.1 When no witnessing agency is required. When no witnessing agency is required to witness inspections and tests under Table N1, the performing inspector shall, on the day of each inspection and test: (i) complete the field inspection and test report, documenting all violating conditions, if any, and affix his or her signature; (ii) provide a copy of such report to the owner or owner's representative; and (iii) affix the inspection date and his or her signature over a stamp identifying his or her approved agency and his or her approval number on the inspection certificate issued by the department attesting to the completion of items (i) and (ii).

28-304.6.4.2 When a witnessing agency is required. When a witnessing agency is required to witness inspections and tests under Table N1, the performing inspector shall, on the day of each inspection and test complete the field inspection and test report, documenting all violating conditions, if any, and affix his or her signature. The witnessing agency inspector shall, on the day of each inspection and test: (i) review and confirm the field inspection report and also affix his or her signature to it; (ii) provide a copy of such report to the owner or owner's representative; and (iii) affix the inspection date and his or her signature over a stamp identifying his or her approved agency and his or her approval number on the inspection certificate issued by the department attesting to the completion of items (i) and (ii).

§28-304.6.5 Inspection and test reports submission. Inspection and test reports shall be submitted on such forms and in such manner as required by the commissioner. Such reports shall comply with the following department rules:

1. The inspection and test reports shall contain signatures of (i) the performing agency inspector and director, (ii) the witnessing agency inspector and director, and (iii) the building owner.

2. The completed inspection and test reports, with all applicable signatures, shall be delivered to the owner by the approved performing and/or witnessing agency within 30 days of the test listing all violating conditions for each device tested, and filed with the department within 60 days after the date of the test by the owner or its authorized designee.

Exception: Inspection and test reports are not required to be submitted to the department for private residence

wheelchair lifts and private residence dumbwaiters devices. However, the owner shall maintain an inspection and test log to be available to the department upon request.

§28-304.6.6 Repair. All defects as found in such inspection and test reports shall be corrected within 120 days after the date of inspection and test, except all hazardous conditions shall be corrected immediately. An affirmation of correction shall be filed within 60 days of the date of correction.

§28-304.7 Required contract. The owner of all new and existing passenger elevators and escalators shall have a contract with an approved agency to perform elevator and escalator maintenance, repair and replacement work as defined by ASME 17.1 as modified by Chapter K1 of Appendix K of the New York City building code. The name, address and telephone number of such agency shall be maintained at each premises, on the mainline disconnect switch and in a location readily accessible to employees of the department and to maintenance and custodial staff at the premises.

§28-304.8 Fees. Every owner of elevators and other devices shall pay to the department an inspection fee and a report filing fee for each elevator or device in the amount prescribed by this code.

§28-304.9 Additional inspections. The commissioner may make such additional inspections as required to enforce the provisions of this code. No fee shall be charged for such additional inspections.

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CHAPTER 30

CHAPTER 30

SECTION BC 3001
GENERAL:

3001.1 Scope. This chapter establishes the minimum safety requirements for and governs the design, construction, installation, alteration, maintenance, inspection, test and operation of elevators, dumbwaiters, escalators, moving walks, industrial lifts and loading ramps, mechanical parking equipment, console or stage lifts, power-operated scaffolds, amusement devices, and special hoisting and conveying equipment. This chapter and all the provisions of this code for new installations shall also apply to elevators in existing buildings moved to new hoistways. High-rise building elevators shall also conform to the provisions of Section 403 of this code.

Exception: Personnel and material hoists used for construction operations subject to the requirements of Chapter 33.

3001.2 Referenced standards. Except as otherwise provided for in this code, the design, construction, installation, alteration, repair and maintenance of elevators and other conveying systems and their components shall conform to ASME A17.1 as modified by Appendix K, Chapter K1, ASME A17.2, ASME A18.1, ASME A17.3 as modified by Appendix K, Chapter K3, ASME A17.5, ASME A17.1S as modified by Appendix K, Chapter K4, ASME A90.1, ASME B20.1 as modified by Appendix K, Chapter K2, ALI ALCTV, and for construction in areas of special flood hazard, Appendix G.

3001.3 Accessibility. The following elevators and lifts shall conform to ICC A117.1:

1. Passenger elevators, including destination-oriented elevators, required to be accessible by Chapter 11;

2. Limited-Use / Limited-Application (LULA) elevators permitted to be installed on an accessible route pursuant to Section 1109.6.1;

3. Platform lifts permitted to be installed on an accessible route pursuant to Section 1109.7; and

4. Private residence elevators serving within an individual dwelling unit in Groups R-2 and R-3 occupancies on an accessible route.

3001.4 Change in use. A change in use of an elevator from freight to passenger, passenger to freight, or from one freight class to another freight class shall comply with Section 8.7 of ASME A17.1/CSA B44.

3001.5 Piping or ductwork. No piping or ductwork of any kind shall be permitted within hoistway or elevator enclosures except:

1. As required for the elevator installation; and

2. Low-voltage wiring less than 50 volts required for fire alarm systems required by this code.

3001.6 Elevator mirrors. A mirror shall be installed in each self-service passenger elevator in multiple dwellings. Such mirror shall be affixed and maintained in a manner sufficient to enable persons entering such elevator to view the inside thereof prior to entry to determine whether any person is in the elevator.

3001.7 Car switch operation. Elevators with car switch operation (manual operation) shall be provided with a signal system by means of which signals can be given from any landing whenever the elevator is desired at that landing.

3001.8 Prohibited devices. The following devices shall be prohibited:

3001.8.1 Manlifts. The installation of manlifts is prohibited.

3001.8.2 Sidewalk elevators. The installation of sidewalk elevators located outside the street line is prohibited.

3001.9 Approved equipment. All equipment listed in ASME A17.1., Section 8.3, as modified by New York City Building Code, Appendix K, Chapter K1, shall be approved by the commissioner.

3001.10 Construction documents. Applications for elevator, escalator, moving walkway and stairway, dumbwaiter, and similar equipment shall contain construction documents that include the following:

1. The location of all machinery, switchboards, junction boxes, and reaction points, with loads indicated;
2. The details of all hoistway conditions including bracket spacing;
3. The estimated maximum vertical forces on the guide ails on application of the safety device;
4. In the case of freight elevators for Class B or C loading, the horizontal forces on the guide-rail faces during loading and unloading; and the estimated maximum horizontal forces in a postwise direction on the guide-rail faces on application of the safety device;
5. The size and weight per foot of any rail reinforcements where provided;
6. Compliance with the accessibility features of this code;
7. The details of capability of the withstanding forces (impact) on door entrance assembly and retaining devices;
8. The withstanding hourly fire rating of the hoistway and the hoistway door assembly;
9. The impact loads imposed on machinery and sheave beams, supports and floors or foundations;
10. The impact load on buffer supports due to buffer engagement at the maximum permissible speed and load;
11. Where compensation tie down is applied, the load on the compensation tie down supports; and
12. The total static and dynamic loads from the governor, buffer and tension system.

3001.11 Special provisions for prior code buildings. Prior code buildings shall be permitted to comply with Section 3001.11.1.

3001.11.1 Existing shafts. Elevators cabs installed in existing shafts shall be permitted to be smaller than that required by this chapter where necessary to fit in the existing shaft, unless a larger cab size is otherwise mandated pursuant to Section 1101.3.

SECTION BC 3002
HOISTWAY ENCLOSURES

3002.1 Hoistway enclosure protection. Elevator, dumbwaiter and other hoistway enclosures shall be shaft enclosures complying with Section 708.

3002.1.1 Opening protectives. Openings in hoistway enclosures shall be protected as required in Chapter 7.

Exception: The elevator car doors and the associated hoistway enclosure doors at the floor level designated for recall in accordance with Section 3003.2 shall be permitted to remain open during Phase I Emergency Recall Operation.

3002.1.2 Hardware. Hardware on opening protectives shall be of an approved type installed as tested, except that approved interlocks, mechanical locks and electric contacts, door and gate electric contacts and door-operating mechanisms shall be exempt from the fire test requirements.

3002.2 Number of elevator cars in a hoistway. Where four or more elevator cars serve all or the same portion of a building, the elevators shall be located in at least two separate hoistways. Not more than four elevator cars shall be located in any single hoistway enclosure.

3002.3 Emergency signs. A sign shall be posted and maintained on every floor at the elevator landing. The sign shall read "IN FIRE EMERGENCY, DO NOT USE ELEVATOR. USE THE EXIT STAIRS". The lettering shall be at least one-half inch block letters in red with white background or as otherwise approved by the commissioner. Such lettering shall be properly spaced to provide good legibility. The sign shall also contain a diagram showing the location where it is posted and the location and letter identification of the stairs on the floor. The sign shall be at least ten inches by twelve inches, located directly above a call button and securely attached to the wall or partition. The top of such sign shall be above six feet from the floor level. The diagram on such sign may be omitted provided that signs containing such diagram are posted in conspicuous places on the respective floor. In such case, the sign at the elevator landing shall be at least two and one half inches by ten inches and the diagram signs shall be at least eight inches by twelve inches.

3002.3.1 Stair and elevator identification signs. Each stair and each bank of elevators shall be identified by an alphabetic letter. A sign indicating the letter of identification for the elevator bank shall be posted and maintained at each elevator landing directly above or as part of the sign specified in Section 3002.3. The stair identification sign shall be posted and maintained on the occupancy side of the stair door. The letter on the sign shall be at least three inches high, of bold type and of contrasting color from the background. Such signs shall be securely attached.

Exceptions:

1. The emergency sign shall not be required for elevators that are part of an accessible means of egress complying with Section 1007.4.

2. The emergency sign shall not be required for elevators that are used for occupant self-evacuation in accordance with Section 3008.

3002.4 Elevator car to accommodate ambulance stretcher. In buildings five stories in height or more, at least one elevator shall provide access to all floors.

3002.4.1 Standby power required for elevators. Emergency power shall be provided to elevators in the following categories:

1. Elevator(s) in high-rise buildings covered by Section 403.1, other than R-2 occupancies, as required by Section 403.4.8.1;

2. Elevator(s) in high-rise buildings in R-2 occupancies more than 125 feet (38 100 mm) in height, as required by Section 403.4.8.2;

3. Elevator(s) in underground buildings, as required by Section 405.4.3;

4. Elevator(s) in Groups B, E, and R-1 occupancies that are subject to Section 2702.2.20; and

5. Elevator(s) serving as accessible means of egress pursuant to Section 1007.4.

3002.4.2 Elevator car to accommodate ambulance stretcher. Where elevators are provided in buildings five stories in height or more, or underground buildings as described in Section 405.1, at least one elevator subject to Section 3003.3 shall be provided with an elevator car of such a size and arrangement to accommodate an ambulance stretcher 24-inches by 84 inches (610 mm by 2134 mm), with not less than 5-inch (127 mm) radius corners, in the horizontal, open position and shall be identified by the international symbol for emergency medical services (star of life). The symbol shall not be less than 3 inches (76 mm) high and shall be placed on both jambs of the hoistway entrances on each floor. Standby power shall be required for such an elevator if it serves a building subject to Section 3002.4.1.

Exceptions:

1. An elevator serving not more than one individual dwelling unit in a building,

regardless of height and number of stories of such a building.

2. Limited-Use/Limited-Application (LULA) elevators (25 feet maximum rise).

3002.5 Emergency doors. Where an elevator is installed in a single blind hoistway or on the outside of a building, there shall be installed in the blind portion of the hoistway or blank face of the building, an emergency door in accordance with ASME A17.1.

3002.6 Prohibited doors. Doors, other than hoistway doors and the elevator car door, shall be prohibited at the point of access to an elevator car unless such doors are readily openable from the car side without a key, tool, special knowledge or effort.

3002.7 Common enclosure with stairway. Elevators shall not be in a common shaft enclosure with a stairway.

Exception: Open parking garages.

3002.8 Glass in elevator enclosures. Glass in elevator enclosures shall comply with Section 2409.1 and ASME A17.1.

SECTION BC 3003
EMERGENCY OPERATIONS

3003.1 Standby power. In buildings and structures where standby power is required or furnished to operate an elevator, the operation shall be in accordance with Sections 3003.1.1 through 3003.1.4.

3003.1.1 Manual transfer. Standby power shall be manually transferable to all elevators in each bank.

3003.1.2 One elevator. Where only one elevator is installed, the elevator shall automatically transfer to standby power within 60 seconds after failure of normal power.

3003.1.3 Two or more elevators. Where two or more elevators are controlled by a common operating system, all elevators shall automatically transfer to standby power within 60 seconds after failure of normal power where the standby power source is of sufficient capacity to operate all elevators at the same time. Where the standby power source is not of sufficient capacity to operate all elevators at the same time, all elevators shall transfer to standby power in sequence, return to the designated landing and disconnect from the standby power source. After all elevators have been returned to the designated level, at least one elevator shall remain operable from the standby power source.

3003.1.4 Venting. Where standby power is connected to elevators, the machine room ventilation or air conditioning shall be connected to the standby power source.

3003.2 Fire-fighters' emergency operation. Elevators shall be provided with Phase I emergency recall operation and Phase II emergency in-car operation in accordance with ASME A17.1 as modified by Appendix K.

3003.3 Elevator in readiness.
Requirements for elevator in readiness shall be as defined in Sections 3003.3.1 through 3003.3.2.

3003.3.1 Elevator in readiness for Fire Department emergency access. Except as provided in Section 3003.3.2, in buildings five stories in height or more, underground buildings as described in Section 405.1, and high-rise buildings, all floors shall be served by at least one elevator that shall be kept available for immediate use by the Fire Department during all hours of the night and day, including holidays, Saturdays and Sundays. There shall be available at all times a person competent to operate the elevator. However, an attendant shall not be required for buildings with occupied floors of 150 feet (45 720mm) or less above the lowest level of the Fire Department vehicle access that have elevators with automatic or continuous pressure operation with keyed

switches meeting the requirements of ASME A17.1 as modified by Appendix K so as to permit sole use of the elevators by the Fire Department.

3003.3.2 Number of elevators. A number of elevators shall be kept available at every floor for the sole use of the Fire Department as required by Sections 3003.3.2.1 and 3003.3.2.2. This requirement shall apply to the following types of buildings:

1. High-rise buildings with occupancies classified in Groups A, B, E, I, F, H, M and S;
2. Buildings with Group B occupancies with a gross area of 200,000 square feet (18 581 m²); and
3. Buildings with a main use or dominant occupancy in Group R-1 or R-2.

Exception: In buildings that are five stories or more in height but are not one of the types of buildings described in Item 1 through 3 in Section 3003.3.2, at least one elevator car in such buildings shall be kept available for sole use by the Fire Department.

SECTION BC 3004
HOISTWAY VENTING

3004.1 RESERVED

3004.2 RESERVED

3004.3 RESERVED

3004.4 Plumbing and mechanical systems. Plumbing and mechanical systems shall not be located in an elevator shaft.

Exception: Floor drains, sumps and sump pumps shall be permitted at the base of the shaft provided they are indirectly connected to the plumbing system.

3004.5 Control of smoke and hot gases. Hoistways of elevators shall be provided with any one of the following means to prevent the accumulation of smoke and hot gases in case of fire in accordance with Sections 3004.5.1 through 3004.5.4.

3004.5.1 Vents in the hoistway enclosures. Hoistway enclosures may be vented in accordance with the following:

1. Location of vents.

1.1. The vents in the side of the hoistway enclosure below the elevator machine room floor or in the roof of the hoistway shall open either directly to the outer air or through noncombustible ducts to the outer air.

1.2. The vents in the wall or roof of an overhead elevator machine room through the smoke hole in the top of the elevator hoistway shall be vented to the outer air through noncombustible ducts.

2. Area of vents. The area of vents in the hoistway or the elevator machine room and the smoke hole shall be not less than 31/2 percent of the area of the hoistway nor less than 3 square feet (0.28 m2) for each elevator car, whichever is greater. Such vents shall comply with the following requirements:

2.1. Open vents. Of the total required vent area, not less than one-third shall be permanently open or equipped with an openable hinged damper. The smoke hole shall be permanently open.

2.2. Closed vents. The two-thirds closed portion of the required vent area either in the hoistway enclosure or in the elevator machine room may consist of windows or skylights glazed with annealed glass not more than ⅛-inch (3.2 mm) thick. A closed damper that opens upon the activation of a smoke detector placed at the top of the hoistway shall be considered closed.

Exception: The total required open vent area shall not be required to be permanently open where all of the vent openings automatically open upon detection of smoke in the elevator lobbies or hoistway, upon power failure (except when provided with a code compliant standby power supply from an approved standby power source) or upon

activation of a manual override control. The manual override control shall be capable of opening and closing the vents and shall be located in an approved location.

3004.5.2 Mechanical ventilation of the hoistway enclosure. Hoistway enclosures may be mechanically vented. The system of mechanical ventilation shall be of sufficient capacity to exhaust at least 12 air changes per hour of the volume of such hoistways through a roof or an approved location on an exterior wall other than the lot line wall. Such system shall comply with the following requirements:

1. The smoke detector shall be placed at the top of the hoistway and shall activate the mechanical ventilation system.
2. Such mechanical ventilation system shall not pass through the overnight sleeping areas of a hotel, multiple dwelling, hospital or similar buildings.
3. Such mechanical ventilation system shall be equipped with a manual shut-off in or near the elevator control panel at the designated level.

3004.5.3 Air pressurization of hoistway enclosure. Hoistways may be air pressurized. Where such system is utilized, the air shall not cause erratic operation of the landing or car door equipment, traveling cables, selector tapes, governor ropes, compensating ropes, or any other components sensitive to excess movement or deflection.

3004.5.4 Alternate means. The commissioner may accept alternate means to prevent the accumulation of smoke and hot gases in the hoistways and machine rooms in case of fire.

SECTION BC 3005
CONVEYING SYSTEMS

3005.1 General. Conveying systems shall comply with the provisions of this section.

3005.2 Escalators and moving walks. Escalators and moving walks shall be constructed of approved noncombustible and fire-retardant materials. This requirement shall not apply to electrical equipment, wiring, wheels, handrails and the use of 1/28-inch (0.9 mm) wood veneers on balustrades backed up with noncombustible materials.

3005.2.1 Enclosure. Escalator floor openings shall be enclosed with shaft enclosures complying with Section 708.

3005.2.2 Escalators. Where provided in below-grade transportation stations, escalators shall have a clear width of 32 inches (815 mm) minimum.

Exception: The clear width is not required in existing facilities undergoing alterations.

3005.3 Conveyors. Conveyors and conveying systems shall comply with ASME B20.1.

3005.3.1 Enclosure. Conveyors and related equipment connecting successive floors or levels shall be enclosed with shaft enclosures complying with Section 708.

3005.3.2 Conveyor safeties. Power-operated conveyors, belts and other material-moving devices shall be equipped with automatic limit switches which will shut off the power in an emergency and automatically stop all operation of the device.

3005.4 RESERVED.

3005.5 Amusement devices. Amusement devices shall also comply with the rules of the department.

SECTION BC 3006
MACHINE ROOMS

3006.1 Access. An *approved* means of access shall be provided to elevator machine rooms and overhead machinery spaces.

3006.2 Venting. Elevator machine rooms that contain solid-state equipment for elevator operation shall be provided with an independent ventilation or air-conditioning system to protect against the overheating of the electrical equipment. The system shall be capable of maintaining temperatures within the range established for the elevator equipment.

3006.3 Pressurization. The elevator machine room serving a pressurized elevator hoistway shall be pressurized upon activation of a heat or smoke detector located in the elevator machine room.

3006.4 Machine rooms and machinery spaces. Elevator machine rooms and machinery spaces shall be enclosed with *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 712, or both. The *fire-resistance rating* shall not be less than the required rating of the hoistway enclosure served by the machinery. Openings in the *fire barriers* shall be protected with assemblies having a *fire protection rating* not less than that required for the hoistway enclosure doors.

Exception:
Where machine rooms and machinery spaces do not abut and have no openings to the hoistway enclosure they serve the *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 712, or both, shall be permitted to be reduced to a 1-hour *fire-resistance rating*.

3006.5 Sprinklers prohibited. Sprinklers are not permitted in elevator machine rooms.

3006.6 Plumbing systems. Plumbing systems not related to elevator machinery shall not be located in elevator equipment rooms.

3006.7 Elevator machinery noise control in multiple dwellings. Gear-driven machinery, gearless machinery, and motor generators located in an elevator machinery room or shaft on a roof, or on a floor other than a floor on grade, shall be supported on vibration isolator pads having a minimum thickness of ½ inch (12.7 mm).

SECTION BC 3007
FIRE SERVICE ACCESS ELEVATOR

3007.1 General. Where required by Section 403.6.1, every floor of the building shall be served by a fire service access elevator complying with Sections 3007.1 through 3007.8. Except as modified in this section, the fire service access elevator shall be installed in accordance with this chapter and rules of the department.

3007.2 Automatic sprinkler system. The building shall be equipped throughout by an automatic sprinkler system in accordance with Section 903.3.1.1, except as otherwise permitted by Section 903.3.1.1.1 and as prohibited by Section 3007.2.1.

3007.2.1 Prohibited locations. Automatic sprinklers shall not be installed in elevator machine rooms, machinery spaces, control rooms, control spaces, and elevator hoistways of fire service access elevators.

3007.2.2 Sprinkler system monitoring. The sprinkler system shall have a sprinkler control valve supervisory switch and waterflow-initiating device provided for each floor that is monitored by the building's fire alarm system.

3007.3 Water protection. An approved method to prevent water from infiltrating into the hoistway enclosure from the operation of the automatic sprinkler system shall be provided:

1. Where an elevator lobby is provided in accordance with Section 3007.6, with respect to the automatic sprinkler system outside of the enclosed elevator lobby.

2. Where a corridor is provided in accordance with Section 3007.6, Exception 2, with respect to the automatic sprinkler system outside of the corridor and with respect to the automatic sprinklers inside the corridor that are beyond 10 feet of the entrance to the hoistway enclosure of the fire service access elevator.

3. Where neither an enclosed elevator lobby nor a corridor is provided in accordance with Section 3007.6, Exception 3, with respect to the automatic sprinklers that are located beyond 10 feet of the entrance to the hoistway enclosure of the fire service access elevator.

3007.4 Reserved.

3007.5 Hoistway enclosures. The fire service access elevator hoistway shall be located in a shaft enclosure complying with Section 708.

3007.5.1 Structural integrity of hoistway enclosures. The fire service access elevator hoistway enclosure shall comply with Sections 403.2.3.1 through 403.2.3.4.

3007.5.2 Hoistway lighting. When firefighters' emergency operation is active, the entire height of the hoistway shall be illuminated at not less than 1 foot-candle (11 lux) as measured from the top of the car of each fire service access elevator.

3007.6 Fire service access elevator lobby. The fire service access elevator shall open into a fire service access elevator lobby in accordance with Sections 3007.6.1 through 3007.6.5. Egress is permitted through the elevator lobby in accordance with Section 708.14.1.

Exceptions:

1. Where a fire service access elevator has two entrances onto a floor, the second entrance shall be permitted to open into an elevator lobby in accordance with Section 708.14.1.

2. A fire service access elevator lobby shall not be required on stories where the elevator opens to a corridor enclosed with a fire barrier, provided all doors opening onto such corridor are smoke and draft controlled doors complying with Section 715.4.3.1 with the UL 1784 test conducted without the artificial bottom seal.

3. A fire service access elevator lobby shall not be required on stories that are that are less than 3,000 square feet (914.4 m2) containing only R-2 occupancies.

3007.6.1 Reserved.

3007.6.2 Lobby enclosure. The fire service access elevator lobby shall be enclosed with a smoke barrier having a fire-resistance rating of not less than one hour, except that lobby doorways shall comply with Section 3007.6.3.

Exception: Enclosed fire service access elevator lobbies are not required at the levels of exit discharge.

3007.6.3 Lobby doorways. Other than doors to the hoistway, elevator control room, or elevator control space, each doorway to a fire service access elevator lobby shall be provided with a 3/4-hour fire door assembly complying with Section 715.4. The fire door assembly shall also comply with the smoke and draft control door assembly requirements of Section 715.4.3.1 with the UL 1784 test conducted without the artificial bottom seal.

3007.6.4 Lobby size. The enclosed fire service access elevator lobby shall be a not less than 120 square feet (11 m2) in an area with a minimum dimension of 6 feet (1828 mm).

3007.6.5 Fire service access elevator symbol. A pictorial symbol of a standardized design designating which elevators are fire service access elevators

shall be installed on each side of the hoistway door frame on the portion of the frame at right angles to the fire service access elevator lobby. The fire service access elevator symbol shall be designed as shown in Figure 3007.6.5 and shall comply with the following:

1. The fire service access elevator symbol shall be not less than 3 inches (76 mm) in height.
2. The helmet shall contrast with the background, with either a light helmet on a dark background or a dark helmet on a light background.
3. The vertical center line of the fire service access elevator symbol shall be centered on the hoistway door frame. Each symbol shall not be less than 78 inches (1981 mm), and not more than 84 (2134 mm) inches above the finished floor at the threshold. 3 inches (76 mm)

3007.7 Elevator system monitoring. The fire service access elevator shall be continuously monitored at the fire command center by a standard emergency service interface system meeting the requirements of NFPA 72.

3007.8 Electrical power. The following features serving each fire service access elevator shall be supplied by both normal power and Type 60/Class 6/Level 1 standby power:

1. Elevator equipment.
2. Elevator hoistway lighting.
3. Ventilation and cooling equipment for elevator machine/control rooms, and machinery/control spaces.
4. Elevator car lighting.

Exception: Standby power relying on natural gas as a fuel source need not be Class 6.

3007.8.1 Protection of wiring or cables. Wires or cables that are located outside of the elevator hoistway and machine room and that provide normal or standby power, control signals, communication with the car, lighting, heating, air conditioning, ventilation and fire-detecting systems to fire service access elevators shall be protected by construction having a fire-resistance rating of not less than 2 hours, shall be a circuit integrity cable having a fire-resistance rating of not less than 2 hours, or shall be protected by a listed electrical circuit protective system having a fire-resistance rating of not less than 2 hours.

Exception: Wiring and cables to control signals are not required to be protected provided that wiring and cables do not serve Phase II emergency in-car operation.

3007.9 Reserved.

SECTION BC 3008
OCCUPANT EVACUATION ELEVATORS

3008.1 General. Where elevators are to be used for occupant self-evacuation during fires, all passenger elevators for general public use shall comply with Sections 3008.1 through 3008.11. Where other elevators are used for occupant self-evacuation, they shall also comply with these sections.

3008.1.1 Additional exit stairway. Where an additional means of egress is required in accordance with Section 403.5.2, an additional exit stairway shall not be required to be installed in buildings provided with occupant evacuation elevators complying with Section 3008.1.

3008.1.2 Fire safety and emergency action plans. The building shall have an approved fire safety and emergency action plans in accordance with the applicable requirements of the *New York City Fire Code*. The fire safety and emergency action plans shall incorporate specific procedures for the occupants using evacuation elevators.

3008.2 Operation. The occupant evacuation elevators shall be used for occupant self-evacuation in accordance with occupant evacuation operation requirements set forth

in rules of the department and the building's fire safety and emergency action plans.

3008.3 Automatic sprinkler system. The building shall be protected throughout by an approved, electrically-supervised automatic sprinkler system in accordance with Section 903.3.1.1, except as otherwise permitted by Section 903.3.1.1.1 and as prohibited by Section 3008.3.1.

3008.3.1 Prohibited locations. Automatic sprinklers shall not be installed in elevator machine rooms, machinery spaces, control rooms, control spaces, and elevator hoistways of occupant evacuation elevators.

3008.3.2 Sprinkler system monitoring. The sprinkler system shall have a sprinkler control valve supervisory switch and water flow initiating device provided for each floor that is monitored by the building's fire alarm system.

3008.4 Water protection. An approved method to prevent water from infiltrating into the hoistway enclosure from the operation of the automatic sprinkler system outside the enclosed occupant evacuation elevator lobby shall be provided.

3008.5 Reserved.

3008.6 Hoistway enclosure protection. Occupant evacuation elevator hoistways shall be located in shaft enclosures complying with Section 708.

3008.6.1 Structural integrity of hoistway enclosures. Occupant evacuation elevator hoistway enclosures shall comply with Sections 403.2.3.1 through 403.2.3.4.

3008.7 Occupant evacuation elevator lobby. The occupant evacuation elevators shall open into an elevator lobby in accordance with Sections 3008.7.1 through 3008.7.6. Egress is permitted through the elevator lobby in accordance with Section 708.14.1.

3008.7.1 Access to Interior exit stairway or ramp. The occupant evacuation elevator lobby shall have direct access from the enclosed elevator lobby to an interior exit stairway or ramp.

Exception: Access to an interior exit stairway or ramp shall be permitted to be through a protected path of travel protected with smoke partitions complying with Section 711. The protected path shall be separated from the enclosed elevator lobby through an opening protected by a smoke and draft control assembly in accordance Section 711.5.2.

3008.7.2 Lobby enclosure. The occupant evacuation elevator lobby shall be enclosed with a smoke barrier having a fire-resistance rating of not less than 1 hour, except that lobby doorways shall comply with Section 3008.7.3.

Exception: Enclosed occupant evacuation elevator lobbies are not required at the levels of exit discharge.

3008.7.3 Lobby doorways. Other than doors to the hoistway, and elevator machine rooms, machinery spaces, control rooms, and control spaces within the lobby enclosure smoke barrier, each doorway to an occupant evacuation elevator lobby shall comply with the smoke and draft control assembly requirements of Section 711.5.2 with the UL 1784 test conducted without the artificial bottom seal. Such doorway shall not be required to have a fire-resistance rating.

3008.7.3.1 Vision panel. A vision panel shall be installed in each door assembly protecting the lobby doorway. The vision panel shall consist of glazing and shall be located to furnish clear vision of the occupant evacuation elevator lobby.

3008.7.3.2 Door closing. Each door assembly protecting the lobby doorway shall be automatic closing upon receipt of any fire alarm signal from the emergency

voice/alarm communication system serving the building.

3008.7.4 Lobby size. Each occupant evacuation elevator lobby shall have minimum floor area as follows:

1. The occupant evacuation elevator lobby floor area shall accommodate, at 3 square feet (0.28 m2) per person, not less than 25 percent of the occupant load of the floor area served by the lobby.

2. The occupant evacuation elevator lobby floor area also shall accommodate one wheelchair space of 30 inches by 48 inches (760 mm by 1220 mm) for each 50 persons, or portion thereof, of the occupant load of the floor area served by the lobby.

Exception: The size of lobbies serving multiple banks of elevators shall have the minimum floor area approved on an individual basis and shall be consistent with the building's fire safety and emergency action plans.

3008.7.5 Signage. An approved sign indicating elevators are suitable for occupant self-evacuation shall be posted on all floors adjacent to each elevator call station serving occupant evacuation elevators.

3008.7.6 Two-way communication system. A two-way communication system shall be provided in each occupant evacuation elevator lobby for the purpose of initiating communication with the fire command center or an alternate location approved by the Fire Department.

3008.7.6.1 Design and installation. The two-way communication system shall be designed and installed in accordance with Sections 1007.8.1 and 1007.8.2.

3008.8 Elevator system monitoring. The occupant evacuation elevators shall be continuously monitored at the fire command center or a central control point approved by the Fire Department and arranged to display all of the following information:

1. Floor location of each elevator car.

2. Direction of travel of each elevator car.

3. Status of each elevator car with respect to whether it is occupied.

4. Status of normal power to the elevator equipment, elevator machinery and electrical apparatus cooling equipment where provided, elevator machine room, control room and control space ventilation and cooling equipment.

5. Status of emergency or standby power system that provides backup power to the elevator equipment, elevator machinery and electrical cooling equipment where provided, elevator machine room, control room and control space ventilation and cooling equipment.

6. Activation of any fire alarm initiating device in any elevator lobby, elevator machine room, machine space containing a motor controller or electric driving machine, control space, control room or elevator hoistway.

3008.8.1 Elevator recall. The fire command center or an alternate location approved by the Fire Department shall be provided with the means to manually initiate a Phase I Emergency Recall of the occupant evacuation elevators in accordance with rules of the department.

3008.9 Electrical power. The following features serving each occupant evacuation elevator shall be supplied by both normal power and Type 60/Class 6/Level 1 standby power:

1. Elevator equipment.

2. Ventilation and cooling equipment for elevator machine/control rooms, and machinery/control spaces.

3. Elevator car lighting.

Exceptions:

1. Standby power relying on natural gas as a fuel source need not be Class 6.

2. Where Exception 2 of Section 403.5.2 is utilized, the standby power generating equipment need only be sized to satisfy the loads required to simultaneously operate those elevators identified in the timed egress analysis described in Exception 2.2.

3008.9.1 Protection of wiring or cables. Wires or cables that are located outside of the elevator hoistway, machine room, control room and control space and that provide normal or standby power, control signals, communication with the car, lighting, heating, air conditioning, ventilation and fire-detecting systems to fire service access elevators shall be protected by construction having a fire-resistance rating of not less than 2 hours, or shall be circuit integrity cable having a fire-resistance rating of not less than 2 hours, or shall be protected by a listed electrical circuit protective system having a fire-resistance rating of not less than 2 hours.

Exception: Wiring and cables to control signals are not required to be protected provided that wiring and cables do not serve Phase II emergency in-car operation.

3008.10 Emergency voice/alarm communication system. The building shall be provided with an emergency voice/alarm communication system. The emergency voice/alarm communication system shall be accessible to the Fire Department. The system shall be provided in accordance with Section 907.5.2.2.

3008.10.1 Notification appliances. No fewer than one audible and one visible notification appliance shall be installed within each occupant evacuation elevator lobby.

3008.11 Hazardous material areas. No building areas shall contain hazardous materials exceeding the maximum allowable quantities per control area as addressed in Section 414.2.

SECTION BC 3009
SERVICE EQUIPMENT CERTIFICATES

3009.1 Required. No service equipment shall be placed in operation until a service equipment certificate of compliance has been obtained in accordance with the provisions of this code.

3009.2 Posting of inspection certificate. At the time a service equipment Certificate of Compliance is issued, an inspection certificate issued by the commissioner shall be posted. No such inspection certificate shall be issued for elevators that are not subject to periodic inspections pursuant to this code. The inspection certificate shall be in such form as the commissioner shall determine by rule and shall be posted in a frame with a transparent cover in the car of every passenger and freight elevator and on or near every escalator and moving walk and power-operated scaffold.

3009.2.1 Alternate posting locations. In lieu of posting the inspection certificate in those locations specified in this section, the inspection certificate may be kept in the on-site building manager's office. In such case, the building manager's office must be open during normal business hours. In addition, notice must be posted in each location listed in Section 3009.2 and kept in a frame with a transparent cover, or a plaque or on the car operating panel, with an indelible inscription, stating that the inspection certificate is located in the building manager's office and identifying the location of such office.

3009.3 Temporary use certificates. The commissioner may issue temporary use certificates for any equipment or device regulated by this code, except power-operated scaffolds, provided that such partial use and operation may be made safely and without endangering public health, safety, and welfare and provided further that such temporary use certificate shall not be issued for a period of more than 30 calendar days, subject to renewal for additional 30-day periods at the discretion of the commissioner. Temporary use certificates for elevators shall also be conditioned upon compliance with the following:

1. The class of service to be permitted shall be designated on the temporary use certificate.

2. The hoistway shall be enclosed throughout in an enclosure complying with ASME A17.1 or with a temporary enclosure in accordance with the requirements for workers' elevators (temporary elevators) of the *Industrial Code of the State of New York*, No. 23.

3009.3.1 Posting of temporary use certificate. The temporary use certificate shall be posted in a conspicuous location on, or adjacent to, the device covered by the certificate and shall state that the device has not been finally approved by the commissioner.

SECTION BC 3010
ELEVATOR, AMUSEMENT AND OTHER DEVICE OPERATORS

3010.1 Elevator operators. With the exception of automatic operation, continuous pressure elevators and sidewalk elevators, every passenger and freight elevator with a rise of more than one story shall be in the charge of a designated competent operator, who shall be at least 18 years old and selected with consideration of his or her abilities to perform his or her duties in a careful and competent manner. Such designated competent operator shall be instructed in the safe and proper operation of the equipment.

3010.2 Amusement device operators. Operators of amusement devices shall meet the requirements of rules of the department.

3010.3 Other device operators. Other devices regulated by this code shall, when deemed necessary by the commissioner to protect public safety, be in the charge of a designated competent operator conforming to such qualifications as the commissioner may prescribe, except that operators for workers' hoists shall be assigned as required by the applicable provisions of ANSI A10.4.

3010.4 Sanction for unlawful operation. If the commissioner finds that any person engaged in operating an elevator, amusement, or other device is not competent to operate the elevator, amusement or other device, the owner, agent or lessee of such elevator, amusement, or other device shall, upon notice from the commissioner, discontinue the operation of such device by such operator.

SECTION BC 3011
ELEVATOR BEING SERVICED, REPAIRED, INSPECTED OR TESTED

3011.1 Signage. When an existing or new automatic passenger elevator in any building or structure is being serviced, repaired, inspected or tested by an elevator company, or elevator personnel, and there are no elevator personnel available to remain in the elevator car, "CAUTION" sign tapes shall be placed across the car door jamb. One strip of "CAUTION" sign tape shall be placed at a height of 18 inches (457 mm) above the car floor and another strip of "CAUTION" sign tape shall be placed at a height of 54 inches (1372 mm) above the car floor.

3011.1.1 Sign tape. The "CAUTION" sign tape shall be 3 inches (76 mm) in width with the words "CAUTION – DO NOT ENTER" repeated every 6 inches (152 mm). The lettering shall be black on yellow background. The letters shall be at least 2 inches (51 mm) high. Caution tape may be replaced with OSHA approved elevator barricades.

3011.1.2 Elevator out of service. When an elevator is out of service with the car door open at a landing prior to the elevator personnel arriving, Sections 3011.1 and 3011.1.1 shall apply.

SECTION BC 3012
ACCIDENTS

3012.1 Accidents. The owner of any device regulated by this chapter shall promptly notify the commissioner of every accident involving injury to any person requiring the services of a physician or damage to property or to apparatus exceeding $1,000 on, about, or in connection with such equipment, before commencing any repairs and shall afford the commissioner every facility for investigating such accident or damage. The commissioner shall make an investigation immediately thereafter, and shall prepare a full and complete report of such investigation. Such report shall give in detail all material facts and information available and the cause or causes as far as they can be determined. Such report shall be a public record. When an accident involves the failure or destruction of any part of the construction or operating mechanism of such equipment, no such equipment shall be used until it has been made safe, and re-inspected by the commissioner. The commissioner may order the discontinuance of such equipment until a new service equipment certificate has been issued by him or her for its use. No part shall be removed from the premises of the damaged construction or operating mechanism until permission to do so has been granted by the commissioner.

SECTION BC3013
EXISTING INSTALLATIONS

3013.1 General. Existing installations shall be modified in accordance with Appendix K, Chapter K3.

SECTION BC 3014
INSPECTION AND TESTING

3014.1 Elevators and conveying systems. Inspection and testing of elevators and conveying systems shall be in accordance with Appendix K. Refer to Chapter 3 of Title 28 of the *Administrative Code* for additional requirements.

3014.2 Amusement devices. Inspection and testing of amusement devices shall comply with rules of the department. Refer to Chapter 3 of Title 28 of the *Administrative Code* for additional requirements.

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K1 - NEW REQUIREMENTS FOR NEW INSTALLATIONS AND/OR ALTERATIONS AS MAY BE REQUIRED BY CODE.

2.11.6.5 Mechanical Locking of Vestibule Doors

(a) Zero Clearance Vestibule. Elevator landings provided with a zero clearance vestibule (not to exceed 150 mm (6 in) from the elevator hoistway door) are permissible only when locking devices accessible from the car are installed exclusively on the door that separates the zero clearance vestibule from the occupied floor space.
(b) Elevator landing on floors other than designated level provided with a vestibule.
(1) A red telephone is installed in the vestibule near the elevator doors in the elevator lobby to communicate with the main lobby fire command station or building manager's office or to central station when the building is not attended. A sign shall be posted near the telephone. The sign shall read **"In Case of Fire or Other Emergency, Use This Phone to Contact Lobby or Building Manager or Central Service Station".**
(2) The locking devices on the vestibule door leading to an exit are released upon the activation of any detection or signaling devices or power failure and are approved as failsafe meeting the requirements of Chapter 9 of the *New York City Building Code*.
(3) At least one exit stair is located within the vestibule.

2.11.7.1.2.1 Hoistway door vision panels must be protected by protective grills made of number sixteen (16) gauge stainless or galvanized steel in accordance with the following specifications:
(a) Grills shall be sized to fit within or over the vision panel frame and completely cover the vision panel opening in the elevator, car doors and hoistway doors.
(b) Grills and vision panel frames shall be secured by means of non-reversible screws or other tamper proof fasteners.
(c) Grills shall contain openings that shall not be larger than 19 mm (0.75 in.) in diameter.
(d) All cut edges shall be deburred.
(e) Requirements for such grills may be waived if certification is submitted that such elevator is operated manually or twenty four (24) hour doorman service is provided. A security guard shall not be considered doorman service.
(f) For the purpose of this section, 6 mm (0.25 in.) thick, listed wire glass on shaft wall side of assembly, 6 mm (0.25 in.) listed wire glass in middle, and 6 mm (0.25 in.) thick polycarbonate on hallway side only, may be used in lieu of the metal protective.

2.12.6.2.6. Elevator Parking Device
(a) Parking Devices Required. Existing elevators that are operated from within the car only shall have elevator-parking devices installed at every landing that is equipped with an unlocking device. On elevators that are not operated from within the car only, an elevator parking device shall be provided at one landing and may be provided at other landings. This device shall be located at a height not greater than 2.11 m (6 ft 11 in) above the floor. Parking
devices are not required for elevators having hoistway doors that are automatically unlocked when the car is within the landing zone.
(b) General Design Requirements. Parking devices shall conform to the following requirements:
(1) They shall be mechanically or electrically operated.
(2) They shall be designed and installed so that friction or sticking or the breaking of any springs used in the device will not permit
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(c) Car interior lighting. The car interior lighting shall not be extinguished and must meet the requirements of 3.4.5 of ASME A17.3 as modified by Chapter K3 of this appendix.

[**2.27.3.4 Interruption of Power.** Upon the resumption of power following a power interruption, the car shall move in the down direction to designated or sky lobby level. Restoration of electrical power following a power interruption shall not cause any elevator to be removed from Phase I or Phase II Operation.]

2.29.1 Identification of Equipment
Each elevator shall be assigned a unique numerical identification, a minimum of 6 mm (0.25 in.) in height. The identification number shall be applied to the following locations:
(a) The driving machine; *(b)* MG and/or Transformers set;
(c) Controller;
(d) Selector;
(e) Governor;
(f) Main line disconnect switch;
(g) The crosshead, or where there is no crosshead, the car frame, such that it is visible from the top of the car;
(h) The car operating panel, minimum of 13 mm (0.5 in.) in height;
(i) Adjacent to or on every elevator entrance at the designated level, minimum of 75 mm (3 in.) height; and
(j) Each bank of elevators shall be identified by an alphabetic letter.

5.2.1.13 Power Operation of Hoistway Doors and Car Doors and Gates. When provided, power operation, power opening, and power closing of hoistway doors and car doors and gates shall conform to 2.13, except as
modified by 5.2.1.13.
(a) Requirement 2.13.1(b) is modified as follows: Power-operated swing hoistway doors shall not be permitted.
(b) Requirement 2.13.2.2.3 does not apply.
(c) Requirement 2.13.3.4 does not apply.
(d) Requirement 2.13.6 does not apply.

6.1.6.3.13 Comb-Step Impact Devices.
Devices of the manual type shall be provided that will cause the opening of the power circuit to the escalator driving machine motor and brake if either
(a) a horizontal force not greater than 1 780 N (400 lbf) in the direction of travel is applied at either side, or not greater than 3 560 N (800 lbf) is applied at the center of the front edge of the combplate; or
(b) a resultant vertical force not greater than 268 N (60 lbf) in the upward direction is applied at the center of the front of the combplate.

6.1.6.3.16 Service ports. Service ports used for diagnostic purposes or for resetting faults, shall be placed in a location accessible only to elevator personnel.

6.1.6.3.17 Phase protection of motors.
Escalators having a polyphase alternating current power supply shall be provided with means to remove power from the drive motor and brake if a reversal of phase rotation, or phase failure of the incoming polyphase alternating-current power occurs.

6.1.6.9.2 Additional signs and monitors.
Signs and monitors in addition to those required by Section 6.1.6.9.1 relating to cautions or warnings applying to escalator passengers, when provided, shall be in a readily visible location, and limited to conveying any additional cautions and/or warnings. The additional signs and monitors shall be prohibited

in the area starting from 3000 mm (118 in.) horizontally outward from the end of the newel and to the point where the steps start to move vertically. Its location shall not impede or otherwise cause persons about to board the escalator to suddenly pause or stop. The sign shall comply with ANSI Z535.2.

6.1.6.9.3 Additional signs or graphics.
Signs or graphics other than those specified in Section 6.1.6.9.1 and Section 6.1.6.9.2 shall not be permitted adjacent to the escalator in such a manner that obstructs boarding passenger view of the signs required in Section 6.1.6.9.1, obstructs or reduces passenger access to the handrails, within the safety zone (see Section 6.1.3.6.4), nor on the escalator except for signs, graphics, manufacturer's identification, owner's identification or markings. They shall not be distracting, create passenger flow hazards, or impair function of safety devices. Step riser signs or graphics, and handrail signs or graphics are not permitted.

6.1.9 New York City Identification Number.
Each escalator shall be assigned a unique numerical identification a minimum of 6 mm (0.25 in) in height. The city identification number shall be applied on the right hand side, facing the newel, at the top and bottom of the escalator as well as the following locations:
(a) The driving machine;
(b) Controller;
(c) Main line disconnect switch.

6.1.9.1 Building identification number.
Each escalator shall be assigned a unique alphabetical or numerical identification, a minimum of 6 mm (0.25 in) in height. The building identification number shall be applied on the exterior, clearly visible, at the top or bottom of the escalator.

6.2.6.3.11 Comb-Pallet Impact Devices.
Devices of the manual reset type shall be provided that will cause the opening of the power circuit to the moving walk driving machine motor and brake if either *(a)* a horizontal force not greater than 1 780 N (400 lbf) in the direction of travel is applied at either side, or not greater than 3 560 N (800 lbf) is applied at the center of the front edge of the combplate; or *(b)* a resultant vertical force not greater than 268 N (60 lbf) in the upward direction is applied at the center of the front of the combplate.

6.2.6.3.13 Phase protection of motors.
Moving walks having a polyphase alternating current power supply shall be provided with means to remove power from the drive motor and brake if a reversal of phase rotation, or phase failure of the incoming polyphase alternating current power occurs.

6.2.6.3.14 Service ports. Service ports used for diagnostic purposes or for resetting faults, shall be placed in a location accessible only to elevator personnel.

6.2.6.8.3 Additional signs or graphics.
Signs or graphics other than those specified in Sections 6.2.6.8.1 and 6.2.6.8.2 shall not be permitted adjacent to the walk in such a manner that obstructs boarding passenger view of the signs required in Section 6.2.6.9.1, obstructs or reduces passenger access to the handrails, within the safety zone, nor on the moving walk except for signs, graphics, manufacturer's identification, owner's identification, or markings required by the *New York City Building Code*. They shall not be distracting, create passenger flow hazards, or impair function of safety devices. Handrail signs or graphics are not permitted on the moving walk.

6.2.9 New York City identification number.
Each moving walk shall be assigned a unique numerical identification a minimum of 6 mm (0.25 in) in height. The city identification number shall be applied on the right hand side, facing the newel, at both ends of the moving walk as well as the following locations:
(a) The driving machine;
(b) Controller;
(c) Main line disconnect switch.

6.2.9.1 Building Identification Number.
Each moving walk shall be assigned a unique alphabetical or numerical identification, a minimum of 6 mm (0.25 in) in height. The building identification number shall be applied on the exterior, clearly visible, at either end of the moving walk.

8.6.4.1.1 Brake maintenance shall be entered in the maintenance records.
8.6.4.1.2 A metal tag indicating the elevator maintenance company and date of service shall be attached to the elevator controller.

8.7.2.10.1 General Requirements
(a) Where all new hoistway entrances are installed, they shall conform to 2.11, 2.12, and 2.13.
(b) Where one or more, but not all, new hoistway entrances are installed, they shall conform to 2.11.2 through 2.11.8 and 8.7.2.10.5.
The entire installation shall also conform to 2.11.6, 2.12, and 2.13.
(c) Where an alteration is made to any hoistway entrance, it shall conform to 2.11.3, 2.11.5, 2.11.6.5, 2.11.7, 2.11.8, and 8.7.2.10.5.
The entire installation shall also conform to 2.12 and 2.13.
(d) Where an emergency door is added or altered, it shall conform to 2.11.1 and 8.7.2.10.5.
(e) Where access openings for cleaning are installed, they shall conform to 2.11.1.4 and 8.7.2.10.5.

8.7.2.10.6 Intermediate hoistway entrances placed out of service. Where permitted by the *New York City Building Code*, an intermediate hoistway entrance placed out of service shall comply with the following:
(a) Interlocks shall remain in the safety circuit with door panel(s) separately secured in closed position on the hoistway side.
(b) Eliminate the capability of automatic elevators from opening the car doors at the floor placed out of service.
(c) Egress and firefighters' service shall not be compromised,
(d) Associated labeling and signaling shall be removed.

8.7.2.17 Change in Travel or Rated Speed
8.7.2.17.1 Increase or Decrease in Travel.
Where an alteration involves an increase or decrease in the travel without any change in the location of the driving machine, the following requirements shall be conformed to:
(a) The terminal-stopping devices shall be relocated to conform to 2.25.
(b) Where the increase in travel is less than 4 570 mm (180 in.), an existing winding-drum machine shall be permitted to be retained, provided the drum is of sufficient dimensions to serve the increased travel with not less than one full turn of wire rope remaining on the winding drum when the car or counterweight has reached its extreme limits of travel.
(c) The bottom and top clearances and runbys for cars and counterweights shall conform to 2.4, except as follows:

(1) Where the increase in travel is at the upper end of the hoistway, the existing bottom car clearance and car and counterweight runby are not required to conform to 2.4. However, if existing clearances are less than as required by 2.4, they shall not be decreased by the change in travel.
(2) Where the increase in travel is at the lower end of the hoistway, the existing overhead car and counterweight clearances are not required to conform to 2.4. However, if existing clearances are less than as required by 2.4, they shall not be decreased by the change in travel.
(3) Where the decrease in travel is at the lowest end of the travel, the installation shall conform to 2.2.4, 2.2.5, and 2.2.6.
(4) Where the only hoistway alteration is the decrease in travel at the upper end of the travel, the installation shall be modified as follows:
(i) Terminal stopping devices shall be provided based on the new top terminal landing location and the final limit switch shall be of the manual reset type.
(ii) A key controlled switch shall be provided in accordance with §8.1.5 (i.e. Group 4) requirements to by-pass the new top terminal stopping devices, when the elevator transfer switch is placed in the Top-of-Car Inspection
Operation position, for access to the hoistway above the terminal landing. The switch shall be manually operated, be labeled "Terminal By-Pass", and shall have two positions; By-Pass and Normal. The switch shall be located in the hoistway, in the vicinity of the terminal limits and shall be accessible to a person standing on the car top. The car transfer switch shall not be removed from the Top-of-Car Inspection Operation position until the terminal limit By-Pass switch is placed in the Normal position.
*(iii)*Existing terminal stopping devices shall remain functional. The hoistway door electro-mechanical safety interlocks shall remain in the safety circuit and locked with door panel(s) separately secured in closed position on the hoistway side.
(iv) Associated floor labeling and signaling shall be removed.

From Welding in Part 8
Where required elsewhere in *the New York City Building Code*, welding of parts, except for tack welds later incorporated into finished welds, shall be undertaken:
(a) by welders qualified in accordance with the requirements of Section 5 of ANSI/AWS D1.1, whereby the welders shall be qualified by the manufacturer or contractor; a professional consulting engineer; or a recognized testing laboratory; or
(b) as per department rules.

8.11.1.4.1.1 Elevators placed out of service (dismantled). Elevators that are dismantled shall have power feed lines disconnected from the main line disconnect switch and shall meet the requirements of subsections (a) or (b), below:
(a) An electric elevator, dumbwaiter, sidewalk elevator or material lift whose suspension ropes have been removed, whose car and counterweight rest at the bottom of the hoistway, and whose hoistway doors have been permanently barricaded or sealed in the closed position on the hoistway side; or
(b) A hydraulic elevator, dumbwaiter, sidewalk elevator or material lift whose car rests at the bottom of the hoistway; whose pressure piping has been disassembled and a removed from the premises; whose hoistway doors have been permanently barricaded or sealed in the closed position.
In addition, an application to dismantle the elevator shall be filed with the department and an inspection fee charged. Thereafter, one (1) additional inspection per year shall be made to verify that the status is unchanged and fees shall be paid for such inspection. Before the installation is put back in service, an application to restore service shall be filed with the department. For access to the bottom of the hoistway, the requirements of Section 8.11.1.4.1.2(b)(4) shall apply.

TABLE N1
REQUIRED INSPECTION AND TEST INTERVALS IN "MONTHS"

		Periodic Inspection by Dept.		Periodic Test on Behalf of Owner (4)									
				Category 1 (2)		Category 3 (Unexposed Portions of Roped Water Hydraulic Elevators and Pressure Vessels)		Category 5 (5)		Notifications (1)(3)	Filing (1)(3)	Performing (1)(3)	Witnessing Agency (1)(3)
Reference Code	Equipment Type	Requirement	Interval	Requirement	Interval	Requirement	Interval	Requirement	Interval				
ASME A17.1	Electric Elev.	8.11.2.1	1/1 to 12/31	8.11.2.2	1/1 to 12/31	N/A	N/A	8.11.2.3	60	Yes (Cat 5)	Yes	Yes	Yes
ASME A17.1	Hyd. Elev.	8.11.3.1	1/1 to 12/31	8.11.3.2	1/1 to 12/31	8.11.3.3	36	Roped 8.11.3.4	60	Yes (Cat 3, 5)	Yes	Yes	Yes
ASME A17.1	Escalators Mov. Walks	8.11.4.1	1/1 to 12/31	8.11.4.2	1/1 to 12/31	N/A	N/A	N/A	N/A	Yes (Cat 1)	Yes	Yes	Yes
ASME A17.1	Sidewalk Elevators	8.11.5.1	1/1 to 12/31	8.11.5.1	1/1 to 12/31	N/A	N/A	8.11.5.1	60	Yes (Cat 5)	Yes	Yes	Yes
ASME A17.1	Dumbwaiters	8.11.5.4	1/1 to 12/31	8.11.5.4	1/1 to 12/31	N/A	N/A	8.11.5.4	60	No	Yes	Yes	No
ASME A17.1	Material Lifts	8.11.5.5	1/1 to 12/31	8.11.5.5	1/1 to 12/31	N/A	N/A	8.11.5.5	60	No	Yes	Yes	No
ASME A17.1	Spec. Purpose Personnel Lift	8.11.5.6	1/1 to 12/31	8.11.5.6	1/1 to 12/31	N/A	N/A	8.11.5.6	60	No	Yes	Yes	No
ASME A17.1	Inclined Elevators	8.11.5.7	1/1 to 12/31	8.11.5.7	1/1 to 12/31	N/A	N/A	8.11.5.7	60	No	Yes	Yes	No
ASME A17.1	Shipboard Elevators	8.11.5.8	1/1 to 12/31	8.11.5.8	1/1 to 12/31	N/A	N/A	8.11.5.8	60	No	Yes	Yes	No
ASME A17.1	Screw Col. Elevators	8.11.5.9	1/1 to 12/31	8.11.5.9	1/1 to 12/31	N/A	N/A	8.11.5.9	60	No	Yes	Yes	No
ASME A17.1	Rooftop Elevators	8.11.5.10	1/1 to 12/31	8.11.5.10	1/1 to 12/31	N/A	N/A	8.11.5.10	60	No	Yes	Yes	No
ASME A17.1	Rack & Pinion Elev.	8.11.5.11	1/1 to 12/31	8.11.5.11	1/1 to 12/31	N/A	N/A	8.11.5.11	60	No	Yes	Yes	No
ASME A17.1	LULA Commercial Bldgs. Only	8.11.5.12	1/1 to 12/31	8.11.5.12	1/1 to 12/31	N/A	N/A	8.11.5.12	60	Yes (Cat 5)	Yes	Yes	Yes
ASME A17.1	Elevators Used for Construction	8.11.5.13	N/A	8.11.5.13	1/1 to 12/31	N/A	N/A	8.11.5.13	60	No	Yes	Yes	Yes
ASME A18.1	Platform Lift	10.2	1/1 to 12/31	10.3.1	1/1 to 12/31	10.3.2	36	10.3.3	60	No	Yes	Yes	No

TABLE N1
REQUIRED INSPECTION AND TEST INTERVALS IN "MONTHS"

		Periodic Inspection by Dept		Periodic Test on Behalf of Owner (4)									
				Category 1 (2)		Category 3 (Unexposed Portions of Roped Water Hydraulic Elevators and Pressure Vessels)		Category 5 (5)		Notifications (1)(3)	Filing (1)(3)	Performing (1)(3)	Witnessing Agency (1)(3)
Reference Code	Equipment Type	Requirement	Interval	Requirement	Interval	Requirement	Interval	Requirement	Interval				
ASME B20.1	Vert. and Inclined Reciprocating Conveyor (VRC)	N/A	N/A	Appendix K2 §6.21.3(b)	1/1 to 12/31	N/A	N/A	Appendix K2 §6.21.3(b)	60	No	No	No	No
ASME A90.1	Man lifts	8.2	1/1 to 12/31	8.1	1/1 to 12/31	N/A	N/A	N/A	N/A	No	Yes	Yes	Yes
Private Residence		-	-	-	-	-	-	-	-	-	-	-	-
ASME A17.1	Elevators	N/A	N/A	8.11.5.2	1/1 to 12/31	N/A	N/A	8.11.5.2	60	No	Yes	Yes	No
ASME A17.1	Dumbwaiters	N/A	N/A			N/A	N/A		60	No	No	No	No
ASME A18.1	Platform Lift	N/A	N/A	10.3.1	1/1 to 12/31	10.3.2	10.3.2	10.3.3	60	No	No	No	No
ASME A18.1	Stairway Chair Lift	N/A	N/A	10.3.1	1/1 to 12/31	N/A	N/A	N/A	N/A	No	No	No	No

Notes:

(1) Where filing with the Department is not required, Owner shall perform inspection and maintain log of each inspection/test performed as required by the *New York City Building Code* and available to the Department upon request.

(2) For Category 1 Inspection/Test, a minimum six (6) month time interval from the date of previous calendar year Category 1 Inspection/Test.

(3) See Article 304.

(4) Dismantled devices do not require Category 1, 3 or 5 Tests.

(5) Category 5 Tests are due by the last day of the month on the 5th anniversary. For example, if the Category 5 Test was last performed on 7/1/09, then the Category 5 Test must be performed by 7/31/14.

2013 K2

CHAPTER K2 MODIFICATIONS TO ASME B20.1-2006, SAFETY STANDARD FOR CONVEYORS AND RELATED EQUIPMENT

K201.1 General. As referenced in Section 3001.2 of the *New York City Building Code*, the provisions of ASME B20.1—06 shall be modified in accordance with this chapter. The section numbers correlate to those in the referenced ASME standard. Refer to the rules of the department for any subsequent additions, modifications or deletions that may have been made to this standard in accordance with Section 28-103.19 of the *Administrative Code*.

1 SCOPE

This standard applies to the design, construction, installation, maintenance, inspection, and operation of conveyors and conveying systems in relation to hazards. The conveyors may be of the bulk material, package, or unit handling types where the installation is designed for permanent, temporary, or portable operation.

This standard shall apply, with the exceptions noted below, to all conveyor installations.

This standard specifically excludes any conveyor designed for, installed for, or used for the movement of human beings. This standard does, however, apply to certain conveying devices that incorporate within their supporting structure, work stations or operator's stations specifically designed for authorized personnel.

This standard does not apply to conveyors such as underground mine conveyors for which specific standards are already in effect, or to equipment such as industrial trucks, tractors, trailers, automatic guided vehicles, tiering machines (except pallet load tierers), cranes, hoists, power shovels, power scoops, bucket drag lines, trenchers, platform elevators designed to carry passengers or operator, manlifts, moving walks, moving stairways (escalators), highway or railroad vehicles, cableways, tramways, dumbwaiters, pneumatic conveyors, robots or integral machine transfer devices. Some of the foregoing have specific standards.

2 REFERENCE TO OTHER CODES

Certain other codes and standards have been cited as references in this Standard. Reference to them does not constitute inclusion of the complete text of such codes or standards as a part of this Standard.

This Safety Standard for conveyors is supplementary to any law or code covering fire or health regulations.

3 INTENT

The intent of this Standard is to provide for safe operation and maintenance of conveying equipment.

Suggestions for improvement of this Standard may be submitted to the Secretary of the B20 Committee, ASME, Three Park Avenue, New York, NY 10016-5990.

Proposals should be written in accordance with the following format:

(a) Specify page and paragraph designation of the pertinent Standard.

(b) Indicate suggested change (addition, deletion, revision, etc.).

(c) Briefly state reason and/or evidence for suggested change.

(d) Separately submit suggested changes if more than one paragraph is affected.

The B20 Committee will consider each suggested change at its first meeting after receipt of the suggested change(s).

The B20 Committee will render an interpretation of any requirement of the Standard. Interpretations will be rendered only in response to a written request sent to the Secretary of the B20 Committee, ASME, Three Park Avenue, New York, NY 10016-5990.

The request for interpretation shall be in the following format:

Subject: Cite the applicable paragraph number(s) and provide a concise description.

Edition: Cite the applicable edition of the standard for which the interpretation is being requested.

Question: Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME committee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

4 DEFINITIONS[1]

actuator: a device that initiates the action of controls or controllers and is manually operated. The actuator may be a push button, toggle switch, foot pedal, hand lever, hand-set timer, or any other device that performs the described function.

antirunaway: a safety device to stop a declining conveyor and thus prevent moving away in the event of a mechanical or electrical failure.

apron pan: one of a series of overlapping or interlocking plates or shapes that, together with others, form the conveyor bed.

automatically controlled: describes the operation be the action of a mechanism that is initiated by some impersonal influence, such as a conveyor that is started by a low-level bin indicator.

backstop: a mechanical device to prevent reversal of a loaded conveyor under action of gravity when forward travel is interrupted.

bed:

(a) that part of a conveyor upon which the load or carrying medium rests or slides while being conveyed

(b) in bulk material conveyors, the mass of material being conveyed

belt idler: a roller or series of rollers that supports the belt of a belt conveyor.

1 Many definitions were extracted from the latest revision of Conveyor Terms and Definitions, Book No. 102, prepared by the Engineering Conference of the Conveyor Equipment Manufacturers Association, Washington, DC 20850. For definitions of terms other than those defined in para. 4, refer to this publication.

belt tripper: a device incorporating a system of pulleys that causes the conveyor belt to discharge material at one or more points along the length of the conveyor.

boom: a cantilevered member or structure that may be hinged, fixed, or pivoted.

brake: a friction device for slowing down conveyor components, bringing conveyor equipment to a controlled stop, holding traveling or traversing equipment in a selected location, preventing reverse travel, and controlling overspeed due to the action of gravity.

bunker: a large bin or compartment for storage of bulk materials.

car unloader: a type of conveyor characterized by a shallow, horizontal loading section that enables it to receive and unload material from hopper bottom cars without requiring a pit or other excavation.

carrier:

(a) a device attached to or hung from trolleys to support the load

(b) the receptacle in which objects are placed for transmittal through a conveying system

(c) the moving part of a vertical or inclined reciprocating conveyor that supports the load

chain: a series of links pivotally joined together to form a medium for conveying or transmitting motion or power. General classes of chain common to conveyors are detachable, pintle, combination, roller, rivet less, coil, inverted tooth, and bar link chains.

chute: a trough through which bulk materials or objects are directed and lowered by gravity. The trough may be open or enclosed, straight or curved.

control: the system governing the starting, stopping, direction of motion, acceleration, speed, retardation, identification, and function of the moving member in a predetermined manner.

controller: an electromechanical device or assembly of devices for starting, stopping, accelerating, or decelerating a drive or serving to

govern in some predetermined manner the power delivered to the drive.

conveying medium: that portion of a conveyor that moves or carries materials, packages, or objects.

conveyor: a horizontal, inclined, or vertical device for moving or transporting bulk material, packages, or objects in a path predetermined by the design of the device and having points of loading and discharge, fixed or selective. Included are skip hoists and vertical reciprocating and inclined reciprocating conveyors. Typical exceptions are those devices known as industrial trucks, tractors, trailers, tiering machines (except pallet load tierers), cranes, hoists, power shovels, power scoops, bucket drag lines, trenchers, platform elevators designed to carry passengers or an operator, man lifts, moving walks, moving stairways (escalators), highway or railway vehicles, cableways, tramways, dumbwaiters, pneumatic conveyors, robots, or integral machine transfer devices.

conveyor belt: a belt used to carry materials and transmit the power required to move the load being conveyed.

conveyor screw: the material-propelling medium of a screw conveyor generally consisting of an assembly of helical flights mounted on a rotating pipe or shaft.

conveyor, apron: a conveyor in which a series of apron pans forms a moving bed.

conveyor, belt: an endless fabric, rubber, plastic, leather, or metal belt operating over suitable drive, tail end, and bend terminals and over belt idlers or slider bed for handling bulk materials, packages, or objects placed directly upon the belt.

conveyor, bucket: any type of conveyor in which the material is carried in a series of buckets.

conveyor, chain: any type of conveyor in which one or more chains act as the conveying medium; a British term for trolley conveyor.

conveyor, declining: a conveyor transporting down a slope.

conveyor, electrified monorail: a conveyor consisting of a network of tracks or guide rails that may be installed horizontally, vertically, inclined, or in combination with one or more self-propelled cars or trolleys that move independently under automatic control from one point to another within the track network, carrying material in containers or by devices suspended from or attached to the cars or trolleys.

conveyor, en masse: a conveyor, comprised of a series of skeleton or solid flights on an endless chain or other linkage, that operates in horizontal, inclined, or vertical paths within a closely fitted casing for the carrying run. Bulk material is conveyed and elevated in a substantially continuous stream with a full cross section of the casing.

conveyor, extendable: a conveyor that may be lengthened or shortened to suit operating needs.

conveyor, flight: a type of conveyor comprised of one or more endless propelling media, such as chain, to which flights are attached and a trough through which material is pushed by the flights.

conveyor, horizontal reciprocating: a conveyor that progressively advances material by a back-and-forth motion of its conveying medium. It may be equipped with hinged flights or tilting dogs or pushers. These units operate generally in the range of 0-30 deg from the horizontal.

conveyor, inclined reciprocating: a reciprocating power- or gravity-actuated unit (not designed to carry passengers or an operator) that receives objects on a carrier. These units operate on inclines generally in the range of 30-70 deg from the horizontal.

conveyor, live roller: a series of rollers over which objects are moved by the application of power to all or some of the rollers. The power-transmitting medium is usually belting or chain.

conveyor, mobile: conveyor, supported on a structure, which is movable under its own power and includes, but is not limited to, radial stackers, winged stackers, reclaiming conveyors, and ship loaders. These conveyors normally handle bulk material.

conveyor, oscillating: a type of vibrating conveyor having a relatively low frequency and

large amplitude of motion, usually powered by a rotating eccentric.

conveyor, overland: a single or series of belt conveyors designed to carry bulk material across country, usually following the general contour of the land.

conveyor, portable: a transportable conveyor that is not self-propelled, usually having supports that provide mobility.

conveyor, power and free: a conveying system wherein the load is carried on a trolley or trolleys that are mechanically propelled through part of the system and may be gravity or manually propelled through another part. This arrangement provides a means of switching the free trolleys into and out of adjacent lines. The spur or subsidiary lines may or may not be powered.

conveyor, pusher bar: two endless chains cross-connected at intervals by bars or rotatable pushers that propel the load along the bed or trough of the conveyor.

conveyor, reciprocating: a conveyor where the carrier or pusher moves forward and back, or up and down, in the same plane.

conveyor, roller: a series of rollers supported in a frame over which objects are advanced manually, by gravity, or by power.

conveyor, roller slat: a slat conveyor using rollers for slats.

conveyor, screw: a conveyor screw revolving in a suitably shaped stationary trough or casing fitted with hangers, trough ends, and other auxiliary accessories.

conveyor, shuttle: any conveyor, such as a belt, chain, apron, screw, etc., in a self-contained structure, movable in a defined path parallel to the flow of the material.

conveyor, slat: a conveyor employing one or more endless chains to which non overlapping, non interlocking spaced slats are attached.

conveyor, suspended tray: a vertical conveyor, having one or more endless chains with suitable pendant trays, cars, or carriers that receives objects at one elevation and delivers them to another.

conveyor, tow: an endless belt- or cable-driven system or chain supported by trolleys from an overhead track or running in a track with means for towing floor-supported or rail-guided trucks, dollies, or carts.

conveyor, trolley: a series of trolleys supported from or within an overhead track and connected by endless propelling means, such as chain, cable, or other linkage, with loads usually suspended from the trolleys.

conveyor, vertical articulated: a type of vertical conveyor in which sections of articulated slat conveyor apron form rigid carriers for vertical movement in continuous flow. The carriers are flexible in but one direction, and they assume a vertical position on the non carrying run to minimize space requirements.

conveyor, vertical chain, opposed shelf type: two or more vertical elevating-conveying units opposed to each other. Each unit consists of one or more endless chains whose adjacent facing runs operate in parallel paths. Thus, each pair of opposing shelves or brackets receives objects (usually dish trays) and delivers them to any number of stations.

conveyor, vertical reciprocating: A permanent reciprocating power or gravity actuated unit (not designed to carry passengers or an operator) that receives objects on a carrier and transmits these objects vertically between two or more levels. *conveyor, vibrating:* a trough, tube, or other device flexibly supported and vibrated at a relatively high frequency and small amplitude to convey bulk material or objects, usually powered by an electrical or pneumatic impulse.

conveyor, wheel: a series of wheels supported in a frame over which objects are moved manually or by gravity. *deflector:*
(a) a device across the path of a conveyor placed at an angle and designed to deflect objects
(b) a plate inserted in the trajectory of a bulk material discharge to change direction *drive:* an assembly of the necessary structural, mechanical, and electrical parts that provides the motive power for a conveyor.

drum: a cylindrical or polygonal rim type of wheel around which cable, chain, belt, or other

linkage may be wrapped. A drum may be drive or driving. The face may be smooth, grooved, fluted, or flanged.

dumbwaiter: a type of material-lifting device specifically limited to a platform area of 0.8 m2 (9 ft2) or less, inside car height of 1.2 m (4 ft) or less, and a hoistway door height of 1.24 m (4 ft 1 in.) or less.2

emergency stop: a stop arising from a sudden and unexpected need and not as a part of the normal operation.

emergency stop device: a device that can be actuated in an emergency situation to stop a conveyor.

enclosed: describes guarding of moving parts in such a manner that inadvertent physical contact by parts of the body is precluded as long as the guard or enclosure remains in place. The guarding may make use of hinged, sliding, or removable doors for inspection or service.

2 See ASME A17.1 for dumbwaiter safety requirements.

flight:

(a) plain or shaped plates suitably made for attachment to the propelling medium of a flight conveyor.

(b) a term applied to any section of a conveyor in a tandem series.

gate: a device or structure by means of which the flow of material may be stopped or regulated; also, a section of conveyor equipped with a hinge mechanism for movable service, often called a hinged section.

grating:

(a) a coarse screen made of parallel or crossed bars to prevent passage of oversize material

(b) a series of parallel and crossed bars used as platform or walkway floors or as coverings for pits and trenches over which traffic may pass. Generally removable to permit access to conveying equipment for servicing

(c) a series of parallel or cross bar units, or both, fastened to or propelled by the conveying medium, used for carrying large, lump-sized bulk material or objects. Generally used to permit passage of air for cooling or heat to maintain temperature

guard:

(a) a covering, barricade, grating, fence, or other form of barrier used to prevent inadvertent physical contact with operating components, such as gears, sprockets, chains, and belts

(b) a structure mounted below an overhead mounted conveyor to protect personnel from falling materials

guarded: not exposed to contact, shielded, fenced, enclosed, or otherwise protected by means of suitable enclosures, covers, casings, shields, troughs, railings, or by nature of location so as to reduce risk of personal injury from accidental contact.

guarded by location: describes moving parts so protected by their remoteness from the floor, platform, walkway, or other working level or by their location with reference to frame, foundation, or structure as to reduce risk of accidental contact by persons or objects. Remoteness from regular or frequent presence of public or employed personnel may, in reasonable circumstances, constitute guarding by location. Unprotected danger points and areas that are inaccessible to the operating personnel in the normal performance of their duties shall be considered guarded by location.

hopper: a box having a funnel-shaped bottom or a bottom reduced in size, narrowed, or necked to receive material and direct it to a conveyor, feeder, or chute.

inactive controls: those controls that are not a part of, or do not contribute to, the present or future contemplated use of the conveyor or system as presently installed and wired.

integral machine transfer device: a part of a machine that loads, unloads, or transfers material (parts) from one location to another within the machine, during processing of the material, and without which the machine could not perform its function. Typically, both the machine and transfer device are supplied together and share the power and control systems.

limit switch: an electrical device by which the movement of a conveyor and allied equipment may be controlled within predetermined limits.

nip point: a point at which a machine element moving in line meets a rotating element in such a manner that it is possible to nip, pinch, squeeze,

or entrap a person or objects coming into contact with one of the two members. The same definition holds for the similar point with respect to two rotating parts or two converging parts in linear movement.

operator's station: location at which actuators are placed for the purpose of starting, stopping, reversing, or otherwise controlling the conveyor or system of conveyors in the course of normal operation.

overload device: a mechanical or electrical device designed to disconnect the driven equipment from the driving equipment in event of an overload on the conveyor.

platform: a working space for persons, elevated above the surrounding floor or ground (such as a balcony) for the operation of machinery and equipment.

prevent: when used in a context such as prevent access or prevent physical contact, means to impede or block; when used in the context such as prevent injury, means to reduce the chances of but does not imply that an injury cannot occur.

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

rail:

(a) one of the longitudinal members in a conveyor frame

(b) the supporting surface under the wheels or rollers of a chain conveyor

(c) the supporting track for equipment mounted on wheels, such as belt tripper, weigh larry, etc.

(d) the vertical members that guide the pendant trays, cars, or carriers in a suspended vertical tray conveyor

rail clamp: an attachment or device for clamping a mobile conveyor or belt tripper to the rail to hold it in a fixed location.

rail stop: a stop mounted on the conveyor rails to limit the travel of traversing machinery.

railing guard (guardrail): a structure consisting of rails and posts, including top rail, post, and, where required, toe boards.

rated capacity: the capacity at the rated speed, as established by the manufacturer or a qualified person, at which safe and satisfactory service can be expected.

rated speed: the speed of the conveyor, as established by the manufacturer or a qualified person, at which safe and satisfactory service can be expected.

remote control: any system of controls in which the actuator is situated in a remote location.

remote location: any location, with respect to the conveyor, from which the presence or position of personnel relative to the conveyor cannot be readily determined from the operator's station.

roller:

(a) a revolving cylinder or wheel over which something is moved. The face may be straight, tapered, crowned, concave, or flanged and corrugated, ribbed, or fluted

(b) a component part or roller chain in which it may serve only to reduce frictional loss occurring as the chain passes over the sprockets. Rollers may also serve as the rolling support for the chain and the load being conveyed

(c) the rotating element upon which a conveyor belt or chain or the object being transported is carried

roller turn: a series of vertical rollers mounted in a frame to guide conveyor chain around a horizontal curve.

safety device: a mechanism or an arrangement placed in use for the specific purposes of preventing an unsafe condition, preventing the continuation of an unsafe condition, warning of an unsafe condition, or limiting or eliminating the unsafe effects of a possible condition.

shall: as used in the context of a provision of this Standard, indicated that the provision is mandatory and must be followed.

shear point or line: the point at which, or the line along which, a moving part meets or passes close enough to a stationary or moving part or object so that part of the human body can be caught, trapped, or pinched between them.

shield guard: a full or partial enclosure or cover, either framed or solid, made from material sufficiently rigid to prevent accidental contact with moving parts.

should: as used in the context of a provision of this Standard, indicates a recommendation, the advisability of which depends on the facts in a particular situation.

skip bucket: the tub or bucket used for containing the material conveyed by a skip hoist.

skip hoist: a bucket or car operating up and down a defined path receiving, elevating, and discharging bulk materials.

slat: a member supported between chains in a slat conveyor; the series of slats form the conveying medium.

snub roller: any pulley used to increase the arc contact between a belt and drive or trail pulley.

spill guard: a stationary device of sufficient strength and capacity to catch, retain, and contain any reasonably foreseeable spillage from a conveyor passing overhead that might cause personal injury.

stacker: a conveyor adapted to piling or stacking bulk materials, packages, or objects. *switch:*

(a) a device for connecting two or more continuous package conveyor lines

(b) an electrical control device

(c) a mechanism that transfers a trolley, carrier, or truck from one track to another at a converging or diverging section

switch, slack cable: a device installed to automatically shut off the power supply when the hoisting cable becomes slack or has slack due to accident or jamming.

take-up: the assembly of the necessary structural and mechanical parts that provides the means to adjust the length of belts, cables, chains, etc. to compensate for stretch, shrinkage, or wear and maintain proper tension.

terminal: a term normally applied to the extreme ends of a belt system, i.e., head and tail pulleys.

tow pin: a moveable or fixed member on a truck, dolly, or cart used to engage the power system on a tow conveyor.

tracks: the beams, shapes, or formed section on which trolleys, rollers, shoes, or wheels roll or slide while being propelled.

transfer car: any wheeled device used for transferring loads from one conveyor line to another; may be manually or automatically operated.

transfer mechanism: any mechanism that transfers objects onto or off a conveyor line or from one conveyor line to another.

tray: a car, carrier, or pallet, usually suspended from the moving element of the conveyor, used to carry conveyed loads.

tread plate: a plate of suitable size fitted between conveyor rollers to permit persons to use it as a working or walking surface.

trolley: an assembly of wheels, bearings, and brackets used for supporting and moving suspended loads or carrying load connecting and conveying elements, such as chain, cable, or other linkage.

truck (also known as cart):
(a) an assembly that supports another unit in either a fixed or adjustable position and that provides mobility *(b)* a wheeled vehicle that can be detached from a conveying medium (usually chain) and pushed by hand

walkway: an elevated passageway for persons above the surrounding floor or ground level, including catwalks, footwalks, runways, and elevated walkways.

workstation: a physical location where a person is normally positioned, which is located by design and supported with facilities necessary for a person to perform prescribed work duties. This position would not apply to maintenance location.

5 GENERAL SAFETY STANDARDS[3]

5.1 Application

Conveyor equipment shall be used to convey only the specified commodities or materials within the rated capacity and the rated speed. Where special use is not indicated, or ratings are not available, good industry practice shall be used.

5.2 Maintenance (Repair)

(a) Maintenance and service shall be performed by qualified and trained personnel.

(b) Where lack of maintenance and service would cause a hazardous condition, the user shall establish a maintenance program to ensure that conveyor components are maintained in a condition that does not constitute a hazard to personnel.

(c) No maintenance or service shall be performed when a conveyor is in operation except as provided in paras. 5.3 and 5.4.

(d) When a conveyor is stopped for maintenance or service, the starting devices, prime movers, or powered accessories shall be locked or tagged out in accordance with a formalized procedure designed to protect all persons or groups involved with the conveyor against an unexpected restart. Personnel should be alerted to the hazard of stored energy, which may exist after the power source is locked out. Refer to ANSI Z244.1-1982, American National Standard for Personnel Protection—Lockout/Tagout of Energy Sources — Minimum Safety Requirements, and OSHA Standard 29 CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)."

(e) All safety devices and guards shall be replaced before starting equipment for normal operation.

5.3 Lubrication

(a) Conveyors shall not be lubricated while in operation unless it is impractical to shut them down for lubrication. Only trained and qualified personnel who are aware of the hazards of the conveyor in motion shall be allowed to lubricate a conveyor that is operating.

(b) Where the drip of lubricants or process liquids on the floor constitutes a hazard, drip pans or other means of eliminating the hazard shall be provided.

3 IMPORTANT: The general safety standards in para. 5 form a part of, and must be used with, the specific standards in para. 6.

5.4 Adjustment or Maintenance During Operation

When adjustment or maintenance must be done while equipment is in operation, only trained and qualified personnel who are aware of the hazard of the conveyor in motion shall be allowed to make adjustment or perform the maintenance or service.

5.5 Backstops and Breaks

Antirunaway, brake, or backstop devices shall be provided on all incline, decline, or vertical conveyors, where the effect of gravity will allow uncontrolled lowering of the load and where this load will cause a hazard to personnel.

5.6 Overload Protection

Where overload conditions would cause damage to equipment that could result in a personal injury, overload devices or suitable warning means shall be provided.

5.7 Gates and Switches

(a) Power-positioned gate and switch sections shall be provided with devices that will prevent these sections from falling in case of power failure.

(b) Means shall be provided on all gate and switch sections to prevent conveyed material from discharging into the open area, created by lifting of the gate or switch.

5.8 Counterweights

When counterweights are supported by belts, cables, chains, and similar means, weights shall be confined in an enclosure to prevent the presence of personnel beneath the counterweight. As an alternative, the arrangement shall provide a means to restrain the falling weight in case of failure of the normal counterweight support.

5.9 Guards and Guarding

5.9.1 General Requirements of Guarding

5.9.1.1 Guarding. Where necessary for the protection of personnel from hazards, all exposed moving machinery parts that present a hazard to personnel at workstations or operators' stations shall be mechanically or electrically guarded or guarded by location or position.

5.9.1.2 Interfacing of Equipment. When two or more pieces of equipment are interfaced, special attention shall be given to the interfaced

area to ensure the presence of adequate guarding and safety devices.

5.9.1.3 Guarding Exceptions. Wherever conditions prevail that would require guarding under this Standard but such guarding would render the conveyor unusable, prominent warning means, such as signs or warning lights, shall be provided in the area or on the equipment in lieu of guarding.

5.9.1.4 Maintenance of Guards and Safety Devices. Guards and safety devices shall be maintained in a serviceable and operational condition. Warning signs provided in accordance with para. 5.9.1.3 shall be maintained in a legible/operational condition.

5.9.2 Guarding by Location or Position

(a) Remoteness from frequent presence of public or employed personnel shall constitute guarding by location.

(b) Overhead conveyors, such as trolley conveyors and hanger-suspended tray conveyors, for which guarding would render the conveyor unusable or would be impracticable, shall have prominent and legible warnings posted in the area or on the equipment, and, where feasible, lines shall be painted on the floor delineating the danger area.

(c) When a conveyor passes over a walkway, roadway, or workstation, it is considered guarded by location if all moving parts are at least 2.44 m (8 ft) above the floor or walking surface or are otherwise located so that personnel cannot inadvertently come in contact with hazardous moving parts.

(d) Although overhead conveyors may be guarded by location, spill guards, pan guards, or equivalent shall be provided if material may fall off the conveyor and endanger personnel.

5.9.3 Guarding of Nip and Shear Points. In general, nip and shear points shall be guarded unless other means to ensure safety are provided. See Section 6 for specific conveyors.

5.10 Headroom

(a) When conveyors are installed above exit passageways, aisles, or corridors, there shall be provided a minimum clearance of 2 m (6 ft 8 in.) measured vertically from the floor or walking surface to the lowest part of the conveyor or guards.

(b) Where system function will be impaired by providing the minimum clearance of 2 m (6 ft 8 in.) through an emergency exit, alternate passageways shall be provided.

(c) It is permissible to allow passage under conveyors with less than 2 m (6 ft 8 in.) clearance from the floor for other than emergency exits if a suitable warning indicates low headroom.

5.11 Controls

5.11.1 Electrical Code. All electrical installations and wiring shall conform to the National Electrical Code (Article 670 and other applicable articles) as published by the National Fire Protection Association and as approved by the American National Standards Institute, Inc.

5.11.2 Control Station

(a) Control stations should be so arranged and located that the operation of the affected equipment is visible from them. Control stations shall be clearly marked or labeled to indicate the function controlled.

(b) A conveyor that would cause injury when started shall not be started until personnel in the area are alerted by a signal or designated person that the conveyor is about to start.

(1) When a conveyor that would cause injury once started is automatically controlled or must be controlled from a remote location, an audible device or devices shall be provided that can be clearly heard at all hazardous points along the conveyor where personnel may be present. The audible warning shall be actuated by the controller device starting the conveyor and continue for a required period of time before the conveyor starts. A flashing light or similar visual warning may be used in conjunction with, or in place of, the audible device if a visual warning is more effective.

(2) Where system function would be seriously hindered or adversely affected by the required time delay, or where the intent of the warning may be misinterpreted (i.e., a work area with many different conveyors and allied devices), a clear, concise, and legible warning sign shall be provided. The warning sign shall indicate that conveyors and allied equipment may be started at any time, danger exists, and personnel must keep clear. These warning signs shall be provided along the conveyor at areas not guarded by position or location.

(c) Remotely and automatically controlled conveyors and conveyors where operator stations

are not manned or are beyond voice or visual contact from drive areas, loading areas, transfer points, and other potentially hazardous locations on the conveyor path not guarded by location, position, or guards shall be furnished with emergency stop buttons, pull cords, limit switches, or similar emergency stop devices.

(1) All such emergency stop devices shall be easily identifiable in the immediate vicinity of such locations unless guarded by location, position, or guards. Where the design, function, and operation of such conveyor clearly is not hazardous to personnel, an emergency stop device is not required.

(2) The emergency stop device shall act directly on the control of the conveyor concerned and not depend on the stopping of any other equipment. The emergency stop devices shall be installed so that they cannot be overridden from other locations.

(d) Inactive and unused actuators, controllers, and wiring should be removed from control stations and panel boards, together with obsolete diagrams, indicators, control labels, and other material that might confuse the operator.

5.11.3 Safety Devices. All safety devices, including wiring of electrical safety devices, shall be arranged to operate such that a power failure or failure of the device itself will not result in a hazardous condition.

5.11.4 Emergency Stops and Restarts. Conveyor controls shall be so arranged that, in case of emergency stop, manual reset or start at the location where the emergency stop was initiated shall be required for the conveyor(s) and associated equipment to resume operation. Before restarting a conveyor that has been stopped because of an emergency, an inspection of the conveyor shall be made and cause of the stoppage determined.

The starting device shall be locked or tagged out before any attempt is made to remove the cause of the stoppage, unless operation is necessary to determine the cause or safely remove the stoppage. Refer to ANSI Z244.1-1982, American National Standard for Personnel Protection—Lockout/Tagout of Energy Sources — Minimum Safety Requirements, and OSHA Standard 29 CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)."

5.12 Operation

(a) Only a trained person shall be permitted to operate a conveyor. Training shall include instruction in operation under normal conditions and emergency situations. This provision does not apply to the interface of the public with conveyors intended for public use, such as at checkout counters.

(b) Where safety is dependent upon stopping or starting devices or both, they shall be kept free of obstructions to permit ready access.

(c) The area around loading and unloading points shall be kept clear of obstructions that could endanger personnel.

(d) No person shall ride on a conveyor, except on a slow-moving assembly conveyor 0.4 m/s (80 ft/min) maximum or on a conveyor that incorporates a station specifically designed for operating personnel.

(e) Personnel working on or near a conveyor shall be instructed as to the location and operation of pertinent stopping devices.

(f) A conveyor shall be used to transport only loads it is designed to handle safely.

(g) Under no circumstances shall the safety characteristics of the conveyor be altered if such alterations would endanger personnel.

(h) Routine inspections and corrective maintenance measures shall be conducted to ensure that all guards and safety features are retained and function properly.

(i) Personnel should be alerted to the potential hazard of entanglement in conveyors caused by items such as long hair, loose clothing, and jewelry.

(j) Conveyors shall not be maintained or serviced while in operation unless proper maintenance or service requires the conveyor to be in motion. In this case, personnel shall be made aware of the hazards and how the task may be safely accomplished.

5.13 Transfer, Loading, and Discharge Points

(a) At transfer, loading, and discharge points where unconfined and uncontrolled freefall of material can result from flooding, ricocheting, overloading, trajectory, leakage, or a combination thereof, such unconfined and uncontrolled freefall of material shall be prevented if it would create a hazard to personnel.

(b) In the absence of a guard or barrier specifically erected to protect personnel, warnings shall be provided to restrict unauthorized personnel from entering hazardous loading, unloading, and transfer areas.

5.14 Hoppers and Chutes

(a) All openings to hoppers and chutes shall be guarded to prevent personnel from accidentally falling or stepping into them or allowing any part of their body to make contact with conveyors below them. Where guards are not practical, warning signs shall be posted.

If the hopper or chute is equipped with a grating to protect against contacting the conveyors below, such grating will be considered as sufficient guarding provided that one dimension of the opening does not exceed 50 mm (2 in.).

(b) Dump hoppers having the hopper flush with the floor and which by their use cannot be guarded shall be equipped with grating having a maximum opening of 50 mm (2 in.) and be heavy enough to withstand any load of personnel or trucks, etc. that may be imposed on it. If the openings in the grating are larger or no grating is provided, temporary railing guard shall be placed around ground level hoppers when dumping operations are not in progress. During dumping operations, warning signs shall be placed in conspicuous locations warning personnel of an open pit. If there is a need to give operators of trucks, loaders, or bulldozers a reference to the hopper location, guide posts shall be used.

5.15 Fire Safety

This Standard is not intended to address fire-related considerations. Applicable national, state, and local codes should be complied with.

6 SPECIFIC SAFETY STANDARDS3

6.1 Belt Conveyors — Fixed in Place

6.1.1 Safety Considerations

(a) Nip and shear points shall be guarded. Typical locations are

(1) at terminals, drives, take-ups, pulleys, and snub rollers where the belt changes direction

(2) where belts wrap around pulleys

(3) at the discharge end of a belt conveyor

(4) on transfers and deflectors used with belt conveyors

(5) at take-ups

(b) It is not the intent of this requirement to provide guarding along the conveyor length where the belt rides on the carrying or return rollers.

(c) Take-up mechanisms may be guarded as an entity by placing standard railings or fencing around the area with suitable warning signs, as an alternative to guarding individual nip and shear points.

(d) On overland conveyors, audible or visual (or both) signaling devices for warning conveyor initiation shall be required only at the transfer, loading, and discharge points or at those points where personnel are normally stationed.

(e) On long overland belt conveyors where a pedestrian overpass or underpass is required, they shall be installed at intervals consistent with usage, normally not to exceed 300 m (1,000 ft).

6.1.2 Operation and Maintenance

(a) Only trained personnel shall track a conveyor belt, which must be done while the conveyor is operating.

(b) The practice of applying a belt dressing or other foreign material to a rotating drive pulley or conveyor belt is hazardous and should be avoided.

(c) The use of portable emergency stop controllers in lieu of permanently installed pull cords, push button stations, etc. shall be permitted for maintenance personnel who patrol overland conveyors. At those points where personnel are normally stationed, the conveyors shall be equipped with permanently installed pull cords or similar stop controllers.

6.2 Guarding of Bucket Conveyors

(a) Guards shall be provided at points where personnel could come in contact with cables, chains, belts, and runways of exposed bucket conveyors.

(b) Inspection or maintenance doors or both should include signs warning of possible danger if opened or removed while the conveyor is in operation.

6.3 Safety Considerations for Chain Conveyors

(a) Chain conveyors, by necessity, have moving chains that cannot be enclosed without impairing the function. They shall be provided with warning signs or personnel barriers, unless guarded by location.

(b) Where a chain conveyor is raised and lowered as a transfer mechanism, mounted within another conveyor, and where enclosure would impair the function, warning signs or personnel barriers shall be provided, unless guarded by location.

6.4 En Masse Conveyors

6.4.1 Safety Considerations. En masse conveyors are not considered as free standing and are to be braced at intervals indicated by the

manufacturer. Eccentric platform loads or other lateral loads may require lateral bracing or other bracing or both.

6.4.2 Guarding. Inspection or maintenance doors or both should include signs warning of possible danger if opened or removed while conveyor is in operation.

6.4.3 Operation and Maintenance

(a) Where flight or casing cleaning or both are required, they shall be performed by trained personnel, with conveyor power supply locked out. Special attention may be required at feed and discharge points.

(b) When coupling or uncoupling the en masse conveyor line, the line shall be restrained to prevent injury through the uncontrolled travel of the broken line.

6.5 Flight and Apron Conveyors — Bulk Material

6.5.1 Safety Considerations. Inclined apron conveyors shall be equipped with lifting blades when the conveyor inclination exceeds the slide angle of the design material.

6.5.2 Operation and Maintenance. At installation, flight and apron conveyors should be "jogged" or hand run through at least one complete revolution to check design clearances prior to running under automatic power.

Flight and apron conveyors handling sticky materials, which tend to build up, shall be cleaned as often as required for safe operation.

6.6 Inclined Reciprocating Conveyors

6.6.1 Safety Considerations

(a) Means shall be provided to prevent hazard to personnel in the event of mechanical or electrical failure. The carrier must be equipped with backstop devices sufficient to stop and hold the carrier and load.

(b) Overtravel devices shall be provided where necessary to minimize potential for injury to personnel.

(c) Riding the conveyor shall be forbidden to all personnel. Warning signs to this effect shall be prominently posted at each point of access and operation.

6.6.2 Guarding

(a) The conveyor shall be guarded so as to prevent injury from inadvertent physical contact.

(b) The conveyor housing shall be equipped with doors or an equivalent means at each manual loading and unloading station, arranged so that they can be opened only when the carrier is present at that level and such that the carrier cannot be actuated until they are closed. This requirement is typically satisfied by use of a mechanical locking device, which is actuated by the motion of the carrier, and an electrical switch indicating that the door is closed.

(c) Inclined reciprocating conveyors that automatically receive and discharge material may have interlocked doors as in (b) above or, as an alternative, may be guarded by a suitable enclosure extending from the path of the moving carrier.

(d) Where the application requires that personnel walk onto the carrier to load or unload material, the carrier shall be provided with standard railings, snap chains, or equivalent, across the loading/unloading side(s). Snap chains shall be at least 1 m (39 in.) at their lowest point.

(e) Controls shall be installed or located so they cannot be actuated by a person on the carrier.

6.6.3. Incline reciprocating conveyor testing. Incline reciprocating conveyors shall be inspected and tested as per section 6.12.3.

6.7 Live Roller Conveyors — Belt or Chain Driven

6.7.1 Safety Considerations

(a) Nip points occur between chain and sprockets on chain driven live roller conveyors.

(b) Nip points can occur between belt and carrier rollers on belt driven live roller conveyors.

(c) Nip points occur at terminals, drives, take-ups, idlers, and snub rollers where the belt changes direction. A return belt idler does not require guarding.

(d) Nip points occur on transfers and deflectors used with live roller conveyors.

(e) Shear points occur at automatic take-ups; they shall be guarded.

6.7.2 Guarding

(a) On chain driven live roller conveyors, unless guarded by location or position, the nip point between chains and sprockets shall be enclosed to prevent entry of hands, fingers, or other parts of the body into a point of hazard by reaching through, over, under, or around the guard.

(b) On belt driven live roller conveyors, nip points between the belt and roller may be considered guarded if the load-carrying rollers are spaced so as to prevent access, if plates or rods are placed between rollers, if pop-out rollers are used as load-carrying rollers, or if other suitable guarding is used, such as guarding by location.

6.8 Mobile Conveyors

6.8.1 Safety Considerations

(a) Mobile conveyors shall be provided with a brake, rail clamp, or other position-locking device for each motion, such as, but not limited to, luffing, slewing, and traversing, where movement would present a hazard.

(b) Limit switches shall be provided on rail-mounted mobile conveyors to limit the travel within design limits. Rail stops shall be provided beyond the design travel limits to physically stop the mobile conveyor in case of overtravel.

(c) Sweeps shall be provided on all rail-mounted mobile conveyors to deflect objects ahead of the nip points between wheels and rails where a hazard to personnel would result without the sweep.

(d) A mobile conveyor shall be designed to be stable against runaway or overturning under normal conditions of operation. Resting a portion of a mobile conveyor on the ground, a pile, or any other support shall not cause instability of the machine.

6.8.2 Guarding

(a) Where power to electrically powered mobile conveyors is provided by trolley or rail, these conductors shall be guarded in such a manner as to prevent accidental contact by personnel.

(b) Access stairways, ladders, and platforms shall be designed and located so as to avoid hazardous shear or nip points between sections of structures that in operation move relative to each other.

6.8.3 Operation and Maintenance

(a) When a mobile conveyor exposed to high wind conditions creates a hazard to personnel, normal operation shall cease, and, if necessary, the conveyor shall be moved to a parking position and secured.

(b) When an operator is required on a mobile conveyor, a platform or cab shall be constructed for his protection. The conveyor shall be designed so that, when the operator is on the platform engaged in the normal performance of his duties, he will be protected from injury.

(c) Where operation is such that there is danger of movement of the mobile conveyor into the stockpile or any other obstacle, a detector shall be provided to stop the conveyor movement.

6.9 Safety Considerations for Portable Conveyors, Extendible Belt Conveyors, and Car Unloaders

(a) The raising and lowering mechanism for the boom of a portable conveyor shall include in its design, or be provided with, a safety device that will hold the boom at any rated angle of inclination.

(b) A powered extendible conveyor shall be equipped with a device located on the outermost boom end that shall stop extension of the conveyor when contact is made with the device as may be required to protect personnel.

(c) An extendible conveyor shall be equipped with momentary contact push buttons without holding circuits to activate powered booms.

(d) Portable conveyors shall be stable when used within the manufacturer's rating so that the conveyor will not topple when in use or when being moved in the manner for which it was intended. When the portable conveyor must be lashed to prevent movement or overturning in high winds, a warning sign indicating the necessity shall be clearly posted.

(e) Guarding by location shall be determined with the boom in its lowest position.

6.10 Safety Considerations for Pusher Bar Conveyors

(a) If a hazard exists where the bar passes through the bed at the discharge end, suitable guards or warnings shall be provided at this point.

(b) Loads on the incline shall have pushers of adequate height above the bed or have top restraining members.

(c) All chains shall be guarded by suitable means, including warning signs, to prevent accidental contact with the moving chain.

(d) In a pusher bar conveyor having a roller bed, where the relationship between the height of the bar and spacing of the rollers creates a hazard, adequate guarding shall be provided.

(e) When a shear point exists between the return pusher bar and a frame member, guarding shall be provided.

(f) When the conveyor is automatically loaded, an automatic spacer shall be provided to

ensure feeding the loads ahead of the pusher bars where a hazard to personnel could exist.

(g) When a pusher bar conveyor discharges to another conveyor, means shall be provided to stop the pusher bar conveyor in the event the receiving conveyor cannot accept another load.

6.11 Roller and Wheel Conveyors

6.11.1 Safety Considerations

(a) Unit or package speeds that could create a safety hazard shall be avoided by limiting the length of the pitched run or using speed retarders, brakes, or other means that effectively provide the control needed.

(b) Personnel shall not be allowed to walk or step on free turning rollers or wheels. Suitable means, such as tread plates, can be used between the rollers as a walking surface for designated operators in the performance of their duties.

6.11.2 Operation and Maintenance. Rollers and wheels shall be free running to prevent unintentional diverting of units being conveyed when such a diverted unit could create a hazard to personnel.

6.12 Safety Considerations for Screw Conveyors

(a) Screw conveyors shall not be operated unless the conveyor housing completely encloses the convey or moving
elements, and power transmission guards are in place, except as provided in (b) and (c) below.

(b) If the conveyor must have an open housing as a condition of its use and application, the entire conveyor is then to be guarded by a railing or fence, unless guarded by location.

(c) Feed openings for shovel, front end loader, or other manual or mechanical equipment shall be constructed in such a way that the conveyor screw is covered by grating. If the nature of the material is such that a grating cannot be used, then the exposed section of the conveyor is to be guarded by a railing, and there shall be warning signs posted.

6.13 Safety Considerations for Shuttle Conveyors, Belt Trippers, and Transfer Cars

(a) These conveyors shall be provided with a brake, rail clamp, or other position-locking device.

(b) Means shall be provided to limit travel. Stops shall be provided beyond the normal travel limits to stop the conveyor in case of overtravel.

(c) When the conveyor and its path are obstructed from view of the controlling operator, the conveyor shall have a device to warn of its movement or provide other means to ensure personnel safety in the area.

(d) Sweeps shall be provided for all moving cars, trippers, or shuttles to deflect objects ahead of pinch points between wheels and rails, where a hazard to personnel would result without the sweep.

(e) Although all nip and shear points shall be guarded, it is not the intent of this requirement to provide guards where the belt rides on the idlers.

(f) Trippers or shuttles may discharge into silo or bunker openings, with or without seals. In either case, openings shall be provided with grating to suit the material being handled, and the width of the openings shall not be large enough to permit personnel to fall through. Where material size requires openings that would permit personnel to fall through, the openings shall be protected by other means.

(g) Where power is electrically provided via trolley or rail, these power conductors shall be guarded in such a manner as to prevent accidental contact by personnel. In explosive areas, explosion-proof equipment and cable reels shall be used instead of trolley and rail.

(h) When a person is required to move with the shuttle, tripper, or transfer car, a workstation shall be provided for his/her protection.

6.14 Skip Hoists — Bulk Materials

6.14.1 Safety Considerations

(a) Limit switches shall be provided to establish travel limits of the skip bucket. Additional switches shall be provided to interrupt the power supply and actuate the hoist brake whenever the skip bucket, through failure of the design travel limit switches or for any other reason, exceeds the design travel limit by a predetermined safe distance.

(b) Slack cable switches shall be provided and so arranged that whenever the skip- or counterweight hoisting rope develops slack or loses tension due to sticking in the guides, overtravel, or for any other reason, power to the drive will be cut off, and the brake will be set.

(c) Riding the skip bucket by personnel shall be forbidden.

6.14.2 Guarding

(a) All sheaves shall be fitted with sheave guards to prevent the wire rope from coming off

the sheaves under a slack cable or similar condition.

(b) The guarding of the wire rope and drum on the hoist is normally not practical due to fleet angle requirements. If the hoist unit is located in an area that is generally accessible, then a complete wire mesh or similar guard shall be placed around the hoist. This guard is not required when guarded by location.

6.14.3 Operation and Maintenance

(a) The following wearing parts should be regularly and frequently inspected by qualified maintenance personnel and maintained regularly or replaced when the degree of wear indicates possibility of failure before the next inspection:

(1) brake shoes and operating parts

(2) hoisting ropes, clamps, and attachments

(3) sheaves, particularly head sheaves

(4) tracks, wheels, and mechanisms

(5) limit switches and slack cable device

(b) Whenever the brake or any parts of the drive train between the brake and drum shaft are being repaired or replaced, the skip bucket and counterweight shall be blocked in their guides.

6.15 Slat Conveyors and Roller Slat Conveyors

6.15.1 Safety Considerations. A slat conveyor can present a shear point when the gap between the slats is great enough to permit access to cross members below the slats. At these points, all members should be a safe distance away from the slats, or a continuous pan under the slats should be provided.

6.15.2 Guarding. A hazard exists at the tail end of a slat conveyor in which the slats are above the center line of the chain. The gap between slats closes when the slats reach the top surface of the conveyor. This area should be guarded. If the material flow enters over the tail sprocket, making guards impractical, a warning sign should identify the hazard.

6.16 Suspended Vertical Tray Conveyors

6.16.1 Safety Considerations

(a) Means shall be provided to sense overloads where these loads could cause failure and injury to personnel.

(b) Automatic loading and unloading devices are recommended to prevent placing of any parts of the human body into the path of vertically traveling carriers.

6.16.2 Guarding

(a) The conveyor shall be installed in an enclosed shaftway or housing to prevent injury from inadvertent physical contact with moving parts of the equipment. Access doors to the shaftway or housing shall be secured so that only authorized service personnel may enter.

(b) For suspended vertical tray conveyors designed so that the pendant tray, car, or carrier comes to a stop during manual loading or unloading, the conveyor housing should be equipped with interlocked doors or equivalent safety barriers at each manual loading and unloading station. The doors shall be mechanically or electrically interlocked to the operation of the conveyor so that they can be opened only when the pendant tray, car, or carrier has stopped and so that the pendant tray, car, or carrier cannot be moved until they are closed.

(c) Suspended vertical tray conveyors designed to automatically receive and discharge material may have interlocked doors as in (b) above or, as an alternative, may be guarded by a suitable enclosure extending on all sides a safe distance from the path of the moving pendant trays, cars, or carriers.

6.17 Tow Conveyors

6.17.1 Tow Conveyors - In the Floor / Overhead

6.17.1.1 Safety Considerations

(a) A clearance space for personnel shall be provided between the side of a cart, or between any load overhanging the side of a cart, and any fixed or moving object.

(b) The cart path shall be identified by a floor stripe parallel to the cart path, one line on each side, located a safe distance from the edge of the cart or overhanging load.

(c) Where wall openings or other conditions do not permit a safe clearance, the reduced clearance area shall be marked with appropriate warnings.

(d) Where a cart may change its direction without warning, such as switching off the main line into a transfer conveyor or a spur, this area shall be marked with an appropriate warning such as diagonal stripes on the floor within the clearance lines.

(e) Where carts start automatically, a warning is required.

(f) Means shall be provided to allow the operator to disengage the tow pin from the conveyor pusher without being in front of the cart.

6.17.1.2 Guarding

(a) Provisions shall be made to prevent runaway carts from exiting the ramp zone and entering work areas.

(b) Ramps with traffic aisles shall have a barrier of sufficient strength and height to prevent a runaway cart from entering the traffic aisle.

(c) Ramps without traffic aisles shall have warning signs to warn personnel not to enter.

(d) Means shall be provided to maintain the stopped position of a ramp conveyor or carts under maximum rated load condition.

(e) Where there is a projection above the floor, the projection and adjacent area shall be identified by appropriate diagonal stripes, warning signs, or both. This identification shall particularly apply to devices that project intermittently at unpredictable times.

6.17.2 Tow Conveyors — Public Use Intended

6.17.2.1 Safety Considerations

(a) Means shall be provided to sense overloads where these loads could cause injury.

(b) Loading and unloading areas shall be provided with means to detect personnel on or in unauthorized proximity to the conveyor and automatically stop or prevent motion.

(c) Means shall be provided to physically restrict people from the path of the towed vehicle.

(d) Riding or walking on the conveyor or towed vehicle shall be forbidden. Warning signs to this effect shall be prominently posted at each point of access and control station.

6.17.2.2 Guarding. Where a parted chain, cable, belt, tow pin, or other linkage would permit a runaway condition on an incline or decline, antirunaway/backstop devices shall be provided.

6.18 Trolley Conveyors and Power and Free Conveyors

6.18.1 Safety Considerations

(a) In areas where the parted chain, cable, or other linkage would permit a runaway condition on an inclined or declined section, and where personnel are present, antirunaway devices shall be provided. The conveyor path may be arranged so that travel of the uncontrolled conveyor will be arrested before it enters an area where personnel are present.

(b) In areas where personnel perform work on the load of a moving conveyor, and guards would impair the workers' performance, the load shall be cradled, hooked, bolted, or otherwise attached to the carrier.

6.18.2 Guarding

(a) Nip points occur at traction wheels, sprockets, caterpillar drives, and roller turns and shall be guarded unless guarded by location.

(b) The telltale effect of the moving conveyor components serves as a warning device and permits unguarded nip or shear points at heights of less than 2.44 m (8 ft).

(c) Automatic stops or closures shall prevent a trolley or trolleys from moving off the track during the portion of a cycle when any track end is not aligned with its mating member.

(d) Hoisting equipment for lift sections or drop sections or both shall stop or control the vertical motion in the event of power failure.

(e) On inclined or declined conveyors or sections, where personnel are present and there may be an occurrence of uncontrolled movement of a free trolley, arresting devices shall be provided. A rigid pusher dog on the power chain with positive carrier engagement shall be considered an acceptable means, or the conveyor path may be arranged so that travel of the uncontrolled free trolley, carrier, or load, or combination thereof, will be arrested before it enters the personnel area.

(f) Guards shall be provided to restrict unauthorized personnel from entering hazardous loading, unloading, and transfer areas. When guarding is not feasible, clear and legible warnings shall be provided.

(g) Access to lift or drop sections shall be guarded to prevent unauthorized personnel from entering the area. Warning signs shall be posted where guarding is not feasible, unless access to lift or drop sections is guarded by location.

(h) Where conveyors are located above personnel and the possibility exists that the transported product may fall off from any cause, guards (spill guards) shall be provided.

6.19 Vertical-Articulated Conveyors

6.19.1 Safety Considerations

(a) The control system shall include means to prevent jamming or spilling objects if the

absence of such controls could produce a hazards to personnel.

(b) Means shall be provided to stop the conveyor in the event a jam occurs where injury to personnel would otherwise result.

6.19.2 Guarding

(a) The conveyor shall be enclosed to prevent injury from inadvertent physical contact with the moving parts of the equipment.

(b) The entry and exit openings in the enclosure shall be guarded by extending the enclosure side guards a safe distance from the path of the vertically moving carrier. A top cover shall be provided to form a tunnel, if practical.

6.20 Vertical Chain-Opposed Shelf Type Conveyors

6.20.1 Safety Considerations. Overload devices shall be furnished to stop the conveyor in the event a jam occurs where injury to personnel would otherwise result.

6.20.2 Guarding

(a) The conveyor shall be housed so as to prevent injury from inadvertent physical contact with the moving parts of the equipment.

(b) The conveyor housing shall be equipped with doors or an equivalent means at each manual loading and unloading station, arranged so that they can be opened only when the carrier is present at that level and such that the carrier cannot be actuated until they are closed. This requirement is typically satisfied by use of a mechanical locking device, which is actuated by the motion of the carrier, and an electrical switch indicating that the door is closed.

(c) Vertical chain-opposed shelf conveyors that automatically receive and discharge material may have interlocked doors as in (b) above or, as an alternative, be guarded by a suitable enclosure extending from the path of the moving carrier platform.

6.21 Vertical-Reciprocating Conveyors

6.21.1 Safety Considerations

(a) Means shall be provided to prevent hazard to personnel in the event of mechanical or electrical failure. The carrier must be equipped with backstop devices sufficient to stop and hold the carrier and load.

(b) Overtravel device(s) shall be provided where necessary to minimize potential for injury to personnel.

(c) Riding the conveyor shall be forbidden to all personnel. Warning signs to this effect shall be prominently posted at each point of access and operation.

(d) Travel distance shall be limited to less than 22 860 mm (75 ft) with a maximum of four landings served.

(e) Conveyor(s) shall be enclosed in a 2-hour fire rated hoistway, equipped with a minimum 1½ hour fire- rated entrance at each landing served.

(f) Access at landings shall be a restricted area for authorized personnel with no public access.

(g) Where there is an occupied space or an unoccupied space not secured against unauthorized access under the hoistway, the conveyor shall be equipped with a safety designed to stop and hold the conveyor with the rated full load capacity independent of the hoisting or driving mechanism.

(h) The operating device shall not be located inside the conveyor enclosure and must be external to the hoistway at each landing served.

(i) The system shall incorporate a position indicator at each floor landing to register the location of the conveyor.

(j) The rated load capacity shall not be less than 239 kg/m2 (49 lbs. per sq ft) with a maximum capacity of 9072 kg (20,000 lbs).

(k) The rated speed shall not exceed 406 mm/sec (80 FPM).

(l) VRCs are permitted only in commercial and industrial occupancies.

6.21.2 Guarding

(a) The conveyor shall be guarded so as to prevent injury from inadvertent physical contact.

(b) The conveyor housing shall be equipped with doors or equivalent means at each manual landing and unloading station, arranged so that they can be opened only when the carrier is present at the level and such that the carrier cannot be actuated until they are closed. This requirement shall be satisfied by the use of an interlock as required by ASME A17.1, Section 2.12.2.

(c) Vertical reciprocating conveyors designed to automatically receive and discharge material shall have interlocked doors as in subsection (b) above .

(d) Where the application requires that personnel walk onto the carrier to load or unload material, the carriers shall be provided with a conveyor enclosure securely fastened to the conveyor platform. The enclosure walls shall be of solid, grille or perforated construction; and

shall be of such strength and support that when subjected to a leaning or falling rated load on the conveyor, the enclosure walls will not deflect or deform in a way that reduces running clearances to less than 13 mm (0.5 in.). Enclosure entrance(s) shall be provided with solid doors or gates; and shall guard the full width opening with a minimum height of 2030 mm (80 in.). Grille or perforated portions of conveyor enclosures and entrance gates shall reject a ball 38 mm (1.5 in.) in diameter.

(e) Controls shall be installed or located so they cannot be actuated by a person on the carrier.

6.21.3 Periodic Testing.

(a) All conveyors shall be inspected and tested as per Table N 1 of ASME A17.1 as modified by Chapter K1of this appendix.

(b) All safety devices shall be tested during the applicable Cat 1 and Cat 5 tests, including any items required to be inspected by the manufacturer. A static full load test shall be performed every five years (Cat 5) to ensure that the conveyor holds the load.

2013 K3

K3 - RETROACTIVE REQUIREMENTS FOR EXISTING ELEVATORS

2.7.2 Elevator Parking Device

(a) Parking Devices Required. Elevators that are operated from within the car only and have manual operated doors that can be opened with a common tool, shall have elevator-parking devices installed at that landing. This device shall be located at a height not greater than 6 ft 11 in. (2.11 m) above the floor. Parking devices are not required for elevators having hoistway doors that are automatically unlocked when the car is within the landing zone.
(b) General Design Requirements. Parking devices shall conform to the following requirements:
(1) They shall be mechanically or electrically operated.
(2) They shall be designed and installed so that friction or sticking or the breaking of any springs used in the device will not permit opening or unlocking a door when the car is outside the landing zone of that floor.
(3) Springs, where used, shall be of the restrained compression type, which will prevent separation of the parts in case the spring breaks.
***(c) Car interior lighting.* The car interior lighting shall not be extinguished and must meet the requirements of Section 3.4.5 of ASME A17.3 as modified by this chapter.**

3.8.4.1 Single plunger brakes.

***(a)* All existing traction elevators with single plunger brakes must comply with either of the following by January 1, 2027:**
***(1)* Alteration of single plunger assemblies to dual-plunger type, or**
***(2)* Compliance with Unintended Car Movement Protection as specified by Section 2.19.2 of ASME A17.1 .**
***(b)* Notwithstanding any inconsistent provision of chapter 1 of title 28 of the *Administrative Code*, the work required to comply with this section may not be performed without a permit from the department.**

3.9.2 Final Terminal Stopping Devices

Upper and lower final terminal electromechanical stopping devices shall be provided and arranged to prevent movement of the car by the normal operating devices in either direction of travel after the car has passed a terminal landing. Final terminal stopping devices shall be located as follows:
(a) Winding Drum Driving Machines. Elevators having winding drum machines shall have stopping switches on the machines and also **installed in the hoistway operated by cams attached to the car. final limit switches and brackets shall be permanently secured and pinned.**
(b) Traction Driving Machines. Elevators having traction driving machines shall have stopping switches installed **in the hoistway operated by cams attached to the car. Final limit switches and brackets shall be permanently secured and pinned.**

3.10.12 System to monitor and prevent automatic operation of passenger and freight elevators with faulty door contact circuits.

All automatic passenger and freight elevators shall comply with this section by January 1, 2020.
Means shall be provided to monitor the position of power-operated car doors that are mechanically coupled with the landing doors or power-operated car doors with manually operated swing-type hall doors, while the car is in the landing zone, in order

(a) to prevent the operation of the car if the car door is not closed (see Section 3.4.2(c) of ASME A17.3), regardless whether the portion of the circuits incorporating the car-door contact or the interlock contact of the landing door coupled with car door, or both, are closed or open, except as permitted under any of the following conditions:
(1) by a car-leveling or truck-leveling device
(2) when a hoistway access switch is operated
(3) when the top-of-car inspection operation utilizing a car door by-pass or hoistway-door bypass switch is activated
(4) when on any mode of inspection operation; and
(b) to prevent, except as permitted by inspection operation, the power closing of the doors if the car door is fully open and any of the following conditions exist:
(1) the car-door contact is closed or the portion of the circuit, incorporating this contact is bypassed;
(2) the interlock contact of the landing door that is coupled to the opened car door is closed or the portion of the circuit, incorporating this contact is bypassed, except when operating during Firefighters' Service Phase II;
Exception: For swing-type door operation, the locking (secondary) contacts shall be monitored.
(3) the car-door contact and the interlock contact of the door that is coupled to the opened car door are closed, or the portions of the circuits incorporating these contacts are bypassed;
Exception: For swing-type door operation, the locking (secondary) contacts shall be monitored.
Design and/or controller modifications shall be approved by the controller manufacturer or a registered design professional. Notwithstanding any inconsistent provision of chapter 1 of title 28 of the Administrative Code, the work required to comply with this section may not be performed without a permit from the department.

3.11.3 Firefighters' Service Operation in Existing Elevators.

Firefighters' service operation shall be installed in accordance with the *New York City Building Code* in all existing elevators serving any of the following:
(a) High rise buildings or buildings classified in occupancy group M except existing R-2.
(b) All buildings or buildings classified in occupancy group A, B, E, I, or R-1 (except for "residential hotels", as such term if defined by the commissioner pursuant to rules and regulations.

2013 K4

SUPPLEMENT TO ASME A17.1–2004 SAFETY CODE FOR ELEVATORS AND ESCALATORS WITH APPENDIX K, CHAPTER K4 OF NYC BUILDING CODE

CHAPTER K4
MODIFICATIONS TO ASME A17.1S-2005 SAFETY CODE FOR MACHINE-ROOM-LESS ("MRL") ELEVATORS

K401.1 General. The provisions of American Society of Mechanical Engineers ("ASME") A17.1S-2005 must be modified in accordance with this chapter. The section numbers correlate to those in the referenced ASME standard.

Part 1 - General

SECTION 1.1
SCOPE

See ASME A17.1-2000 including A17.1a-2002 and A17.1b-2003 as amended by Chapter K1 of Appendix K of the *New York City Building Code* for additional, relevant requirements.

SECTION 1.3
DEFINITIONS

control room, elevator, dumbwaiter, material lift: an enclosed control space outside the hoistway, intended for full bodily entry, which contains the motor controller. The room could also contain electrical and/or mechanical equipment used directly in connection with the elevator, dumbwaiter, or material lift but not the electric driving machine or the hydraulic machine. (See Appendix Q.)

control space, elevator, dumbwaiter, material lift: a space outside the hoistway, intended for full bodily entry, which contains the motor controller. The space could also contain electrical and/or mechanical equipment used directly in connection with the elevator, dumbwaiter, or material lift, but not the electric driving machine or the hydraulic machine. (See Appendix Q of A17.1S as amended by Chapter K4 of the *New York City Building Code*).

NOTE: See 2.7.6.3.2 for an exception regarding the location of a motor controller.

machine room and control room, remote, elevator, dumbwaiter, material lift: a machine room or control room that is not attached to the outside perimeter or surface of the walls, ceiling, or floor of the hoistway. (See Appendix Q.)

machine room, elevator, dumbwaiter, material lift: an enclosed machinery space outside the hoistway, intended for full bodily entry, which contains the electric driving machine or the hydraulic machine. The room could also contain electrical and/or mechanical equipment used directly in connection with the elevator, dumbwaiter, or material lift. (See Appendix Q.)

machinery space, elevator, dumbwaiter, material lift: a space inside or outside the hoistway, intended to be accessed with or without full bodily entry, which contains elevator, dumbwaiter, or material lift mechanical equipment, and could also contain electrical equipment used directly in connection with the elevator, dumbwaiter, or material lift. This space could also contain the electric driving machine or the hydraulic machine. (See Appendix Q.) Machinery space in hoistways may not contain a motion controller, a motor controller or an operation controller.

machinery space and control space, remote, elevator, dumbwaiter, material lift: a machinery space or control space that is not within the hoistway, machine room, or control room, and that is not attached to the outside perimeter or surface of the walls, ceiling, or floor of the hoistway. (See Appendix Q.)

Part 2 - Electric Elevators

SCOPE

Part 2 applies to electric elevators installed at an angle greater than 70 deg from the horizontal. It applies to other equipment only as referenced in the applicable Part.

NOTE: See also Part 8 for additional requirements that apply to *electric elevators*.

SECTION 2.1
CONSTRUCTION OF HOISTWAYS AND HOISTWAY ENCLOSURES

2.1.1 Hoistway Enclosures

Hoistway enclosures shall conform to 2.1.1.1, 2.1.1.2, or 2.1.1.3.

2.1.1.1 Fire-Resistive Construction

2.1.1.1.1 Where fire-resistive construction is required, hoistways shall be enclosed in conformance with the requirements of the building code (see 1.3).

2.1.1.1.2 Partitions between hoistways and

(a) machinery spaces outside the hoistway

(b) machine rooms

(c) control spaces outside the hoistway

(d) control rooms

having fire-resistive enclosures shall be of noncombustible solid or openwork construction that meets the requirements of 2.1.1.2.2(d)(1), (2), and (3). Partitions of solid construction shall be permitted to have openings essential for ropes, drums, sheaves, and other elevator equipment.

Openwork construction shall reject a ball 25mm(1 in.) in diameter, except where there are openings essential for ropes, drums, sheaves, and other elevator equipment.

2.1.1.1.3 Hoistway enclosure openings shall be protected with entrances or access doors having a fire protection rating conforming to the requirements of the building code.

2.1.1.2 Non-Fire-Resistive Construction

2.1.1.2.1 Where fire-resistive construction is not required by the building code, hoistway construction shall conform to 2.1.1.2.2 or 2.1.1.3.

2.1.1.2.2 The hoistway shall be fully enclosed conforming to 2.1.1.2.2(a), (b), (c), and (d); or 2.1.1.2.2(a), (b), and (e).

(a) Enclosures and doors shall be unperforated to a height of 2 000 mm (79 in.) above each floor or landing and above the treads of adjacent stairways. The enclosure shall be unperforated, adjacent to, and for 150 mm (6 in.) on either side of any moving equipment that is within 100 mm (4 in.) of the enclosure.

(b) Partitions between hoistways and

(1) machinery spaces outside the hoistway

(2) machine rooms

(3) control spaces outside the hoistway

(4) control rooms

shall be of solid or openwork construction that meets the requirements of 2.1.1.2.2(d)(1), (2), and (3). Partitions of solid construction shall be permitted to have openings essential for ropes, drums, sheaves, and other elevator equipment. Openwork construction shall reject a ball 25 mm (1 in.) in diameter, except where there are openings for ropes, drums, sheaves, and other elevator equipment.

(c) Openwork enclosures, where used above the 2 000 mm (79 in.) level, shall reject a ball 25 mm (1 in.) in diameter.

(d) Openwork enclosures shall be

(1) at least 2.2 mm (0.087 in.) thick wire, if of steel wire grille

(2) at least 2.2 mm (0.087 in.) thick, if of expanded metal

(3) so supported and braced as to deflect not over 15 mm (0.6 in.) when subjected to a force of 450 N (100 lbf) applied horizontally at any point

(e) Enclosures shall be permitted to be glass, provided it is laminated glass conforming to ANSI Z97.1, 16 CFR Part 1201, or CAN/CGSB-12.1, whichever is applicable (see Part 9). Markings as specified in the applicable standard shall be on each separate piece of glass and shall remain visible after installation.

2.1.1.2.3 Entrances shall be in conformance with 2.11, except 2.11.14, 2.11.15, 2.11.16, and 2.11.18.

2.1.1.3 Partially Enclosed Hoistways. For elevators that are not fully enclosed, protection at least 2 400 mm (94.5 in.) high shall be provided on the hoistway sides that are located 1 500 mm (59 in.) or less from elevator equipment to areas accessible to other than elevator personnel. Such protection shall comply with 2.1.1.2.

2.1.1.4 Multiple Hoistways. The number of elevators permissible in a hoistway shall be in conformance with the building code.

2.1.1.5 Strength of Enclosure. The hoistway enclosure adjacent to a landing opening shall be of sufficient strength to maintain, in true lateral

alignment, the hoistway entrances. Operating mechanisms and locking devices shall be supported by the building wall, if loadbearing, or by other building structure. Adequate consideration shall be given to pressure exerted on hoistway enclosures as a result of windage and elevator operation.

2.1.2 Construction at Top and Bottom of the Hoistway

2.1.2.1 Construction at Top of the Hoistway. The top of the hoistway shall be enclosed as required by the building code.

2.1.2.2 Construction at Bottom of Hoistway. Pits extending to the ground shall have noncombustible floors, and shall be designed to prevent entry of ground water into the pit. The pit floor of any hoistway not extending to the ground shall be of construction having a fire-resistance rating at least equal to that required for the hoistway enclosure. (See also 2.2 and 2.6.)

2.1.2.3 Strength of Pit Floor. The pit equipment, beams, floor, and their supports shall be designed and constructed to meet the applicable building code requirements and to withstand the following loads, without permanent deformation, in the manner in which they occur:

(a) the impact load due to car or counterweight buffer engagement at 125% of the rated speed or 125% of the striking speed where reduced stroke buffers are used (see 8.2.3)

(b) the part of the load transmitted due to the application of the car safety, or where applicable, the counterweight safety

(c) compensation up-pull load where compensation tie- down is applied (see 2.17.17)

(d) the loads imposed by a driving machine where applicable (see 2.9)

(e) any other elevator-related loads that are transmitted to the pit floor

2.1.3 Floor Over Hoistways

2.1.3.1 General Requirements

2.1.3.1.1 A metal or concrete floor shall be provided at the top of the hoistway

(a) where a machine room or control room is located above the hoistway

(b) below overhead sheaves and other equipment that are located over the hoistway and means of access conforming to 2.7.6.3.3 are not provided

(c) below governors that are located over the hoistway and means of access conforming to 2.7.6.3.4 are not provided

2.1.3.1.2 Floors are not required below secondary and deflecting sheaves of traction-type machines located over the hoistway.

2.1.3.2 Strength of Floor. Overhead floors shall be capable of sustaining a concentrated load of 1 000 N (225 lb) on any 2 000 mm2 (3 in.2) area, and in addition, where it constitutes the floor of the main or secondary level machinery space, it shall be designed for a live load of not less than 6 kPa (125 lb/ft2) in all open areas.

Where the elevator driving machine is to be supported solely by the machine room floor slab, the floor slab shall be designed in accordance with 2.9.4 and 2.9.5.

2.1.3.3 Construction of Floors. Floors shall be of concrete or metal construction with or without perforations. Metal floors shall conform to the following:

(a) If of bar-type grating, the openings between bars shall reject a ball 20 mm (0.8 in.) in diameter.

(b) If of perforated sheet metal or of fabricated openwork construction, the openings shall reject a ball 25mm (1 in.) in diameter.

2.1.3.4 Area to Be Covered by Floor. Where a floor over a hoistway is required by 2.1.3.1, the floor shall extend over the entire area of the hoistway where the cross-sectional area is 10 m2 (108 ft2) or less. Where the cross-sectional area is greater, the floor shall extend not less than 600 mm (24 in.) beyond the general contour of the machine or sheaves or other equipment, and to the entrance to the machinery space at or above the level of that floor. Where the floor does not cover the entire horizontal area of the hoistway, the open or exposed sides shall be provided with a standard railing conforming to 2.10.2.

2.1.4 Control of Smoke and Hot Gases

Hoistways must be provided with means to prevent the accumulation of smoke and hot gases when required by the *New York City Building Code.*

2.1.5 Windows and Skylights

In jurisdictions not enforcing the NBCC, windows in the walls of hoistway enclosures are prohibited.

Windows and skylights and their frames and sashes in machine rooms and control rooms shall conform to the requirements of the building code (see 1.3).

2.1.6 Projections, Recesses, and Setbacks in Hoistway Enclosures

Hoistway enclosures shall have flush surfaces on the hoistway side, subject to the requirements of 2.1.6.1 and 2.1.6.2.

2.1.6.1 On sides for loading and unloading, landing sills, hoistway doors, door tracks, and hangers shall be permitted to project inside the hoistway enclosure. Sills shall be guarded as required by 2.11.10.1.

2.1.6.2 On sides not used for loading and unloading:

(a) Recesses, except those necessary for installation of elevator equipment, must not be permitted;

(b) Beams, floor slabs, or other building construction making an angle less than 75 degrees with the horizontal must not project more than 50 mm (2 in) inside the hoistway enclosure unless the top surface of the projection is beveled at an angle not less than 75 degrees with the horizontal;

(c) Separator beams between adjacent elevators are not required to have bevels;

(d) Where setbacks exceeding 50 mm (2 in) occur in the enclosure wall, the top of the setback must be beveled at an angle of not less than 85 degrees with the horizontal;

(e) Bevels are not required if the projections and setbacks are covered with material conforming to the following:

(1) It must be equal to or stronger than 1.110 mm (0.0437 in) wire;

(2) It must have openings not exceeding 25 mm (1 in);

(3) It must be supported and braced such that it will not deflect more than 25 mm (1 in) when subjected to a force of 4.79 kPa (100 lbs per sq ft) applied horizontally at any point.

SECTION 2.2
PITS

2.2.1 General

A pit shall be provided for every elevator.

2.2.2 Design and Construction of Pits

2.2.2.1 The construction of the pitfalls, the pit floor, and any pit access doors (see 2.2.4) shall conform to 2.1.1 and 2.1.2.

2.2.2.2 The floor of the pit shall be approximately level, except that

(a) trenches or depressions shall be permitted for the installation of buffers, compensating sheaves and frames, and vertically sliding biparting hoistway doors, where structural conditions make such trenches or depressions necessary

(b) in existing buildings, where new elevators are installed or existing elevators are altered, existing foundation footings extending above the general level of the pit floor shall be permitted to remain in place, provided that the maximum encroachment of such footings does not exceed 15% of the cubic content of the pit, and further provided that it is impracticable to remove the footing

2.2.2.3 Permanent provisions shall be made to prevent accumulation of ground water in the pit (see 2.1.2.2).

2.2.2.4 Drains and sump pumps, where provided, shall comply with the applicable plumbing code, and they shall be provided with a positive means to prevent water, gases, and odors from entering the hoistway.

2.2.2.5 Elevators with sprinklers in the shaftway must be provided with a drain or sump pump.

2.2.2.6 Sumps and sump pumps in pits, where provided, shall be covered. The cover shall be secured and level with the pit floor.

2.2.2.7 In jurisdictions enforcing the NBCC sump pumps and their control equipment shall not be installed in any elevator pit.

2.2.3 Guards Between Adjacent Pits

2.2.3.1 Where there is a difference in level between the floors of adjacent pits, a metal guard, unperforated, or perforated with openings that will reject a ball 50 mm (2 in.) in diameter, shall be installed for separating such pits. Guards shall extend not less than 2 000 mm (79 in.) above the level of the higher pit floor and a self-closing access door shall be permitted.

2.2.3.2 Where the difference in level is 600 mm (24 in.) or less, a standard railing conforming to 2.10.2 shall be permitted to be installed in lieu of the guard.

2.2.4 Access to Pits

Safe and convenient access shall be provided to all pits, and shall conform to 2.2.4.1 through 2.2.4.4.

2.2.4.1 Access must be by means of the lowest hoistway door or by means of a separate pit access door, located at the level of the pit floor.

2.2.4.2 There shall be installed in the pit of each elevator, where the pit extends more than 900mm(35 in.) below the sill of the pit access door, a fixed vertical ladder of noncombustible material, located within reach of the access door. The ladder shall extend not less than 1 200 mm (48 in.) above the sill of the access door. The rungs, cleats, or steps shall be a minimum of 400 mm (16 in.) wide. When unavoidable obstructions are encountered, the width shall be permitted to be decreased to less than 400 mm (16 in.). The reduced width shall be as wide as the available space permits, but not less than 225 mm (9 in.). The rungs, cleats, or steps shall be spaced 300 mm (12 in.) on center. A clear distance of not less than 180 mm (7 in.) from the centerline of the rungs, cleats, or steps to the nearest permanent object in back of the ladder shall be provided. When unavoidable obstructions are

encountered, the distance shall be permitted to be reduced to 115 mm (4.5 in.). Side rails, if provided, shall have a clear distance of not less than 115 mm (4.5 in.) from their centerline to the nearest permanent object. The nearest point of the ladder shall be within 1 000 mm (39 in.), measured horizontally from the means to unlock the egress door from the pit.

Pit access by a ladder shall not be permitted when the pit floor is more than 3 000 mm (120 in.) below the sill of the access door, except where there is no building floor below the bottom terminal landing, this height shall be permitted to be greater but not more than 4 200 mm (165 in.).

2.2.4.3 Pits shall be accessible only to elevator personnel.

2.2.4.4 Separate pit door, when provided, shall be subject to the following requirements:

(a) If the door swings into the pit, it shall be located so that it does not interfere with moving equipment.

(b) If the door swings out, and the lowest structural or mechanical part, equipment, or device installed beneath the car platform, except guide shoes or rollers or safety jaw assemblies, projects below the top of the separate pit access door opening when the car is level with the bottom terminal landing

(1) an electric contact conforming to 2.26.2.26 shall be provided to prevent operation of the elevator when the door is open

(2) the door shall be provided with a vision panel(s) that is glazed with clear wired glass not less than 6 mm (0.25 in.) thick, will reject a ball 150 mm (6 in.) in diameter, and have an area of not more than 0.03 m2 (47 in.2)

(c) The door shall provide a minimum opening of 750 mm (29.5 in.) in width and 1 825 mm (72 in.) in height.

(d) The door shall be equipped with a barrier conforming to 2.11.1.2(i), where the door sill is located more than 300 mm (12 in.) above the pit floor.

(e) The door shall be self-closing and provided with a spring-type lock arranged to permit the door to be opened from inside of the pit without a key. Such doors shall be kept closed and locked. The key shall be of Group 1 Security (see 8.1).

(f) Pit doors must be labeled "DANGER: ELEVATOR PIT" with letters not less than 51 mm (2 in) high.

2.2.5 Illumination of Pits

A permanent lighting fixture shall be provided and shall conform to 2.2.5.1 through 2.2.5.3.

2.2.5.1 The lighting shall provide an illumination of not less than 100 lx (10 fc) at the pit floor and at a pit platform, when provided.

2.2.5.2 The light bulb(s) shall be externally guarded to prevent contact and accidental breakage.

2.2.5.3 The light switch shall be so located as to be accessible from the pit access door.

2.2.6 Stop Switch in Pits

An enclosed stop switch(es), meeting the requirements of 2.26.2.7 and 2.2.6.1 through 2.2.6.3, shall be installed in the pit of each elevator.

2.2.6.1 The stop 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.

2.2.6.2 In elevators where access to the pit is through the lowest landing hoistway door, a stop switch shall be located approximately 450 mm (18 in.) above the floor level of the landing, within reach from this access floor and adjacent to the pit ladder, if provided. When the pit exceeds 1 700 mm (67 in.) in depth, an additional stop switch is required adjacent to the pit ladder and approximately 1 200 mm (47 in.) above the pit floor.

2.2.6.3 Where more than one switch is provided, they shall be wired in series.

2.2.7 Minimum Pit Depths Required

The pit depth 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 car clearance and runby required by 2.4.1.

2.2.8 Access to Underside of Car

Where the distance from the pit floor to the underside of the plank channels or slings exceeds 2 100mm(83 in.), with the car at the lowest landing, a means shall be permanently installed or permanently stored in the pit to provide access to the equipment on the underside of the car.

SECTION 2.3
LOCATION AND GUARDING OF COUNTERWEIGHTS

2.3.1 Location of Counterweights

Counterweights shall be located in the hoistway of the elevator that they serve, or in a remote hoistway subject to the limitations and requirements of 2.3.3.

2.3.2 Counterweight Guards

2.3.2.1 Metal guards shall be installed in the pit and/or a machine room or control room located underneath the hoistway on all open sides of the counterweight runway, except that

(a) the guard, or portion thereof, is not required on the side facing the car where there is no space greater than 500 mm (20 in.) between compensating ropes (chains), or between compensating ropes (chains) and counterweight rails, or between compensating ropes (chains) and guards

(b) where pit-mounted buffers are used, the guard is not required where the bottom of the counterweight resting on its compressed buffer is 2 130 mm (84 in.) or more above the pit floor, or above the machine or control room floor if located underneath the hoistway.

2.3.2.2 Guards shall

(a) extend from the lowest part of the counterweight assembly when the counterweight is resting on the fully compressed buffer to a point not less than 2 100 mm (83 in.) and not more than 2 450 mm (96 in.) above the pit floor

(b) be the full width of the area being guarded

(c) not prevent determination of the counterweight runby

(d) be fastened to a metal frame reinforced and braced to be at least equal in strength and stiffness to 2 mm (0.074 in.) thick sheet steel

(e) if perforated, reject a ball 25mm(1 in.) in diameter

2.3.2.3 Guarding of Counterweights in a Multiple-Elevator Hoistway. Where a counterweight is located between elevators, the counterweight runway shall be guarded on the side next to the adjacent elevator. The guard shall be of noncombustible material. The guard, if of openwork material, shall reject a ball 25 mm (1 in.) in diameter and be made from material equal to or stronger than 1.110 mm (0.0437 in.) diameter wire. The guard shall be so supported that when subjected to a force of 450 N (100 lbf) applied over an area of 100 mm X 100 mm (4 in. X 4 in.) at any location, the deflection shall not reduce the clearance between the guard and the counterweight below 25 mm (1 in.).

2.3.3 Remote Counterweight Hoistways

Where elevators are not provided with either compensating means or counterweight safeties, the counterweights shall be permitted to be located in a remote hoistway conforming to 2.3.3.1 through 2.3.3.6.

2.3.3.1 The hoistway shall be fully enclosed and shall be fire resistive, conforming to 2.1.1.1 if it penetrates separate fire-resistive areas of the structure.

2.3.3.2 Construction at the top and bottom of the hoistway shall conform to 2.1.2.

2.3.3.3 Permanent means shall be provided for inspection, repair, and maintenance of the counterweight, deflecting and secondary sheaves, hoistway, ropes, counterweight guide rails, and counterweight buffers or bumpers. Entry doors into the separate counterweight hoistway shall be provided at top, bottom, and center of counterweight hoistway, but in no case shall the entry doors be more than 11m(36 ft) from sill to sill. Doors shall be located and of such width to provide unobstructed access to the space between the counterweight guides. The height of the door shall be at least 1 975 mm (78 in.). Doors shall conform to 2.11.1.2(b) through (e), inclusive. An enclosed stop switch, meeting the requirements of 2.26.2.5(a), (b), and (c), a permanent electric light switch, duplex receptacle, and light shall be provided in the hoistway immediately inside the entry door.

2.3.3.4 Ropes and sheaves leading to the separate counterweight hoistways shall be protected against unauthorized access.

2.3.3.5 Not more than four counterweights shall be located in a single separate counterweight hoistway. Multiple counterweights located in a single hoistway shall be separated by means of an unperforated metal guard at the top, bottom, and center of the hoistway. Guards shall extend a minimum of 2 450 mm (96 in.) in length opposite the entry door. Doors and all other means described in 2.3.3.3 shall be provided for each counterweight.

2.3.3.6 There shall be a clearance of not less than 600mm(24 in.) between the weight in the counterweight frame and the wall containing the entry door.

2.3.4 Counterweight Runway Enclosures Where a counterweight is located in the same hoistway as the car, the runway for the counterweight shall be permitted to be separated from the runway for the car, provided it conforms to 2.3.4.1 and 2.3.4.2.

2.3.4.1 The partition shall be noncombustible. Unperforated metal partitions shall be equal to or stronger than 1.2 mm (0.047 in.) thick sheet steel. Openwork partitions shall be either wire grille at least 2.2 mm (0.087 in.) in diameter or expanded metal at least 2.2mm (0.087 in.) in thickness.

2.3.4.2 The counterweight runway shall be permitted to be fully enclosed for the full height, provided that the partitions are removable in sections weighing not more than 25 kg (55 lb), which permit inspection and maintenance of the entire

counterweight assembly and the inspection of the counterweight guide rails and guide-rail brackets.

SECTION 2.4
VERTICAL CLEARANCES AND RUNBYS FOR CARS AND COUNTERWEIGHTS

2.4.1 Bottom Car Clearances

2.4.1.1 When the car rests on its fully compressed buffers or bumpers, there shall be a vertical clearance of not less than 600 mm (24 in.) between the pit floor and the lowest structural or mechanical part, equipment, or device installed beneath the car platform, except as specified in 2.4.1.2.

2.4.1.2 The 600 mm (24 in.) clearance does not apply to

(a) any equipment on the car within 300 mm (12 in.) horizontally from any side of the car platform

(b) any equipment located on or traveling with the car located within 300 mm (12 in.) horizontally from either side of the car frame centerline parallel to the plane of the guide rails

(c) any equipment mounted in or on the pit floor located within 300 mm (12 in.) horizontally from either side of the car frame centerline parallel to the guide rail

2.4.1.3 In no case shall the available refuge space be less than either of the following:

(a) a horizontal area of 600 mm X 1 200 mm (24 in. X 48 in.) with a height of 600 mm (24 in) *(b)* a horizontal area of 450 mm X 900 mm (18 in. X 35 in.) with a height of 1 070 mm (42 in.)

2.4.1.4 Trenches and depressions or foundation encroachments permitted by 2.2.2.2 shall not be considered in determining these clearances.

2.4.1.5 When the car is resting on its fully compressed buffers or bumpers, no part of the car, or any equipment attached thereto or equipment traveling with the car, shall strike any part of the pit or any equipment mounted therein.

2.4.1.6 In any area in the pit, outside the refuge space, where the vertical clearance is less than 600 mm (24 in.), that area shall be clearly marked on the pit floor. Markings shall not be required in the area under the platform guard and guiding means if that is the only area in the pit where the vertical clearance is less than 600 mm (24 in.). The marking shall consist of alternating 100 mm (4 in.) diagonal red and white stripes. In addition, a sign with the words "DANGER LOW CLEARANCE" shall be prominently posted on the hoistway enclosure and be visible from within the pit and the entrance to the pit. The sign shall conform to ANSI Z535.2 or CAN/CSA-Z321, whichever is applicable (see Part 9). The sign shall be of such material and construction that the letters and figures stamped, etched, cast, or otherwise applied to the face shall remain permanently and readily legible.

Table 2.4.2.2 Minimum Bottom Runby for Counterweight Elevators With Spring Buffers or Solid Bumpers and Rheostatic Control or Single- Speed AC Control

Rated Speed, m/s (ft/min)	Runby, mm (in.)
Not over 0.13 (not over 25)	75 (3)
Over 0.13 to 0.25 (over 25 to 50)	150 (6)
Over 0.25 to 0.50 (over 50 to 100)	225 (9)
Over 0.50 to 1.0 (over 100 to 200)	300 (12)

2.4.2 Minimum Bottom Runby for Counterweighted Elevators

The bottom runby of cars and counterweights shall be not less than the requirements stated in 2.4.2.1 and 2.4.2.2.

2.4.2.1 Where oil buffers are used, the bottom runby shall be not less than 150 mm (6 in.), except that

(a) where practical difficulties prevent a sufficient pit depth or where a top clearance cannot be provided to obtain the runby specified, it shall be permitted to be reduced

(b) where spring-return-type oil buffers are used, the runby shall be permitted to be eliminated so that the buffers are compressed by amounts not exceeding those permitted by 2.22.4.8, when the car floor is level with the terminal landings

2.4.2.2 Where spring buffers or solid bumpers are used, the bottom runby shall be not less than 150 mm (6 in.), except for rheostatic and single-speed AC control, not less than shown in Table 2.4.2.2.

2.4.3 Minimum Bottom Runby for Uncounterweighted Elevators

The bottom runby of uncounterweighted elevators shall be not less than

(a) 75 mm (3 in.) where the rated speed does not exceed 0.15 m/s (30 ft/min)

(b) 150 mm (6 in.) where the rated speed exceeds 0.15 m/s (30 ft/min)

2.4.4 Maximum Bottom Runby

In no case shall the maximum bottom runby exceed

(a) 600 mm (24 in.) for cars

(b) 900 mm (35 in.) for counterweights

2.4.5 Counterweight Runby Data Plate

A data plate permanently and securely attached shall be provided in the pit, in the vicinity of the counterweight buffer, indicating the maximum designed counterweight runby. The data plate shall conform to 2.16.3.3, except that the letters shall be not less than 25 mm (1 in.) in height.

2.4.6 Top Car Clearances for Counterweighted Elevators

2.4.6.1 General Requirements. The top car clearance shall be not less than the sum of either of the following:

(a) the dimensions specified in 2.4.6.2(a) through (d)

(b) the dimensions specified in 2.4.6.2(a), (b), (c), and (e)

2.4.6.2 Components of the Top Car Clearances. The following shall be considered when calculating the minimum top car clearances:

(a) the designed maximum bottom counterweight runby [see 2.4.4(b)]

(b) the stroke of the counterweight buffer, determined as follows:

(1) for full-stroke buffers, the stroke of the buffer used, or the remaining stroke when the buffer is compressed with the car at the top terminal landing (see 2.4.2 and 2.22.4.8); or

(2) for reduced-stroke oil buffers (see 2.22.4.1.2), the full stroke required by 2.22.4.1.1.

(c) 600 mm (24 in.) 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, but in no case shall there be less than 150 mm (6 in.) clearance above the equipment, exclusive of guide shoe assemblies or gate posts for vertically sliding gates, mounted on the car top or in or on the car crosshead when the car has reached its maximum upward movement.

NOTE: See also 2.4.12, requirements for refuge space on top of car enclosure.

(d) 1/2 the gravity stopping distance, based on:

(1) 115% of the rated speed where oil buffers are used, or 115% of the reduced striking speed when emergency terminal speed-limiting devices meeting the requirements of 2.25.4 are used and no compensating rope tie-down device in conformance with 2.17.17 is provided (see 8.2.5 for gravity stopping distances); or

(2) the governor tripping speed where spring buffers are used.

(e) the distance to which the compensating rope tie down device, if provided (see 2.17.17) limits the jump of the car when the counterweight strikes the buffers at speeds specified in 2.4.6.2(d).

2.4.7 Top Car Clearance for Uncounterweighted Elevators

The top car clearance shall be not less than the greater of the following:

(a) 750 mm (29.5 in.); or

(b) 150 mm (6 in.), plus the amount that any equipment mounted on the car crosshead, or above the car top when no crosshead is provided, projects vertically above the crosshead or top.

NOTE (2.4.7): See also 2.4.12, requirements for refuge space on top of car enclosure.

2.4.8 Vertical Clearances With Underslung Car Frames

Where an underslung car frame is used, the clearances between the overhead car rope dead-end hitch or overhead car sheave and the portions of the car structure vertically below them, when the car floor is level with the top terminal landing, shall be not less than the following:

(a) where no counterweight is used, 230 mm (9 in.)

(b) where a counterweight is used, the sum of the following items:

(1) the bottom counterweight runby (see 2.4.2)

(2) the stroke of the counterweight buffer used, or the remaining stroke when the buffer is compressed with the car at the top terminal landing (see 2.4.2 and 2.22.4.8)

(3) 150 mm (6 in.)

(4) 1/2 the gravity stopping distance based on 115% of the rated speed where oil buffers are used, or 115% of the reduced striking speed when emergency terminal speed-limiting devices meeting the requirements of 2.25.4 are used and no provision is made to prevent the jump of the car at counterweight buffer engagement, or on governor tripping speed where spring buffers are used (see 8.2.5 for gravity stopping distances)

NOTE [2.4.8(b)(4)]: See also 2.4.12, requirements for refuge space on top of car enclosure.

2.4.9 Top Counterweight Clearances

The top counterweight clearance shall be not less than the sum of the following items:

(a) the bottom car runby (see 2.4.2)

(b) the stroke of the car buffer used, or the remaining stroke when the buffer is compressed with the car at the bottom terminal landing (see 2.4.2 and 2.22.4.8)

(c) 150 mm (6 in.)

(d) 1/2 the gravity stopping distance based on

(1) 115% of the rated speed where oil buffers are used, or 115% of the reduced striking speed when emergency terminal speed-limiting devices meeting the requirements of 2.25.4 are used and no provision is made to prevent the jump of the counterweight at car buffer engagement; or

(2) the governor tripping speed where spring buffers are used (see 8.2.5 for gravity stopping distances).

2.4.10 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 requirements of 2.4.10.1 and 2.4.10.2 shall be met.

2.4.10.1 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 2.4.6 and 2.4.7.

2.4.10.2 Such beams or construction shall be located not less than 600 mm (24 in.) horizontally from the crosshead.

2.4.11 Equipment on Top of Car Not Permitted to Strike Overhead Structure

When the car crosshead, or car top where no crosshead is provided, is at a distance equal to that specified in 2.4.6.2(c) 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.

2.4.12 Refuge Space on Top of Car Enclosure

2.4.12.1 An unobstructed horizontal area of not less than 0.5 m2 (5.4 ft2) shall be provided on top of the car enclosure for refuge space. It shall measure not less than 600 mm (24 in.) on any side. This area shall be permitted to include the space utilized for the top emergency exit [see 2.14.1.5.1(f)]. 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 1 100 mm (43 in.) when the car has reached its maximum upward movement.

2.4.12.2 In any area outside the refuge space where the vertical clearance between the top of the car enclosure and the overhead structure or other obstructions is less than specified in 2.4.12.1, the top of the car enclosure shall be clearly marked. The marking shall consist of alternating 100 mm (4 in.) diagonal red and white stripes. In addition, a sign with the words "DANGER LOW CLEARANCE" shall be prominently posted on the crosshead and be visible from the entrance. The sign shall conform to ANSI Z535.2 or CAN/CSA-Z321, whichever is applicable (see Part 9). The sign shall be of such material and construction that the letters and figures stamped, etched, cast, or otherwise applied to the face shall remain permanently and readily legible.

SECTION 2.5
HORIZONTAL CAR AND COUNTERWEIGHT CLEARANCES

2.5.1 Clearances Between Cars, Counterweights, and Hoistway Enclosures

2.5.1.1 Between Car and Hoistway Enclosures. The clearance between the car and the hoistway enclosure shall be not less than 20 mm (0.8 in.), except on the sides used for loading and unloading.

2.5.1.2 Between Car and Counterweight and Counterweight Guard. The clearance between the car and the counterweight shall be not less than 25 mm (1 in.). The clearance between the car and the counterweight guard, counterweight and the counterweight guard, and between the counterweight and the hoistway enclosure shall be not less than 20 mm (0.8 in.).

2.5.1.3 Between Cars in Multiple Hoistways. The running clearance between the cars and any equipment attached thereto, of elevators operating in a multiple hoistway, shall be not less than 50 mm (2 in.).

2.5.1.4 Between Car 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 or counterbalanced hoistway door, or of any vertically sliding counterbalanced biparting hoistway door, shall be not less than

(a) where car side guides are used

(1) 13 mm (0.5 in.) for all elevators except freight elevators

(2) 20 mm (0.8 in.) for freight elevators

(b) where car corner guides are used, 20 mm (0.8 in.)The maximum clearance shall be not more than 32mm (1.25 in.).

2.5.1.5 Clearance Between Loading Side of Car Platforms and Hoistway Enclosures

2.5.1.5.1 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

(a) 190 mm (7.5 in.) for vertically sliding doors

(b) 125 mm (5 in.) for other doors

2.5.1.5.2 This clearance shall be maintained until the car is resting on its fully compressed buffer.

2.5.1.5.3 The clearance is not limited on passenger elevators, provided that

(a) a car door interlock conforming to 2.14.4.2 is provided to prevent a door from being opened unless the car is within the unlocking zone

(b) the strength of the door complies with 2.11.11.2, 2.11.11.4, 2.11.11.6, 2.11.11.7, and 2.11.11.8

2.5.1.6 Clearance Between Car Platform Apron and Pit Enclosure. Where the lowest landing sill projects into the hoistway, the clearance between the car platform apron and the pit enclosure or fascia plate shall be not more than 32mm(1.25 in.). This clearance shall be maintained until the car is resting on its fully compressed buffer.

2.5.1.7 Measurement of Clearances. The clearances specified in 2.5.1 shall be measured with no load on the car platform.

SECTION 2.6
PROTECTION OF SPACE BELOW HOISTWAYS

Where a hoistway does not extend to the lowest floor of the building and there is space below the hoistway that is accessible, requirements of 2.6.1 and 2.6.2 shall be complied with.

2.6.1 Where the Space Is Underneath the Counterweight and/or Its Guides

Where the space is underneath the counterweight and/or its guides

(a) the counterweight shall be provided with a counterweight safety conforming to 2.17.4

(b) spring buffers, if used, shall conform to 2.22, except that they shall not be fully compressed when struck by the counterweight at the following speeds (see 2.1.2.3):

(1) at governor tripping speed where the counterweight safety is governor operated, or

(2) 125% of the rated speed where the counterweight safety is not governor operated

2.6.2 Where the Space Is Underneath the Car and/or Its Guides

Where the space is underneath the car and/or its guides and if spring buffers are used, they shall be so designed and installed that they will not be fully compressed solid or to a fixed stop when struck by the car with its rated load at the governor tripping speed (see 2.1.2.3).

SECTION 2.7
MACHINERY SPACES, MACHINE ROOMS, CONTROL SPACES, AND CONTROL ROOMS

A machinery space outside the hoistway containing an electric driving machine and a motor controller shall be a machine room.

2.7.1 Enclosure of Rooms and Spaces

Machinery space and control space enclosures located outside the hoistway and machine room and control room enclosures shall conform to the requirements of 2.7.1.1 or 2.7.1.2, and shall also conform to 2.7.1.3, as applicable.

2.7.1.1 Fire-Resistive Construction. Where the building code requires fire-resistive construction, the construction shall conform to the requirements of 2.7.1.1.1 and 2.7.1.1.2.

2.7.1.1.1 Spaces containing machines, motor controllers, sheaves, and other machinery shall be separated from the remainder of the building by a fire-resistive enclosure conforming to the requirements of the building code.

2.7.1.1.2 Openings in room and space enclosures shall be protected with access doors having a fire protection rating conforming to the requirements of the building code.

NOTES (2.7.1.1):

(1) See 2.1.3 for floors of machine rooms and control rooms over the hoistway.

(2) See 2.8.1 for separating elevator machinery from building machinery.

(3) See 2.1.1.1.2 for partitions between machine rooms and hoistways.

2.7.1.2 Non-Fire-Resistive Construction. Where the building code does not require fire-resistive construction, the construction shall conform to the requirements of 2.7.1.2.1 and 2.7.1.2.2.

2.7.1.2.1 Enclosure of the rooms or spaces shall comply with the following:

(a) Machine rooms and control rooms shall be enclosed with noncombustible material to a height of not less than 2 000 mm (79 in.).

(b) Machinery spaces shall be enclosed with noncombustible material to a height of not less than 2 000 mm (79 in.), or to the height of the machinery space if it is less than 2 000 mm (79 in.).

(c) Control spaces shall be enclosed with noncombustible material to a height of not less than 2 000 mm (79 in.).

2.7.1.2.2 The room and space enclosure, if of openwork material, shall reject a ball 50 mm (2 in.) in diameter.

2.7.1.3 Floors

2.7.1.3.1 Difference in Floor Levels. Differences in levels of floors shall be avoided where practicable. Where there is a difference in level exceeding 400 mm (16 in.), a standard railing conforming to 2.10.2 shall be provided (see also 2.7.3.3.1 and 2.7.3.3.2).

2.7.1.3.2 Where machine beams are provided, the floor shall be located above or level with the top of the machine beams.

2.7.2 Maintenance Path and Clearance

2.7.2.1 Maintenance Path in Machine Rooms and Control Rooms. A clear path of not less than 450 mm (18 in.) shall be provided to all components that require maintenance.

2.7.2.2 Maintenance Path in Machinery Spaces and Control Spaces. All components requiring maintenance in machinery spaces and control spaces shall have safe and convenient access.

2.7.2.3 Maintenance Clearance in Machine Rooms and Control Rooms. A clearance of not less than 450 mm (18 in.) shall be provided in the direction required for maintenance access.

2.7.2.4 Maintenance Clearance in Machinery Spaces and Control Spaces

2.7.2.4.1 Where a space is intended to be accessed with full bodily entry, then the requirements of 2.7.2.3 shall apply.

2.7.2.4.2 Where a space is not intended to be accessed with full bodily entry then all components requiring maintenance shall have safe and convenient access.

NOTE (2.7.2): For electrical clearance requirements, see NFPA 70 or CSA C22.1, whichever is applicable (see Part 9).

2.7.3 Access to Machinery Spaces, Machine Rooms, Control Spaces, and Control Rooms

2.7.3.1 General Requirements

2.7.3.1.1 A permanent and unobstructed means of access shall be provided to

(a) machine rooms and control rooms

(b) machinery spaces and control spaces outside the hoistway

(c) machinery spaces and control spaces inside the hoistway that do not have a means of access to the space as specified in 2.7.3.1.2.

(d) A control space and machinery space for elevators must only be located where working clearances required for the control space will not impede upon the path of travel in unrestricted areas. Where the elevator control space is located in a path of travel in an unrestricted area, a clear path of travel parallel to the control space must not be less than the required working clearance plus 1219 mm (48 in) perpendicular to the control space. A permanent barricade needed to establish the working clearances for the control space must be accessible to elevator personnel from the control space. The barricade must be deployed whenever the doors to the control space are in the open position. (See figure Q-2.)

2.7.3.1.2 Access to machinery spaces and control spaces inside the hoistway

(a) from the pit shall comply with 2.2.4 and 2.7.5.2.4

(b) from the car top shall comply with 2.12.6 and 2.12.7

(c) from a platform shall comply with 2.7.5.3.5

(d) from inside the car shall comply with 2.7.5.1.4

2.7.3.2 Passage Across Roofs. The requirements of 2.7.3.2.1 and 2.7.3.2.2 shall be conformed to where passage over roofs is necessary to reach the means of access to machinery spaces, machine rooms, control spaces, and control rooms.

2.7.3.2.1 A stairway with a swinging door and platform at the top level, conforming to 2.7.3.3, shall be provided from the top floor of the building to the roof level. Hatch covers, as a means of access to roofs, shall not be permitted.

2.7.3.2.2 Where the passage is over a roof having a slope exceeding 15 deg from the horizontal, or over a roof where there is no parapet or guard rail at least 1 070 mm (42 in.) high around the roof or passageway, a permanent, unobstructed and substantial walkway not less than 600 mm (24 in.) wide, equipped on the side sloping away from the walk with a railing conforming to 2.10.2.1, 2.10.2.2, and 2.10.2.3, shall be provided from the building exit door at the roof level to the means of access.

2.7.3.3 Means of Access. The means of access to the following shall conform to 2.7.3.3.1 through 2.7.3.3.5:

(a) machine rooms, control rooms, and machinery spaces and control spaces outside the hoistway, and machinery spaces and control spaces inside the hoistway that do not have a means of access to the space as specified in 2.7.3.1.2

(b) between different floor levels in machine rooms, in control rooms and in machinery spaces or control spaces outside the hoistway

(c) from within machine rooms or control rooms to machinery spaces and control spaces

2.7.3.3.1 A permanent, fixed, noncombustible ladder or stair shall be provided where the floor of the room or the space above or below the floor or roof from which the means of access leads, or where the distance between floor levels in the room or space, is more than 200 mm (8 in.).

2.7.3.3.2 A permanent, noncombustible stair shall be provided where the floor of the room or the space above or below the floor or roof from which the means of access leads, or where the distance between floor levels in the room or space, is 900 mm (35 in.) or more. Vertical ladders with handgrips shall be permitted to be used in lieu of stairs for access to overhead machinery spaces, except those containing controllers and motor generators.

2.7.3.3.3 Permanent, fixed, noncombustible ladders shall conform to ANSI A14.3.

2.7.3.3.4 Permanent, noncombustible stairs shall have a maximum angle of 60 deg from the horizontal, and shall be equipped with a noncombustible railing conforming to 2.10.2.1, 2.10.2.2, and 2.10.2.3.

2.7.3.3.5 A permanent, noncombustible platform or floor shall be provided at the top of the stairs with noncombustible railings conforming to 2.10.2.1, 2.10.2.2, and 2.10.2.3 on each open side. In jurisdictions not enforcing the NBCC, the size of the platform shall be sufficient to permit the full swing of the door plus 600 mm (24 in.) from the top of the riser to the swing line of the door. The floor of the platform shall be at the level of not more than 200 mm (8 in.) below the level of the access-door sill. Where the door swings inward, the width of the platform shall be not less than 750 mm (29.5 in.), and the length not less than the width of the door.

2.7.3.4 Access Doors and Openings

2.7.3.4.1 Access doors shall be

(a) self-closing and self-locking

(b) provided with a spring-type lock arranged to permit the doors to be opened from the inside without a key

(c) kept closed and locked

(d) Labeled "ELEVATOR EQUIPMENT" with letters not less than 51 mm (2 in) high.

2.7.3.4.2 Access doors to machine rooms, control rooms and control spaces must be provided.

2.7.3.4.3 Access doors for spaces specified in 2.7.4.2, 2.7.4.3, and 2.7.4.4 other than those for machine rooms or control rooms shall be a minimum width and height of 750 mm (29.5 in.). Keys to unlock the access doors shall be Group 2 Security (see 8.1).

2.7.3.4.4 Access doors for control spaces outside the hoistway shall be a minimum width and height of 750 mm (29.5 in.). Keys to unlock the access doors shall be Group 2 Security (see 8.1).

2.7.3.4.5 Doors are not required at openings in machine room or control room floors for access to machinery spaces, provided the access opening is provided on all four sides with a standard railing conforming to 2.10.2, one side of which is arranged to slide or swing to provide access to the ladder or stairs leading to the space. Trap doors, where provided, shall have a standard railing conforming to 2.10.2 or guard wings on all open nonaccess sides.

2.7.3.4.6 Access openings in elevator hoistway enclosures where full bodily entry is not necessary for maintenance and inspection of components shall be

(a) located to permit the required maintenance and inspection.

(b) of maximum width of 600 mm (24 in.) and a maximum height of 600 mm (24 in.). These dimensions shall be permitted to be increased, provided that any resultant opening through the access opening into the hoistway shall reject a 300 mm (12 in.) diameter ball.

(c) provided with doors that shall be kept closed and locked. Keys to unlock the access doors to the elevator hoistways shall be of Group 1 Security (see 8.1).

(d) labeled "DANGER: ELEVATOR HOISTWAY" with letters not less than 51 mm (2 in) high and have an electrical safety switch that will remove power from the hoist machine and brake if the door is opened.

2.7.3.5 Stop Switch for Machinery Spaces or Control Spaces. A stop switch conforming to 2.26.2.24, or a disconnecting means where required by NFPA 70 or CSA C22.1, whichever is applicable (see Part 9), accessible and visible from the point of access to machinery spaces or control spaces shall be provided for each elevator. Where access to machinery spaces is from the pit, from the top of the car, or from inside the car, the stop switch in the pit, the stop switch on top of the car, or, where provided, the emergency stop switch in the car, respectively, meet these requirements.

2.7.4 Headroom in Machinery Spaces, Machine Rooms, Control Spaces, and Control Rooms

2.7.4.1 Elevator machine rooms, control rooms, and machinery spaces containing an elevator driving machine not located in the hoistway shall have a clear headroom of not less than 2 130 mm (84 in.). (See also 2.7.4.5.)

2.7.4.2 Where a floor or platform is provided at the top of the hoistway (see 2.1.3), machinery spaces above such a floor or platform shall have a clear headroom of not less than the following:

(a) spaces containing motor-generators, 2 130 mm (84 in.)

(b) spaces containing only overhead, secondary, or deflecting sheaves, 1 070 mm (42 in.)

(c) spaces containing overhead, secondary, or deflecting sheaves, and governors, signal machines, or other equipment, 1 350 mm (53 in.)

2.7.4.3 Where floors are provided under overhead, secondary, or deflecting sheaves [see 2.7.4.2(b) and (c)] the machine and supporting beams shall be permitted to encroach on the required headroom, provided there is a clearance of not less than 900 mm (35 in.) high and minimum width of 750 mm (29.5 in.) in the path of access to sheaves, governors, signal machines, or other equipment.

2.7.4.4 Where a machinery space is located outside but not above the hoistway, the headroom of the area from which any work is performed on the equipment located inside such space shall be not less than 2 000mm (78 in.), except

(a) spaces containing motor-generators, the headroom shall be not less than 2 130 mm (84 in.)

(b) spaces containing only overhead, secondary, or deflecting sheaves, the headroom shall be not less than 1 070 mm (42 in.)

(c) spaces containing overhead, secondary, or deflecting sheaves, and governors, signal machines, or other equipment, the headroom shall be not less than 1 350 mm (53 in.)

(d) as permitted in 2.7.4.3

2.7.4.5 When working from inside the car, or from the top of the car in accordance with 2.7.5.1, or from the pit in accordance with 2.7.5.2, the headroom when the means required by 2.7.5.1 or 2.7.5.2 are engaged shall

(a) comply with the height of working space requirements of NFPA 70 or CSA C22.1, whichever is applicable (see Part 9)

(b) in no case be less than 1 350 mm (53 in.)

2.7.4.6 Control spaces outside the hoistway intended for full bodily entry shall have a clear headroom of not less than 2 000 mm (78 in.) or the height of the equipment, whichever is the greater.

NOTE: For control spaces outside the hoistway not intended for full bodily entry, seeNFPA70 orCSAC22.1, whichever is applicable (see Part 9).

2.7.5 Working Areas Inside the Hoistway and in the Pit

2.7.5.1 Working Areas in the Car or on the Car Top. The requirements of 2.7.5.1.1 through 2.7.5.1.4 shall be complied with if maintenance or inspections of the elevator driving machine brake, emergency brake, elevator motion controller, or motor controller are to be carried out from inside the car or from the car top.

2.7.5.1.1 If maintenance or inspection of the elevator driving machine brake or an emergency brake, or of elevator motion controllers or motor controllers from inside the car or from the car top could result in unexpected vertical car movement, a means to prevent this movement shall be provided.

2.7.5.1.2 The means shall

(a) be independent of the elevator driving machine brake, emergency brake, motion controller, and motor controller

(b) support not less than the unbalanced weight of the system with no load and up to rated load (see also 2.16.8) in the car and all suspension ropes in place. The minimum factor of safety shall be not less than 3.5, and the materials used shall not have an elongation of less than 15% in a length of 50 mm (2 in.) when tested in accordance with ASTM E8.

(c) when in the engaged position, actuate an electrical device conforming to 2.26.2.34, which shall cause the power to be removed from the elevator driving machine motor and brake

(d) not cause stresses and deflections that exceed the applicable requirements for the structure(s) to which the means transmits load based on 100% of the static unbalanced weight of the system (see also 2.16.8)

(e) have a sign in conformance with the requirements of ANSI Z535.2 or CAN/CSA-Z321, whichever is applicable, which shall be prominently posted in the work area stating: "WARNING! Engage '_____' before maintaining or inspecting brake, emergency brake, or controller. Follow manufacturers instructions for use of '_____'" (see 8.6.10.6). Unless the means has been designed to support not less than the unsuspended car with rated load (see also 2.16.8), it shall also contain the following wording: "Elevator suspension means must be in place during use."

NOTE: Substitute name of actual means for "____" in the above signage.

(f) be so designed as to prevent accidental disengagement

(g) when engaged, not require electrical power or the completion or maintenance of an electrical circuit to remain engaged.

2.7.5.1.3 When the means required in 2.7.5.1.1 is engaged, egress from the working area shall be provided (see also 2.7.3.4.3). The use of the car top emergency exit for egress and re-entry is permitted subject to the following:

(a) all edges of the exit opening are smooth and free of burrs

(b) means shall be provided to descend safely to the floor of the car, and subsequently ascend safely to the car top

(c) the means required in 2.7.5.1.1 shall not be arranged to be engaged at a position that would permit a vertical gap between the bottom of the vertical face of the platform guard and the elevator landing sill.

2.7.5.1.4 If provided, equipment access panels in the car for access to equipment outside the car shall comply with 2.14.2.2(g)(1), (2), and (5) and shall be provided with

(a) a key-operated lock capable of being locked without a key

(b) an electrical switch that shall cause the power to be removed from the driving machine motor and brake when the access panel is open (see 2.26.2.35)

(c) a key that shall be Group 1 Security (see 8.1) The access panels shall be kept closed and locked, shall not be self-closing, and shall be self-locking.

2.7.5.2 Working Areas in the Pit. The requirements of 2.7.5.2.1 through 2.7.5.2.4 shall be complied with if maintenance or inspections of the elevator driving machine brake or an emergency brake or of elevator motion controllers or motor controllers is to be carried out from the pit.

2.7.5.2.1 A means in compliance with 2.7.5.1.1, 2.7.5.1.2, and 2.7.4.5 shall be provided; or a mechanical device shall be provided to stop vertical car movement to create a vertical clearance as required by 2.7.4.5 between the floor of the working area and the lowest part of the car, and between the floor of the working area and the counterweight where a counterweight guard in conformance with 2.3.2 is not provided.

(a) The mechanical device shall be able to stop vertical car movement at up to and including 115% of rated speed with rated load. The retardation shall not exceed that required by 2.22.3 or 2.22.4, as applicable.

(b) The mechanical device shall be permitted to be moved into the active position manually or automatically.

(c) When the mechanical device is in the active position, it shall operate an electrical contact, which when in the open position, shall permit the car to move only on inspection operation [see 2.26.1.4.1 and 2.26.9.3(d)]. The electrical contact shall be positively opened mechanically and its opening shall not depend solely on springs.

(d) A sign in conformance with the requirements of ANSI Z535.2 or CAN/CSA-Z321, whichever is applicable, shall be prominently posted in the work area stating: "WARNING! Position '_____' before maintaining or inspecting brake, emergency brake, or controller. Follow manufacturers instructions for use of '____'" (see 8.6.10.6).

NOTE: Substitute name of actual device for "____" in the above signage.

(e) The mechanical device shall be designed to prevent accidental movement from the active position.

(f) The mechanical device shall not require electrical power or the completion or maintenance of an electrical circuit to be maintained in the active position.

2.7.5.2.2 Pit inspection operation, in compliance with 2.26.1.4, shall be permitted to be provided in the pit (see 2.26.1.4.4).

2.7.5.2.3 When the means required in 2.7.5.2.1 is in the active position, safe and convenient egress from the working area shall be provided (see also 2.7.3.4.3).

(a) Where the egress is through the landing door

(1) the landing door shall be openable from the hoistway side

(2) the means shall be arranged to provide vertical clearance of not less than 1 220 mm (48 in.) between the bottom edge of the platform guard and the elevator landing

(b) Where the egress is through a separate pit access door, the door opening shall not be blocked by the car.

2.7.5.2.4 Where maintenance or inspections of the elevator driving machine brake or an emergency brake or of elevator motion controllers or motor controllers is to be carried out from the pit, and the distance from the pit floor to this equipment is more than 2 100mm(83 in.), a means shall be permanently installed or permanently stored in the pit to provide access to the equipment.

2.7.5.3 Working Platforms. A platform located in the car, on the car, or in the hoistway shall be permitted for access to and maintenance and inspection of equipment in machinery spaces or control spaces in the hoistway and shall comply with 2.7.5.3.1 through 2.7.5.3.6 (see also 8.6.10.8).

2.7.5.3.1 A working platform shall be permanently installed, and it shall be permitted to be retractable. Retractable platforms, that are in the line of movement of the car or counterweight when in the operating position, shall operate a working platform electrical device(s) (see 2.26.2.36) that shall cause the power to be removed from the elevator driving machine motor and brake unless the platform is in its fully retracted position.

2.7.5.3.2 A working platform shall be able to support in any position at least 2 000 N (450 lb), with

a load concentration of at least 1 000 N (225 lb) over an area of 40 000 mm2 (64 in.2) with a factor of safety of not less than 5. If the platform is to be used for handling heavy equipment, the dimensions and the strength of the platform shall be considered accordingly.

2.7.5.3.3 A working platform shall be provided with a standard railing conforming to 2.10.2 on the open or exposed sides where the perpendicular distance between the edges of the platform and the adjacent hoistway enclosure exceeds 300 mm (12 in.) horizontal clearance, and the difference in level between the platform and the surrounding surface exceeds 400 mm (16 in.).

2.7.5.3.4 Where a car or counterweight passes within 300 mm (12 in.) horizontally from a working platform, a means of protection against shearing hazards shall be provided to a height as measured from the platform standing surface of not less than 2 130 mm (84 in.), or not less than the maximum upward movement of the car or counterweight. The means shall be at least equal in strength and stiffness to 2 mm(0.074 in.) thick sheet steel. If perforated, it shall reject a ball 25mm (1 in.) in diameter.

2.7.5.3.5 Where the access to a working platform that is in the line of movement of the car or counterweight is not through the elevator landing doors, but through an access panel or door in the hoistway, it shall be equipped with a device conforming to the requirements of 2.11.1.2(e) to prevent operation of the machine unless the access panel or door is closed and locked. **2.7.5.3.6** Working platform inspection operation, in compliance with 2.26.1.4, shall be permitted to be provided at the location of a working platform. [See 2.7.5.5(b) for additional requirements when the working platform is in the line of movement of the car.]

2.7.5.4 Working Platforms in the Line of Movement of the Car or Counterweight. Working platforms in the line of movement of the car or counterweight shall be permitted

(a) where retractable stops are provided and the car is

(1) below the platform, the travel of the elevator shall be limited by a retractable stop(s) in such a manner that the car shall be stopped below the platform at least the distance required for car top refuge space (see 2.4.12.1)

(2) above the platform the travel of the elevator shall be limited by a retractable stop(s) in such a manner that the car shall be stopped above the platform at least the distance required in 2.7.4.5; or

(b) where the elevator is provided with a device conforming to 2.7.5.1.1 and 2.7.5.1.2.

2.7.5.5 Retractable Stops. Retractable stops, where provided, shall

(a) be equipped with a retractable stop electrical device(s) (see 2.26.2.37), that shall cause the power to be removed from the elevator driving machine motor and brake, unless the stops are completely in the retracted position.

(b) be permitted to be equipped with an electrical device(s) that permits operation of the car only on inspection operation when the platform is in the operating position and the stops are in the fully extended position. When provided with such an electrical device and the stop(s) is in the extended position, an additional stopping device conforming to 2.25.3.1 and 2.25.3.3 through 2.25.3.5 shall cause the car to stop before it strikes the movable stop(s). This additional stopping device shall be rendered ineffective when the stop(s) is in the retracted position. Any electrical device(s) used to render the additional stopping device ineffective shall be in conformance with 2.26.4.3, 2.26.9.3(a), and 2.26.9.4.

(c) be operable from outside the hoistway or from the platform.

(d) be able to stop the car traveling at 115% of rated speed with rated load. The retardation shall not exceed that required by 2.22.3 or 2.22.4, as applicable.

(e) be so designed as to prevent accidental disengagement.

2.7.6 Location of Machinery Spaces, Machine Rooms, Control Spaces, Control Rooms, and Equipment

2.7.6.1 Location of Machine Rooms and Control Rooms. Elevator machine rooms and control rooms, where provided, shall not be located in the hoistway.

2.7.6.2 Location of machinery spaces and control spaces. Machinery spaces may be located inside or outside the hoistway. Control spaces are not permitted inside the hoistway. Control spaces are only permitted inside the building.

2.7.6.3 Location of Equipment. The location of equipment used directly in connection with the elevator shall conform to the requirements of 2.7.6.3.1 through 2.7.6.3.4.

2.7.6.3.1 The electric driving machine shall be located in a machinery space or machine room.

2.7.6.3.2 The motor controller shall be located in a machinery space, machine room, control space, or control room.

A motor controller shall be permitted to be located outside the specified spaces, provided it is enclosed in a locked cabinet. The locked cabinet shall be

(a) readily accessible for maintenance and inspection at all times.

(b) provided with cabinet door(s) or panel(s) that are not self-closing, that are self-locking, and which shall be kept closed and locked. Keys shall be Group 1 Security (see 8.1).

(c) lit by permanently installed electric lighting with a lighting intensity of at least 200 lx (19 fc) at the floor level.

(d) located in a space that is provided with natural or mechanical means to keep the ambient air temperature and humidity in the range specified by the elevator equipment manufacturer to ensure safe and normal operation of the elevator. The temperature and humidity range shall be permanently posted on the cabinet.

NOTE (2.7.6.3.2): For electrical clearance requirements, see NFPA 70 or CSA C22.1, whichever is applicable (see Part 9).

2.7.6.3.3 Where sheaves and other equipment (except governors) are located overhead inside the hoistway, they shall be provided with a means of access from outside the hoistway conforming to the requirements of 2.7.3.3, unless they can be inspected and serviced from the top of the car.

2.7.6.3.4 Where a governor is located inside the hoistway, means of access conforming to the requirements of §2.7.3.3 and §2.7.3.4 for inspection and servicing the governor must be provided from outside the hoistway.

2.7.6.4 Means Necessary for Tests. Where an elevator driving machine brake or an emergency brake, or an elevator motion controller or motor controller is located in the hoistway or pit, means necessary for tests that require movement of the car or release of the driving machine brake or emergency brake, shall be provided and arranged so that they can be operated from outside the hoistway and shall conform to 2.7.6.4.1 through 2.7.6.4.3. These means are also permitted to be used by elevator personnel for passenger rescue. These means must be permanently installed.

2.7.6.4.1 Where direct observation of the elevator drive sheave or ropes is not possible from the location of the means necessary for tests which require movement of the car or release of the driving machine brake or emergency brake, display devices or the equivalent shall be provided. They shall be visible from the location of the means and shall convey the following information about the elevator simultaneously

(a) the direction of movement

(b) the reaching of a position within the door unlocking zone

(c) an indication of the speed The display devices or the equivalent shall remain operable during a failure of the normal building power supply. The power source shall be capable of providing for the operation of the display devices or the equivalent for at least 4 h. Where batteries are used, a monitoring system shall be provided. In the event that during normal operation of the car, the monitoring indicates insufficient power to operate the display devices or the equivalent, the car shall not be permitted to restart after a normal stop at a landing.

2.7.6.4.2 The means necessary for tests shall be permitted to be located within an inspection and test panel conforming to the requirements of 2.7.6.5.2.

2.7.6.4.3 A means to move the car from outside the hoistway shall be provided and it shall conform to the following:

(a) it shall not be dependent on the availability of normal power.

(b) it shall be accessible for operation by elevator personnel only with a key that is Group 1 Security (see 8.1).

(c) it shall allow the car to move only with continuous effort.

(d) If the car is moved manually, the effort required to move the car in the direction of load imbalance must not exceed 400 N (90 lbf). If the means used is removable, it must be stored outside the hoistway and access to the means must be with a key that is Group 1 Security. It must be suitably marked to indicate the machine for which it is intended. It must also contain instructions on its use and be labeled "Machine Brake Release".

(e) Where the manual effort required to move the car exceeds 400 N (90 lbf), a means of electrical operation shall be provided to allow the car to be moved. This means of electrical operation shall require constant pressure operating devices to move the car, and when activated, operation of the car by all other operating means shall be prevented. A failure of a single constant pressure operating device shall not permit the elevator to move or continue to move. Where batteries are used for this electrical operation, a monitoring system shall be provided. In the event, that during normal operation of the car, the monitoring system indicates insufficient power to move the car, the car shall not be permitted to restart after a normal stop at a landing.

2.7.6.5 Inspection and Test Panel

2.7.6.5.1 The inspection and test panel shall be required where any of the following are not accessible from outside the hoistway:

(a) The "CAR DOOR BYPASS" and "HOISTWAY DOOR BYPASS" switches required by 2.26.1.5; or

(b) the devices necessary for the manual reset of the detection means for ascending car overspeed protection[see 2.19.1.2(a)(4)], and protection against unintended car movement [see 2.19.2.2(a)(4)], or

(c) the circuits of the following devices:

(1) the car-safety mechanism switch (see 2.26.2.9)

(2) the car buffer switch, where provided (see 2.26.2.22)

(3) the top and bottom final terminal stopping devices (see 2.26.2.11)

(4) the car and counterweight governor switches, where provided (see 2.26.2.10)

2.7.6.5.2 The inspection and test panel, where provided shall

(a) be readily accessible for maintenance and inspection at all times.

(b) have the required devices located behind a locked door or panel that does not open into the hoistway, which is not self-closing, which is self-locking, and which shall be kept closed and locked. Keys shall be of Group 1 Security (see 8.1).

(c) be provided with a stop switch, conforming to 2.26.2.24.

(d) be lit by permanently installed electric lighting with a lighting intensity of at least 200 lx (19 fc) at the floor level. A switch placed inside or close to the enclosure shall control lighting of the enclosure.

(e) include the display devices as required by 2.7.6.4.1.

(f) include the "CAR DOOR BYPASS" and "HOISTWAY DOOR BYPASS" switches where required by 2.26.1.5.

(g) include the devices necessary for the manual reset of the detection means for ascending car overspeed protection [see 2.19.1.2(a)(4)], and protection against Unintended Car Movement [see 2.19.2.2(a)(4)] where these devices are not accessible from outside the hoistway.

(h) where the circuits of the devices in 2.7.6.5.1(c)(1) through (4) are not accessible from outside the hoistway, include landing inspection operation in conformance with 2.26.1.4.4, and which shall be permitted to render ineffective the following electrical protective devices, individually or as a group or groups, in conformance with the requirements of 2.26.9.3(a) and 2.26.9.4:

(1) the car-safety mechanism switch (see 2.26.2.9)

(2) the car buffer switch, where provided (see 2.26.2.22)

(3) the top and bottom final terminal stopping devices (see 2.26.2.11)

(4) the car and counterweight governor switches, where provided (see 2.26.2.10)

NOTE (2.7.6.5): For electrical clearance requirements, see NFPA 70 or CSA C22.1, whichever is applicable (see Part 9). See also 2.8.3.3.2.

2.7.6.6 Equipment Exposure to Weather. Machines, control equipment, sheaves, and other machinery shall not be exposed to the weather unless they are suitable for the application.

2.7.7 Machine Rooms and Control Rooms Underneath the Hoistway

When a machine room or control room is located underneath the hoistway, it shall conform to 2.7.7.1 through 2.7.7.5. **2.7.7.1** The machine or control room shall have a solid ceiling (pit floor, at the normal pit depth) of concrete or steel above the machine room or control room, with a minimum 2 130 mm (84 in.) clearance above the machine room or control room floor.

2.7.7.2 The ceiling of the machine or control room shall be capable of sustaining a concentrated load of 1 000 N (225 lbf) on any 2 000 mm2 (3 in.2) area, and it shall be designed for a live load of 6 kPa (125 lbf/ft2) and loads imposed by rails and/or buffers, if applicable.

2.7.7.3 The car and counterweight guide rails and buffer supports shall be permitted to extend into the machine room and be supported by the machine room floor. If the counterweight buffer or buffer support extends to the machine room or control room floor, a counterweight safety is not required unless the space below the machine room is not permanently secured against access. If a counterweight buffer is supported at the machine room ceiling (pit floor), a counterweight safety is required. (See 2.6.1 for additional requirements.)

2.7.7.4 The solid ceiling (pit floor at normal pit depth) shall be permitted to be slotted for the penetration of equipment (suspension ropes, selector drives, electrical conduit, rails, buffers, etc.). Passage and guards shall be provided in conformance with 2.3.2 and 2.10.1 for both the machine or control room and pit. A counterweight guard shall be installed at the pit floor as well as the machine or control room floor if the counterweight extends into the machine or

control room and 2.3.2.1(a) does not apply. The guard in the machine or control room shall extend to the ceiling.

2.7.7.5 Compensating ropes or chains and traveling cables shall not extend into the machine room located underneath the hoistway.

2.7.8 Remote Machine Rooms and Control Rooms

Elevators that are provided with remote machine rooms and/or control rooms shall conform to 2.7.8.1 through 2.7.8.4.

2.7.8.1 Ropes and sheaves leading to the remote machine room that penetrate separate fire-resistive areas of the structure shall be fully enclosed, and the enclosures shall conform to 2.1.1.1.

2.7.8.2 Rope and sheave enclosures leading to the remote machine room shall be protected against unauthorized access.

2.7.8.3 Permanent means of access shall be provided to the enclosures for inspection, repair, and maintenance of hoist ropes passing over sheaves that are not located in the hoistway or remote machine rooms. Access doors to these enclosures shall be provided at each sheave location, conforming to 2.7.3.4. Access openings shall be provided for inspection and maintenance of hoist ropes passing over sheaves and shall conform to 2.7.3.4. A stop switch meeting the requirements of 2.26.2.23, a permanent electric duplex receptacle, a light switch, and light shall be provided in the enclosures immediately inside the access doors and openings.

2.7.8.4 A permanent means of communication between the elevator car and remote machine room and or control room shall be provided.

2.7.9 Lighting, Temperature, and Humidity in Machinery Spaces, Machine Rooms, Control Spaces, and Control Rooms

2.7.9.1 Lighting. Permanently installed electric lighting shall be provided in all machinery spaces, machine rooms, control spaces, and control rooms. The illumination shall be not less than 200 lx (19 fc) at the floor level, at the standing surface of a working platform (see 2.7.5.3), or at the level of the standing surface when the car is in the blocked position (see 2.7.5.1). The lighting control switch shall be located within easy reach of the access to such rooms or spaces. Where practicable, the light control switch shall be located on the lock-jamb side of the access door.

2.7.9.2 Temperature and Humidity. Machinery spaces, machine rooms, control spaces, and control rooms shall be provided with natural or mechanical means to keep the ambient air temperature and humidity in the range specified by the elevator equipment manufacturer to ensure safe and normal operation of the elevator. The temperature and humidity range, shall be permanently posted in the machine room, control room, control space, or where specified by the equipment manufacturer, in the machinery space.

SECTION 2.8
EQUIPMENT IN HOISTWAYS, MACHINERY SPACES, MACHINE ROOMS, CONTROL SPACES, AND CONTROL ROOMS

2.8.1 Equipment Allowed Only machinery and equipment used directly in connection with the elevator shall be permitted in elevator hoistways, machinery spaces, machine rooms, control spaces, and control rooms.

2.8.2 Electrical Equipment and Wiring

2.8.2.1 Installation of electrical equipment and wiring shall conform to NFPA 70 or CSA-C22.1, whichever is applicable (see Part 9).

2.8.2.2 Only such electrical wiring, raceways, and cables used directly in connection with the elevator, including wiring for signals, for communication with the car, for lighting, heating, air conditioning, and ventilating the car, for fire detecting systems, for pit sump pumps, and for heating and lighting the hoistway and/or the machinery space, machine room, control space, or control room shall be permitted to be installed inside the hoistway, machinery space, machine room, control space, or control room.

2.8.2.3 Bonding conductors from the lightning protection system grounding down conductor to long vertical metal bodies in the hoistway such as elevator rails and vertical wireways shall be permitted to be installed in the hoistway as required by NFPA 780, or CAN/CSAB72, whichever is applicable (see Part 9). The lightning protection system grounding down conductor shall not be permitted in the hoistway, and the elevator rails shall not be used as the lightning protection system grounding down conductor. Bonding conductors installed in the hoistway shall not interfere with the operation of the elevator.

2.8.3 Pipes, Ducts, Tanks, and Sprinklers

2.8.3.1 Steam and hot-water pipes shall be permitted to be installed in hoistways, machinery spaces, machine rooms, control spaces, and control rooms for the purpose of heating these areas only, subject to 2.8.3.1.1 through 2.8.3.1.3.

2.8.3.1.1 Heating pipes shall convey only low-pressure steam [100 kPa (15 psi) or less] or hot water [100°C (212°F) or less].

2.8.3.1.2 All risers and return pipes shall be located outside the hoistway. When the machinery space, machine room, control space, or control room is located above the roof of the building, heating pipes for the machinery space, machine room, control space, or control room shall be permitted to be located in the hoistway between the top floor and the machinery space, machine room, control space, or control room.

2.8.3.1.3 Traps and shutoff valves shall be provided in accessible locations outside the hoistway.

2.8.3.2 Ducts shall be permitted to be installed in the hoistway, machinery space, machine room, control space, or control room for the purpose of heating, cooling, ventilating, and venting these areas only and shall not encroach upon the required clearances.

2.8.3.3 Sprinkler systems conforming to NFPA 13 must be permitted to be installed in the hoistway or machinery space, subject to §2.8.3.3.1 through §2.8.3.3.4.

2.8.3.3.1 All risers and returns shall be located outside these spaces. Branch lines in the hoistway shall supply sprinklers at not more than one floor level. When the machinery space, machine room, control space, or control room is located above the roof of the building, risers, return pipes, and branch lines for these sprinklers shall be permitted to be located in the hoistway between the top floor and the machinery space, machine room, control space, or control room.

2.8.3.3.2 In jurisdictions not enforcing the NBCC, where elevator equipment is located or its enclosure is configured such that application of water from sprinklers could cause unsafe elevator operation, means shall be provided to automatically disconnect the main line power supply to the affected elevator upon or prior to the application of water.

(a) This means shall be independent of the elevator control and shall not be self-resetting.

(b) Heat detectors and sprinkler flow switches used to initiate main line elevator power shutdown shall comply with the requirements of NFPA 72.

(c) The activation of sprinklers outside of such locations shall not disconnect the main line elevator power supply. See also 2.27.3.3.6.

2.8.3.3.3 Smoke detectors shall not be used to activate sprinklers in these spaces or to disconnect the main line power supply.

2.8.3.3.4 In jurisdictions not enforcing the NBCC, when sprinklers are installed in the hoistway, all electrical equipment, except earthquake protective devices conforming to 8.4.10.1.2(d), located less than 1 220 mm (48 in.) above the pit floor, shall be

(a) weatherproof (NEMA4)

(b) wiring shall be identified for use in wet locations in accordance with the requirements in NFPA 70

2.8.3.4 Other pipes or ducts conveying gases, vapors, or liquid and not used in connection with the operation of the elevator shall not be installed in any hoistway, machinery space, machine room, control space, or control room. Where a machinery space, machine room, control space, control room, or hoistway extend above the roof of a building, pipes shall be permitted from roof drains to the closest point where they can be diverted out of this space. Pipes shall be covered to prevent leakage or condensate from entering the machinery space, machine room, control space, control room, or hoistway.

2.8.3.5 Where permitted and provided, pipes, drains, and tanks, or similar equipment that contains liquids, shall not be located directly above the elevator equipment and shall not encroach upon the required clearances in the hoistway, machinery space, machine room, control space, or control room.

2.8.4 Electrical Heaters

Listed/certified electrical heaters shall be permitted.

2.8.5 Air Conditioning

Air conditioning equipment is permitted to be installed in machinery spaces, machine rooms, control spaces, or control rooms for the purpose of cooling these areas only, subject to 2.8.5.1 through 2.8.5.5.

2.8.5.1 Air conditioning equipment shall not be located directly above elevator equipment.

2.8.5.2 The clear headroom below suspended air conditioning equipment shall conform to 2.7.4.

2.8.5.3 Means shall be provided to collect and drain condensation water from these spaces. Condensation drains shall not be located directly above elevator equipment. Drains connected directly to sewers shall not be installed.

2.8.5.4 Safe and convenient access within the elevator machinery space, machine room, control space, or control room shall be provided to the air-conditioning equipment for servicing and maintaining.

NOTE: See also 2.7.3.1.

2.8.5.5 There shall be no exposed gears, sprockets, belts, pulleys, or chains.

NOTES (2.8.5):

(1) See 2.8.3.2 for requirements for duct work.

(2) These requirements do not pertain to air-conditioning equipment used to cool selective elevator equipment.

2.8.6 Miscellaneous Equipment

Enclosed moving, rotating, hanging machinery, equipment, stationary decorative lighting, stationary signage or other stationary special effects devices, securely attached to either one or more of the car,

counterweight, or hoistway shall be permitted, provided that the elevator, including the equipment and devices, conforms to 2.4, 2.5, 2.8.1, 2.14.2.1.1, 2.15.7, 8.2.2.1, and 8.2.9.1. Any unenclosed moving, rotating, or hanging machinery or equipment, attached to the exterior of the car or counterweight, interior of the hoistway, exterior of the car, or any other elevator equipment in the hoistway is prohibited unless it is used in conjunction with the designed use of the elevator.

SECTION 2.9
MACHINERY AND SHEAVE BEAMS, SUPPORTS, AND FOUNDATIONS

2.9.1 Supports Required

Machines, machinery, sheaves, and hitches shall be supported by overhead beams, structural floors, structural walls, or guide rails.

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

2.9.1.2 Supporting beams, if used, shall be of steel or reinforced concrete.

2.9.1.3 Beams are not required under machine(s), sheave(s), and machinery or control equipment that is supported on floors, provided such floors are designed and installed to support the load imposed thereon, or where supported by guide rails or structural walls designed to meet the requirements of 2.9.3.3.

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

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

(a) 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 that portion, if any, of the machinery space, machine room, control space, or control room floor supported thereon

(b) two times the sum of the tensions in all wire ropes supported by the beams, floors, and their supports with rated load in the car

NOTE [2.9.2.1(b)]: These tensions are doubled to take care of accelerations and decelerations.

2.9.2.2 Foundations, Beams, and Floors for Machinery and Sheaves Not Located Directly Over the Hoistway. The supports for machines and sheaves located below or at the sides of the hoistway shall meet the requirements of 2.9.2.2.1 through 2.9.2.2.4.

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

2.9.2.2.2 The sheave beams and the foundation bolts shall withstand two times the vertical force component acting thereon as a result of the tension in all the suspension ropes, less the weight of the machine or sheaves.

2.9.2.2.3 The sheave beams and the foundation bolts shall withstand two times the horizontal force component, if any, acting thereon as a result of the tension in all the suspension ropes.

2.9.2.2.4 The foundation shall withstand two times the overturning moment, if any, acting thereon as a result of the tension in all the suspension ropes.

2.9.3 Securing of Machinery and Equipment to Beams, Foundations, Guide Rails, Structural Walls, or Floors

2.9.3.1 Overhead Beams and Floors

2.9.3.1.1 Where overhead beams and floors are used to support machinery or equipment, the machinery or equipment shall be secured to and supported on or from the top of overhead beams or floors, except for the following equipment:

(a) secondary or deflecting sheaves of traction elevators

(b) devices and their accessories for limiting or retarding car speed

2.9.3.1.2 Securing bolts or fastenings are not required where sound isolation in compression is used between bases of machinery or equipment and supporting beams or floors.

2.9.3.2 Beams or Foundations Supporting Machinery and Sheaves Not Located Directly Over the Hoistway

2.9.3.2.1 Machines and sheaves located below or at one side of a hoistway shall be anchored to beams, foundations, or floors with bolts, conforming to ASTM A 307, of sufficient size and number to withstand the applicable load conditions specified in 2.9.2.2. Based on these initial loads, total tension in anchor bolts shall not exceed 85 MPa (12,000 psi) of net section, and the total shear shall not exceed 60 MPa (9,000 psi) of actual area in the shear plane. (See also 2.9.3.5.)

2.9.3.2.2 Where bolts are used through greater than 5 deg 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 greater than 5 deg sloping flanges shall seat on beveled steel washers.

2.9.3.3 Securing of Machines, Sheaves, Equipment, and Hitches to Guide Rails or Structural Walls

2.9.3.3.1 Machines, sheaves, equipment, and hitches shall be permitted to be secured to and supported by the guide rails or structural walls, provided that the tension in the hoisting ropes and the weight of the equipment will not develop direct tensions in the bolts or rivets.

2.9.3.3.2 Securing bolts or fastenings are not required where sound isolation in compression is used between bases of machinery or equipment and their supports.

2.9.3.3.3 Bolts used to secure equipment to the guide rails or structural walls shall conform to ASTM A 307, and be of sufficient size and number to withstand the applicable load conditions specified in 2.9.2.2. Based on these initial loads, total tension in support bolts shall not exceed 85 MPa (12,000 psi) of net section, and the total shear in bolts and rivets shall not exceed 60 Mpa (9,000 psi) of actual area in the shear plane. The requirements of 2.9.3.2.2 for bolts and 2.9.3.4.3 and 2.9.3.4.4 for hitch plates shall also apply. The stresses in welds due to tensions in the hoisting ropes shall not exceed 55 Mpa (8,000 psi) on the throat area of the welds. (See also 2.9.3.5.)

2.9.3.3.4 Guide rails used to support machines, equipment, sheaves, and hitches shall meet the requirements of 2.23.4.

2.9.3.4 Overhead Hoisting Rope Hitches

2.9.3.4.1 Where hoisting ropes are secured to the structure above a hoistway, the hitch plates and hitchplate blocking beams, where used, shall be secured to and mounted on top of overhead beams, machine beams, or on top of auxiliary beams connected to the webs of overhead beams.

2.9.3.4.2 Hitch plates, blocking, or auxiliary beams shall be secured by bolts conforming to ASTM A 307, rivets conforming to ASTM A 502, or welding conforming to 8.8, and shall be so located that the tension in the hoisting ropes will not develop direct tensions in the bolts or rivets. Where bolts and rivets are subjected to shearing stresses due to tension in the hoisting ropes, the total shear shall not exceed 60 MPa (9,000 psi) of actual area in the shear plane. The stresses in welds due to tensions in the hoisting ropes shall not exceed 55 Mpa (8,000 psi) on the throat area of the welds. (See also 2.9.3.5.)

2.9.3.4.3 The hitch plate supporting structure shall be designed to withstand two times the sum of the tensions in all hoisting ropes attached to the hitch plates. (See also 2.15.13.)

2.9.3.4.4 Total stresses in hitch plates and hitchplate shapes shall not exceed 85 MPa (12,000 psi).

2.9.3.5 Bolts Made of Steel. Bolts made of steel used to comply with the requirements of 2.9.3.2.1, 2.9.3.3.3, and 2.9.3.4.2 having a greater strength than specified by ASTM A 307 shall be permitted, provided that the maximum allowable stresses increased proportionally based on the ratio of the ultimate strengths. Elongation shall conform to the requirements of the corresponding ASTM specification.

2.9.3.6 Cast Metals in Tension or Bending. Cast metals having an elongation of less than 20% in a length of 50mm(2 in.), when measured in accordance with ASTM E 8, which are subject to tension or bending, shall not be used to support machinery or equipment from the underside of overhead beams or floors.

2.9.4 Allowable Stresses for Machinery and Sheave Beams or Floors, Their Supports, and Any Support Members That Transmit Load to the Guide Rails or Structural Walls

2.9.4.1 The unit stresses for all machinery and sheave beams and floors and their supports, based on the loads computed as specified in 2.9.2 or 2.9.6, whichever is greater, shall not exceed 80% of those permitted for static loads by the following standards:

(a) Structural Steel. AISC Book No. S326 or CAN/CSA-S16.1, whichever is applicable (see Part 9).

(b) Reinforced Concrete. ANSI/ACI 318 or CAN3-A23.3, whichever is applicable (see Part 9).

2.9.4.2 Where stresses due to loads, other than elevator loads supported on the beams or floor, exceed those due to the elevator loads, 100% of the permitted stresses are permitted.

2.9.4.3 Cast Metals in Tension or Bending. Cast metals having an elongation of less than 20% in a length of 50mm(2 in.), when measured in accordance with ASTM E 8, which are subject to tension or bending, shall not be used to support machinery or equipment from guide rails or structural walls.

2.9.5 Allowable Deflections of Machinery and Sheave Beams, Their Supports, and Any Support Members Loaded in Bending Which Transmit Load to Guide Rails or Structural Walls

The allowable deflections of machinery and sheave beams, their immediate supports, and any support members loaded in bending which transmit load to guide rails or structural walls under static load shall not exceed l/1666 of the span.

2.9.6 Allowable Stresses Due to Emergency Braking

Machinery and sheave beams, supports, any support members which transmit load to guide rails or structural walls and any fastenings subject to forces due to the application of the emergency brake (see 2.19.4) shall be designed to withstand the maximum forces developed during the retardation phase of the emergency braking so that the resulting stresses due to the emergency braking and all other loading acting simultaneously, if applicable, shall not exceed those specified in 2.9.4.

SECTION 2.10
GUARDING OF EQUIPMENT AND STANDARD RAILING

2.10.1 Guarding of Equipment

In machinery spaces, machine rooms, control spaces, and control rooms, the following shall be guarded to protect against accidental contact:

(a) driving machine sheaves and ropes whose vertical projection upon a horizontal plane extends beyond the base of the machine, unless the driving machine sheave is so located as to minimize the possibility of contact

(b) sheaves

(c) exposed gears, sprockets, tape or rope sheaves, or drums of selectors, floor controllers, or signal machines, and their driving ropes, chains, or tapes

(d) keys, keyways, and screws in projecting shafts Handwinding wheels and flywheels that are not guarded shall have yellow markings.

2.10.2 Standard Railing

A standard railing shall be substantially constructed of metal and shall consist of a top rail, intermediate rail or equivalent structural member or solid panel, and toe board.

2.10.2.1 Top Rail. The top rail shall have a smooth surface, and the upper surface shall be located at a vertical height of 1 070 mm (42 in.) from the working surface.

2.10.2.2 Intermediate Rail, Member, or Panel. The intermediate rail or equivalent structural member or solid panel shall be located approximately centered between the top rail and the working surface.

2.10.2.3 Toe-Board. The toe-board shall be securely fastened and have a height not less than 100 mm (4 in.) above the working surface.

2.10.2.4 Strength of Standard Railing. A standard railing shall be capable of resisting anywhere along its length the following forces when applied separately, without deflecting more than 75 mm (3 in.) and without permanent deformation:

(a) a force of at least 890 N (200 lbf) applied in any lateral or downward vertical direction, at any point along the top rail.

(b) a force of at least 666 N (150 lbf) applied in any lateral or downward vertical direction at any point along the center of the intermediate rail, member, or panel. If the standard railing is a solid panel extending from the top rail to the toe-board, the application of the force specified in 2.10.2.4(a) shall be considered to meet the requirements of 2.10.2.4(b).

(c) a force of 225 N (50 lbf) applied in a lateral direction to the toe-board.

SECTION 2.11
PROTECTION OF HOISTWAY OPENINGS

2.11.1 Entrances and Emergency Doors Required

2.11.1.1 Hoistway Landing Entrances. All elevator hoistway landing openings shall be provided with entrances that shall guard the full height and width of the openings. Entrances must be at least 2 030 mm (80 in) in height and 915 mm (36 in) in width.

2.11.1.2 Emergency Doors in Blind Hoistways. Where an elevator is installed in a single blind hoistway, there shall be installed in the blind portion of the hoistway an emergency door at every third floor, but not more than 11 m (36 ft) from sill to sill, conforming to the following:

(a) The clear opening shall be at least 915 mm (36 in wide) by 2 030 mm (80 in) high.

(b) It shall be easily accessible and free from fixed obstructions.

(c) It shall be either of the horizontally sliding or swinging single-section type, irrespective of the type of door installed at other landings.

(d) It shall be self-closing and self-locking and shall be marked, in letters not less than 50 mm (2 in.) high, "DANGER, ELEVATOR HOISTWAY."

(e) It shall be provided with an electromechanical device that will prevent the operation of the driving machine unless the door is closed and locked (see 2.26.2.25).

(f) It shall be unlocked from the landing side only through the use of a cylinder-type lock, having not less than five pins or five discs. The cylinder lock shall

(1) not be unlocked by any key that will open any other lock or device used for any purpose in the building

(2) be so designed that the key shall be removable only in the locked position

(g) It shall be openable from the hoistway side without the use of a key.

(h) The key shall be of Group 1 Security (see 8.1). This key shall also be made available to emergency personnel during an emergency.

(i) A hinged self-closing barrier independent of the door shall be installed horizontally across the entrance on the hoistway side at a height of 1 070 mm (42 in.). The barrier shall not open into the hoistway.

2.11.1.3 Telephone as Alternative to Emergency Doors. Where an elevator is installed in a single blind hoistway, and there are no landings from which to gain access through an emergency door, a means of two-way conversation conforming to 2.27.1.1 shall be provided.

NOTE: Examples are pulp mills, grain elevators, dams, or similar locations.

2.11.1.4 Access Openings for Cleaning of Car and Hoistway Enclosures. Nonremovable sliding or swing panels or doors in the hoistway conforming to 2.11.1.2(d), (f), (g), and (i) shall be permitted for access to car or hoistway transparent enclosures for cleaning purposes. An electromechanical device shall be provided that will prevent the operation of the driving machine unless the access panels or doors are closed and locked (see 2.26.2.32). Key shall be Group 2 Security (see 8.1).

2.11.2 Types of Entrances

2.11.2.1 Passenger Elevators. For passenger elevators, entrances shall be one of the following types:

(a) horizontally sliding;

(b) horizontally swinging, single-section;

(c) Reserved

(d) hand- or power-operated vertically sliding that slide up to open.

2.11.2.2 Freight Elevators. For freight elevators, entrances shall be one of the following types:

(a) horizontally sliding

(b) swinging, single-section

(c) Reserved

(d) center-opening, two-section horizontally swinging, subject to restrictions of 2.11.2.3

(e) vertically sliding biparting counterbalanced (see 2.16.4)

(f) vertically sliding counterweighted, single or multisection

2.11.2.3 Limitations of Use of Center-Opening Swinging Entrances. Center-opening swinging entrances shall be permitted only

(a) for freight elevators which can be operated only from the car; or

(b) for freight elevators not accessible to the general public that can be operated from outside the hoistway, and that are located in factories, warehouses, garages, and similar industrial buildings.

2.11.3 Closing of Hoistway Doors

2.11.3.1 Horizontally sliding or single-section swinging doors of automatic-operation elevators shall be provided with door closers arranged to close an open door automatically if the car, for any reason, leaves the landing zone.

2.11.3.2 Horizontally sliding doors shall be closed when the car is at a landing, except when

(a) the car is operated by a designated attendant in the car;

(b) loading or unloading;

(c) the elevator conforms to 2.27.3.2.1 and 2.27.3.2.3 through 2.27.3.2.6, Phase I Emergency Recall Operation by fire alarm initiating device; or

(d) the car is at the recall level when Phase I is in effect [see 2.27.3.1.6(a)].

2.11.3.3 On center-opening doors, if there is an interlock on only one panel, the door closer required by 2.11.3.1 shall be provided on the leading panel that operates in the opposite direction (see 2.11.11.7).

2.11.4 Location of Horizontally Sliding or Swinging Hoistway Doors

Horizontally sliding or swinging doors shall be so located that the distance from the hoistway face of the doors to the edge of the hoistway landing sill, measured from the face of the door section nearest to the car, shall be not more than the requirements specified in 2.11.4.1 and 2.11.4.2.

2.11.4.1 For elevators that can be operated only from the car, 100 mm (4 in.), except that where new elevators are installed in existing multiple hoistways or where alterations involving replacement of the doors are made to existing elevators in multiple hoistways, and the location of the door openings is such that the 100 mm (4 in.) dimension specified cannot be maintained, the distance specified is permitted to be increased to not more than 125mm(5 in.) where horizontally sliding doors are used.

2.11.4.2 For elevators with automatic or continuous pressure operation, 19 mm (0.75 in.) for swinging doors and 57 mm (2.25 in.) for sliding doors, except that

(a) freight elevators not accessible to the general public, and which are located in factories, warehouses, garages, and similar industrial buildings are permitted to have single-section or center-opening two-section

horizontally swinging doors conforming to 2.11.4.1; or

(b) for swinging doors used on elevators with automatic and continuous-pressure operation, the distance shall be permitted to be increased from 19 mm to 57 mm (0.75 in. to 2.25 in.) if such doors are emergency doors conforming to 2.11.1. (See also 2.14.4.5.)

2.11.5 Projection of Entrances and Other Equipment Beyond the Landing Sills

Entrances and equipment shall not project into an elevator hoistway beyond the line of the landing sill, except for

(a) equipment required for interlocking, indicator and signal devices, and door operating devices

(b) vertical slide entrances

2.11.6 Opening of Hoistway Doors

2.11.6.1 When the car is within the unlocking zone, the hoistway doors shall be openable by hand from within the car without the use of tools.

2.11.6.2 Means shall not be provided for locking out of service the doors at

(a) the top terminal landing

(b) the bottom terminal landing

(c) the designated and alternate landings for elevators equipped with Phase I Emergency Recall Operation, when Phase I is effective

(d) Any landing for elevator equipped with Phase II Emergency In-Car Operation with Phase II is effective.

(e) Consecutive vacant floors.

(f) Main lobby street floor.

2.11.6.3 Egress from the interior of the car to any elevator landing by means of the car and hoistway doors shall be unrestricted once the car and hoistway doors are open.

2.11.6.4 Handles or other means provided for operation of manually operated doors shall be so located that it is not necessary to reach the back of any panel, jamb, or sash to operate them.

2.11.6.5 Vestibule.

2.11.6.5.1 Elevator landings provided with a zero clearance vestibule (not to exceed 150 mm (6 in) from the elevator hoistway door) are permissible only when locking devices accessible from the car are installed exclusively on the door that separates the zero clearance vestibule from the occupied floor space.

2.11.6.5.2 Where the vestibule is not a zero clearance vestibule as defined in §2.11.6.5.1, locking devices at the vestibule will be permitted under any one of the following conditions:

(a) A red telephone is installed in the vestibule near the elevator doors to communicate with lobby fire command station or building manager's office or to central service station when the building is not attended. A sign must be posted near the telephone. The sign must read "In Case of Fire or Other Emergency Use This Phone to Contact Lobby or Building Manager or Central Service Station";

(b) The locking devices on the vestibule door leading to an exit are released upon activation of any detection or signaling devices, or power failure;

(c) At least one exit stair is located within the vestibule.

2.11.7 Glass in Hoistway Doors

Glass in hoistway doors shall conform to 2.11.7.1 and 2.11.7.2.

2.11.7.1 Vision panels. For elevators with automatic or continuous-pressure operation, manually operated or self-closing hoistway doors of the vertically or horizontally sliding type must be provided with a vision panel. In multi-section doors, the vision panel is required in one section only, but is permitted to be placed in all sections. All horizontally swinging elevator doors must be provided with vision panels. Vision panels are permitted for any type of hoistway door. Vision panels are not required at the landing of automatic operation elevators equipped with horizontally sliding car and hoistway doors.

Where required or used, vision panels must conform to §2.11.7.1.1 through §2.11.7.1.7.

2.11.7.1.1 The area of any single vision panel must not be less than 0.008 m^2 (12 in^2), and the total area of one or more panels in any hoistway door must not be more than 0.026 m^2 (40 in^2).

2.11.7.1.2 Each clear panel opening shall reject a ball 150 mm (6 in.) in diameter.

2.11.7.1.3 Muntins used between panel sections shall be of noncombustible material and of substantial construction.

2.11.7.1.4 Panel opening shall be glazed with either of the following:

(a) clear wire glass not less than 6 mm (0.25 in.)

(b) other transparent glazing material not less than 6 mm (0.25 in.) thick that meets the impact safety standard 16 CFR Part 1201 or CAN/CGSB-12.1, CAN/ CGSB-12.11, or CAN/CGSB-12.12, whichever is applicable (see Part 9)

2.11.7.1.5 The center of the panel shall be located not less than 1 300 mm (51 in.) and not more than 1 700 mm (67 in.) above the landing, except that for vertically sliding biparting counterbalanced doors, it

shall be located to conform to the dimensions specified insofar as the door design will permit.

2.11.7.1.6 Vision panels in power-operated doors shall be substantially flush with the surface of the landing side of the door.

2.11.7.1.7 Vision panels shall be protected by protective grilles made of steel not less than 1.4 mm (0.055 in.) thick, in accordance with the following specifications:

(a) Grilles shall be sized to fit within or over the vision panel frame and completely cover the vision panel opening in the hoistway door.

(b) Grilles shall be secured by means that deter removal by common tools.

(c) Grilles shall contain openings that shall be not larger than 19 mm X 19 mm (0.75 in. X 0.75 in.) in diameter. Such openings shall be spaced at 25 mm(1 in.) center-to-center. *(d)* Grille edges shall be free of burrs and beveled.

(e) Grilles shall be installed on the hoistway side of the door.

2.11.7.2 Glass Doors. Where provided, glass hoistway doors shall conform to 2.11.7.2.1 through 2.11.7.2.5.

2.11.7.2.1 The glass shall be laminated glass conforming to 16 CFR Part 1201 or CAN/CGSB-12.1. Markings as specified in the applicable standard shall be on each separate piece of glass and shall remain visible after installation.

2.11.7.2.2 The glass shall be not less than 60% of the total visible door panel surface area as seen from the landing side of the doors. Door lap shall not be used in calculating glass size.

2.11.7.2.3 In power-operated doors, the glass panel shall be substantially flush with the surface of the landing side of the door.

2.11.7.2.4 A nonglass edge shall be provided on the leading edge of the door panel.

2.11.7.2.5 The glass door shall conform to 2.11.11.5.7 for horizontally sliding type entrances, 2.11.12.4 for vertically sliding type entrances, or 2.11.13.3 for swinging entrances.

2.11.8 Weights for Closing or Balancing Doors

Hoistway door weights, where used for closing or balancing doors, shall be guided or restrained to prevent them from coming out of their runway. The bottom of the guides or other restraining means shall be so constructed as to retain the weights if the weight suspension means breaks.

2.11.9 Hoistway Door Locking Devices and Power Operation

2.11.9.1 Locking Devices. Doors shall be provided with door locking devices conforming to 2.12.

2.11.9.2 Power Operation. Where hoistway doors are power operated or are opened or closed by power, their operation shall conform to 2.13.

2.11.10 Landing-Sill Guards, Landing-Sill Illumination, Hinged Landing Sills, and Tracks on Landings

2.11.10.1 Landing-Sill Guards

2.11.10.1.1 Landing sills shall be guarded on the underside with guard plates of smooth metal not less than 1.4 mm (0.055 in.) thick, extending the full width of the car sill exposed to the landing entrance, and securely fastened in place. Landing sill guards are not required for

(a) vertically sliding biparting counterbalanced doors

(b) vertically sliding counterweighted doors that slide down to open

(c) elevators where the landing sills do not project into the hoistway

2.11.10.1.2 Where a car leveling device is provided and the hoistway edge of the sill is either flush with or projects into the hoistway, the guard shall have a straight vertical face extending below the sill not less than the depth of the leveling zone plus 75 mm (3 in.). Where the sill projects inward from the hoistway enclosure, the bottom of the guard shall also be beveled at an angle of not less than 60 deg and not more than 75 deg from the horizontal, or the guard shall be extended from the hoistway edge of the landing sill to the top of door hanger pocket of the entrance next below.

2.11.10.1.3 Where no car leveling device is provided and the sill projects inward from the general line of the hoistway, the guard shall be either beveled at an angle of not less than 60 deg and not more than 75 deg from the horizontal, or have a straight vertical face extending from the hoistway edge of the landing sill to the top of door hanger pocket of the entrance below.

2.11.10.2 Illumination at Landing Sills. The building corridors shall be so lighted that the illumination at the landing sills, when an elevator is in service, shall be not less than 100 lx (10 fc).

2.11.10.3 Hinged Hoistway Landing Sills. Hinged hoistway landing sills provided in connection with vertically sliding, biparting, counterbalanced doors of freight elevators shall be hinged on the landing side so that they can be lowered only when the landing doors are in the fully opened position.

2.11.11 Entrances, Horizontal Slide Type

2.11.11.1 Landing Sills. Landing sills shall

(a) be of metal and of sufficient strength to support the loads to be carried by the sills when loading and unloading the car, and be secured in place

(b) be substantially flush with the floor surface of the elevator landings

(c) be so designed and maintained as to provide a secure foothold over the entire width of the door opening

2.11.11.2 Hangers, Tracks, and Track Supports. Hangers, tracks, and their supports and fastenings for doors shall be constructed to withstand, without damage or appreciable deflection, an imposed static load equal to four times the weight of each panel as applied successively downward and upward at the vertical centerline of the panel. (See 2.11.11.5.7 and 2.11.11.5.8.)

2.11.11.3 Entrance Frames

2.11.11.3.1 Where used, entrance frames shall be anchored to the sills and to the building structure or the track supports. The head of the entrance frame shall not be used to support the weight of the wall over the frame.

2.11.11.3.2 Where decorative material is applied to listed/certified frames, it shall conform to the requirements of the certifying organization.

2.11.11.4 Hangers. Hangers shall conform to 2.11.11.4.1 and 2.11.11.4.2.

2.11.11.4.1 Means shall be provided to prevent the hangers from jumping the track.

2.11.11.4.2 Stops shall be provided in the entrance assembly to prevent hangers from overrunning the end of the track.

2.11.11.5 Panels. Panels shall conform to 2.11.11.5.1 through 2.11.11.5.8.

2.11.11.5.1 The panels shall overlap the top and sides of the opening, and each other, in the case of multispeed entrances, by not less than 13 mm (0.5 in.).

Where entrances without frames are used, the overlap shall extend the thickness of the facing used to finish the opening plus 13 mm (0.5 in.) or more.

2.11.11.5.2 The clearance shall not exceed 10 mm (0.375 in.) between

(a) the panel and the frame

(b) the panel and the wall, where entrances without frames are used in masonry or concrete

(c) related panels of multispeed entrances

(d) the panel and the sill measured vertically

2.11.11.5.3 The leading panel edge of side-opening entrances shall not close into pockets in the strike jamb and shall be smooth and free of sharp projections.

2.11.11.5.4 The meeting panel edges of center opening entrances shall be smooth and free of sharp projection.

The meeting panel edges of center-opening entrances shall be protected with not less than one resilient male member extending the full height of the panel. The resilient members shall be permitted to interlock by not more than 10 mm (0.375 in.).

When in the closed position, the distance between the metal parts of the meeting panels shall not exceed 13mm (0.5 in.).

2.11.11.5.5 No areas shall be depressed or raised more than 3 mm (0.125 in.) from the adjacent area and edges shall be beveled at not more than 30 deg to the panel surface.

2.11.11.5.6 Where decorative material is applied to listed/certified panels, it shall conform to the requirements of the certifying organization.

2.11.11.5.7 The entrance assembly shall be capable of withstanding a force of 2 500 N (560 lbf) applied on the landing side at right angles to and approximately at the center of a panel. This force shall be distributed over an area of approximately 100 mm X 100 mm (4 in. X 4 in.). There shall be no appreciable permanent displacement or deformation of any parts of the entrance assembly resulting from this test.

2.11.11.5.8 Means shall be provided to prevent opening of locked doors more than 20 mm (0.8 in.) per panel at the farthest point from the interlock when a force of 135 N (30 lbf) is applied in the opening direction at the leading edge of the door at the farthest point from the interlock.

2.11.11.6 Bottom Guides. Bottom guides shall conform to the following:

(a) The bottom of each panel must be guided by two or more members.

(b) Guide members shall be securely fastened.

(c) The guide members and any reinforcements or guards shall engage the corresponding member by not less than 6 mm (0.25 in.). (See 2.11.11.5.7.)

2.11.11.7 Multipanel Entrances. Panels of multipanel doors shall conform to either 2.11.11.7.1 or 2.11.11.7.2. Multiple-speed and center-opening multiple-speed doors shall also conform to 2.11.11.7.3.

2.11.11.7.1 Panels shall be interconnected directly or through their hangers so as to assure simultaneous movement of all panels. The factor of

safety of the interconnecting means shall not be less than 10 for cast iron or 5 for other materials.

2.11.11.7.2 Panels shall be equipped with hoistway door interlocks on each driven panel and provided with a door closer(s) installed to comply with 2.11.3.1. All panels shall move simultaneously when the car is at the landing.

2.11.11.7.3 Multiple speed and center-opening multiple-speed panels shall be provided with secondary mechanical interconnecting means to ensure that individual panels of multiple panel doors moving in the same direction cannot become separated from the panel that is locked by the interlock in the event that the normal interconnecting means fails.

2.11.11.7.4 Where cable and pulleys are used to connect panels of multisection sliding doors, each pulley shall be equipped with a guard to prevent the cable from leaving the pulley.

2.11.11.8 Hoistway Door Safety Retainers. The top and bottom of horizontally sliding doors shall be provided with a means of retaining the closed door panel in position if the primary guiding means fail, and preventing displacement of the door panel top and bottom by more than 20 mm (0.8 in.) when the door panel is subjected to a force of 5 000 N (1,125 lbf) in the direction of the hoistway applied at right angles to the panel over an area of 300 mm X 300 mm (12 in. X 12 in.) at the approximate center of the panel. The retaining means shall also withstand, without detachment or permanent deformation, a force of 1 000 N (225 lbf) applied upward at any point along the width of the door panel and, while this force is maintained, an additional force of 1 100 N (250 lbf) applied at right angles to the door at the center of the panel. This force shall be distributed over an area of 300 mm X 300 mm (12 in. X 12 in.).

The retaining means shall not be subjected to wear or stress during normal door operation or maintenance.

2.11.11.9 Beams, Walls, Floors, and Supports. The building structural supports of the entrance, such as building beams, walls, and floors, shall be designed to withstand the horizontal forces stipulated in 2.11.11.8.

2.11.11.10 Hoistway Door to Sill Clearance. The horizontal distance from the hoistway side of the leading edge of the hoistway door, or sight guard, if provided, to the edge of the landing sill, shall not exceed 13 mm (0.5 in.). The vertical clearance between the sight guard, if provided, and the landing sill shall not exceed 13 mm (0.5 in.).

2.11.12 Entrances, Vertical Slide Type

2.11.12.1 Landing Sills

2.11.12.1.1 Landing sills shall be of metal and of sufficient strength to support the loads to be carried by the sills when loading and unloading the car, and be secured in place (see 2.16.2.2 for classes of loading); the load on the sill during loading and unloading shall be considered to be the same as that on the platform members specified in 8.2.2.6.

2.11.12.1.2 Landing sills shall be secured to the building structure in substantially the same plane as the elevator landing floor.

2.11.12.2 Entrance Frames. Where used, frames shall conform to 2.11.12.2.1 through 2.11.12.2.4.

2.11.12.2.1 Entrance frames shall be anchored to the sills and to the building structure or track supports.

2.11.12.2.2 The weight of the wall above the frame shall be supported by either of the following:

(a) lintel

(b) the head of the frames when designed to support the load

2.11.12.2.3 In gypsum board (dry wall) construction, the frame side jambs shall be extended and securely fastened to the building structure above the frame.

2.11.12.2.4 Where decorative material is applied to listed/certified frames, it shall conform to the requirements of the certifying organization.

2.11.12.3 Rails. The panel guide rails shall be securely fastened to the building structure and the entrance frame, at intervals, throughout their entire length. Rails and their supports shall withstand the forces specified in 2.11.12.4.6. Where truckable sills are provided as specified in 2.11.12.4.2, the rails shall withstand any reactions that could be transmitted to the rails as a result of loading and unloading operations.

2.11.12.4 Panels. Panels shall conform to 2.11.12.4.1 through 2.11.12.4.8.

2.11.12.4.1 The panels shall be constructed of noncombustible material, or of a structural core made of combustible material if covered with not less than 0.45 mm (0.0175 in.) sheet metal.

2.11.12.4.2 The lower panel of biparting entrances and the top of the panel of vertical slide entrances that slide down to open shall be provided with a truckable sill designed for the loads specified in 2.11.12.1.1. Provisions shall be made to transmit the panel sill load to the building structure.

2.11.12.4.3 Panels of biparting counterbalanced entrances shall conform to the following:

(a) They shall be provided with means to stop the closing panels when the distance between the closing

rigid members of the panel is not less than 20mm(0.8 in.) and not more than 50 mm (2 in.).

(b) A fire-resistive, nonshearing, and noncrushing member of either the meeting or overlapping type shall be provided on the upper panel to close the distance between the rigid door sections when in contact with the stops. This member shall allow a minimum compressible clearance of 20 mm (0.8 in.).

(c) Rigid members that overlap the meeting edge, and center-latching devices, are prohibited.

2.11.12.4.4 The panels, with their attachments for doors that slide up to open, shall overlap the sides and top of the entrance opening by at least 50 mm (2 in.) when in the closed position. Other vertically sliding panels and their attachments shall overlap their entrance openings and sills by at least 50 mm (2 in.) when in the closed position. The overlap shall extend at least 50 mm (2 in.) beyond the thickness of any facing used to finish the opening.

2.11.12.4.5 The clearance between a panel and the frame lintel, between a panel and the sill, and between related panels of multispeed entrances, shall not exceed 25 mm (1 in.).

2.11.12.4.6 Panels, rails, and door guides shall conform to the strength requirements of 2.11.11.5.7. Hangers, guides, and guide shoes shall not be permanently displaced or deformed by more than 20 mm (0.8 in.) when their panel is subjected to a force of 5 000N (1,125 lbf) in the direction of the hoistway applied at right angles to the panel over an area of 300 mm X 300 mm (12 in. X 12 in.) at the approximate center of the panel.

2.11.12.4.7 Means shall be provided to close the opening between the upper panel of pass-type entrances and the entrance frame lintel. The sum of the clearance between the panel, the device used to close the opening, and the entrance lintel shall not exceed 25 mm (1 in.).

2.11.12.4.8 Means shall be provided to prevent the opening of locked doors more than 25 mm (1 in.) per panel at the farthest point from the interlock when a force of 135 N (30 lbf) is applied in the opening direction at the leading edge of the door at the farthest point from the interlock.

2.11.12.5 Guides. Panel guides shall conform to 2.11.12.5.1 through 2.11.12.5.3.

2.11.12.5.1 Each panel shall be equipped with not less than four guide members or with continuous guides.

2.11.12.5.2 Guide members shall be securely fastened to the panels.

2.11.12.5.3 Guide members shall be designed to withstand the forces specified in 2.11.12.4.6.

2.11.12.6 Counterweighting or Counterbalancing.

Single or multisection vertically sliding panels shall be so counterweighted, and vertically sliding biparting panels shall be so counterbalanced, that they will not open or close by gravity. Fastenings shall be provided to prevent the fall of a counterweight, and the detachment or dislodgment of counterweight parts or of balancing weights. Suspension means and their connections, for vertically sliding biparting counterbalanced doors and for the counterweights of vertically sliding counterweighted doors, shall have a factor of safety of not less than 5.

2.11.12.7 Sill Guards. Where the panel sill or other structural member projects more than 13 mm (0.5 in.) into the hoistway or beyond the panel surface below it, the projection shall be provided with a metal guard not less than 1.4mm(0.055 in.) thick and beveled at an angle of not less than 50 deg and not more than 75 deg from the horizontal.

2.11.12.8 Pull Straps. Manually operated vertically sliding biparting entrances shall be provided with pull straps on the inside and outside of the door. The length of the pull straps shall conform to 2.11.12.8.1 and 2.11.12.8.2.

2.11.12.8.1 The bottom of the strap shall be not more than 2 000 mm (79 in.) above the landing when the panel is in the fully opened position.

2.11.12.8.2 The length of the strap shall not be extended by means of ropes or other materials.

2.11.13 Entrances, Swinging Type

2.11.13.1 Landing Sills. Landing sills shall

(a) be of metal and of sufficient strength to support the loads to be carried by the sills when loading and unloading the car, and be secured in place

(b) be substantially flush with the floor surface of the elevator landings

(c) be so designed and maintained as to provide a secure foothold over the entire width of the door opening

2.11.13.2 Entrance Frames. Frames shall conform to 2.11.13.2.1 and 2.11.13.2.2.

2.11.13.2.1 They shall be designed to support in place the panels with their hinges or pivots, closer if attached to the frame and interlock. They shall withstand the forces referred to in 2.11.13.3.5, and the forces resulting from the normal opening of the door or normal attempts to open it when locked in the closed position.

2.11.13.2.2 Where decorative material is applied to listed/certified panels, it shall conform to the requirements of the certifying organization.

2.11.13.3 Panels. Panels shall conform to 2.11.13.3.1 through 2.11.13.3.7.

2.11.13.3.1 The panels shall overlap the part of the frame against which they close by not less than 13 mm (0.5 in.).

2.11.13.3.2 The clearance between a panel and its sill shall not exceed 10 mm (0.375 in.).

2.11.13.3.3 Handles or knobs on the hoistway side of door panels are not permitted. Unlatching devices that do not project beyond the face of the door panel on the hoistway side shall be permitted.

2.11.13.3.4 Where decorative material is applied to listed/certified panels, it shall conform to the requirements of the certifying organization.

2.11.13.3.5 Panels and their assembled accessories shall

(a) be capable of withstanding a force on the handle of not less than 450 N (100 lbf) in the opening direction of a closed and locked door. There shall be no permanent displacement or deformation of the handle or the door panel resulting from this force.

(b) conform to 2.11.11.5.7.

(c) not be permanently displaced or deformed by more than 20 mm (0.75 in.) when the panel is subjected to a force of 5 000 N (1,125 lbf) in the direction of the hoistway, applied at right angles to the panel over an area of 300mm X 300mm (12 in. X 12 in.) at the approximate center of the panel.

2.11.13.3.6 Center-opening horizontally swinging doors shall have one door section provided with an overlapping astragal on its vertical edge, except where each door section is provided with a landing door interlock [see 2.12.2.4.4(c)].

2.11.13.3.7 Center-opening horizontally swinging doors shall have door stops provided at the top entrances that will stop each door panel when closed and that will meet the requirements specified in 2.11.13.3.5.

2.11.13.4 Hinges. Hinges of the mortise and surface type shall conform to the requirements of NFPA80, Table 2-4.3.1.

2.11.13.5 Entrances With Combination Horizontally Sliding and Swinging Panels. Where both the sliding and swinging panels are not equipped with hoistway door interlocks or locks and contacts conforming to 2.12, the horizontally sliding and swinging panels forming a part of the entrance shall be so interconnected that

(a) the swinging panel can be opened only when the sliding panel is in the open position

(b) both panels swing as a unit

2.11.14 Fire Tests

2.11.14.1 In jurisdictions enforcing the NBCC

(a) the fire protection rating of entrances and doors shall be determined in accordance with the requirements specified in the NBCC (CAN4-S104)

(b) where required, the hoistway door interlock mechanism and associated wiring shall remain operational for a period of 1 h when subjected to the standard fire exposure test described in CAN4-S104

NOTE (2.11.14.1): Requirements 2.11.14.2 through 2.11.18 do not apply in jurisdictions enforcing the NBCC.

2.11.14.2 In jurisdictions not enforcing the NBCC, 2.11.15 through 2.11.18, and 2.11.14.2.1 through 2.11.14.2.3 apply where fire-resistive construction is required by 2.1.1.1.3.

2.11.14.2.1 Entrances shall be subjected to the type tests specified in 8.3.4.

2.11.14.2.2 The following basic types of entrances shall be tested:

(a) Horizontally Sliding Type. Test a side-sliding and a center-opening assembly.

(b) Swinging Type. Test a single swinging assembly.

(c) Vertically Sliding Type. Test a biparting assembly.

2.11.14.2.3 When an entrance assembly has been tested for one type of wall construction, i.e., masonry or drywall, only the frame-to-wall interface shall be acceptable to the certifying organization for other types of construction.

2.11.15 Marking

2.11.15.1 Labeling of tested assembly. Sections 2.11.15.1.1 and 2.11.15.1.2 apply. Where required by the New York City Building Code, the entire entrance assembly must be of an approved type.

2.11.15.1.1 Each entrance shall be labeled. Each label shall be permanently attached to the equipment and shall be readily visible after installation. The following data shall be on the label:

(a) certifying organization's name or identifying symbol

(b) the name, trademark, or file number by which the organization that manufactured the product can be identified

(c) statement of compliance with 8.3.4

2.11.15.1.2 Labels shall be provided for each entrance as follows:

(a) One label shall be provided for the door panels.

(b) One label shall be provided for the frame, except that no label is required where frames are installed in masonry or concrete and the panel overlaps the wall in conformance with 2.11.11.5.1 and 2.11.11.5.2, or 2.11.12.4.4.

(c) One label shall be provided for the transom panel. One label shall be permitted to be provided for the frame and transom, provided that the label states that it includes both the frame and the transom.

(d) Where entrance hardware components have not all been tested in complete assembly, individually labeled hardware components that are designed to be compatible with the entrance assembly shall be provided. A single label shall be permitted to be provided for the entrance hardware where the entrance hardware components are equivalent to those tested in a complete assembly.

(e) A single label shall be permitted to be provided for the entire entrance assembly where components are equivalent to those tested as a complete assembly.

2.11.15.2 Other Assemblies. In jurisdictions not enforcing the NBCC, the following shall apply. Other assemblies of the three basic types (see 2.11.14) shall qualify for labeling or listing/certification:

(a) when composed of panel(s), frame, and hardware of the same type as tested and not exceeding the overall height and width of any panel and frame of the largest size tested; or

(b) when such panel(s), frame, and hardware are modified, and test or technical data demonstrates that the modifications will meet the performance requirements of the test procedure in 8.3.3.

All other elements of the assembly shall conform to all other applicable requirements of this Code.

2.11.15.3 Entrances Larger Than Tested Assemblies.

In jurisdictions not enforcing the NBCC, the following shall apply. When the entrance is too large for the regularly available test facilities, the certifying organization shall be permitted to issue oversize certificates or oversize labels, or such entrances shall be permitted to be used subject to approval by the authority having jurisdiction.

2.11.16 Factory Inspections

In jurisdictions not enforcing the NBCC, the following shall apply. The manufacturing facilities for the production of entrances or components thereof shall be inspected by the certifying organization at random at least quarterly, or if they are not manufactured on a continuous basis, at the time they are being produced, to assure that production methods are such that entrances or components thereof similar to those tested are being produced.

2.11.17 Transoms and Fixed Side Panels

In jurisdictions not enforcing the NBCC, the following shall apply. Transoms and fixed side panels shall be permitted to close openings above and beside the horizontally sliding or horizontally swinging type entrances, provided that

(a) the opening closed by the transom and fixed side panel does not exceed in width or height the dimensions of the entrance in which it is installed

(b) the transom panels and fixed side panels are

(1) constructed in a manner equivalent to the construction of the entrance panels

(2) secured

2.11.18 Installation Instructions

In jurisdictions not enforcing the NBCC, the following shall apply:

(a) Instructions detailing the application and installation of door listed/certified panels and entrance hardware shall be provided.

(b) Where frames are used, instructions detailing the listed/certified frame-to-wall interface shall be provided.

2.11.19 Gasketing of Hoistway Entrances

Where gasketing material is applied to fire-resistive entrances, it shall conform to 2.11.19.1 through 2.11.19.4.

2.11.19.1 The gasketing material shall be subjected to the tests specified in UL 10B, NFPA 252, or CAN4-S104, whichever is applicable (see Part 9).

2.11.19.2 The gasketing material shall withstand the maximum elevated temperature tests as defined by UL 1784 standard without deterioration.

2.11.19.3 Each section of the gasketing material shall be labeled. Each label shall bear the name of the manufacturer and a statement indicating conformance with 2.11.19.1 and 2.11.19.2. The label shall be visible after installation

2.11.19.4 Labeled gasketing material shall conform to 2.11.16 or the NBCC, whichever is applicable.

NOTES (2.11.19):

(1) See also 2.1.1.5, 2.11.3, and 2.13.4 for additional requirements to be considered when gasketing material is applied to a hoistway entrance.

(2) These requirements do not evaluate the air and/or smoke leakage performance of the gasketing material.

SECTION 2.12
HOISTWAY DOOR LOCKING DEVICES AND ELECTRIC CONTACTS, AND HOISTWAY ACCESS SWITCHES

2.12.1 General

2.12.1.1 When the car is stopped within the unlocking zone, the hoistway doors shall be unlocked,

or locked but openable from the landing side either manually or by power.

2.12.1.2 When the car is outside the unlocking zone, the hoistway doors shall be openable from the landing side only by a hoistway door unlocking device (see 2.12.6, 2.12.7, and Nonmandatory Appendix B).

2.12.1.3 For security purposes, hoistway doors shall be permitted to be locked out of service, subject to the requirements of 2.11.6.

2.12.1.4 Passenger elevator hoistway doors shall be equipped with interlocks conforming to 2.12.2.

2.12.1.5 Freight elevator hoistway doors shall be equipped with interlocks conforming to 2.12.2 or combination mechanical locks and electric contacts conforming to, and where permitted by, 2.12.3.

2.12.2 Interlocks

2.12.2.1 General. Each entrance at a landing to an elevator used for passengers or freight and not conforming to 2.12.3.1 shall be equipped with one or more interlocks meeting the design requirements of 2.12.2.4.

2.12.2.2 Closed Position of Hoistway Doors.

Hoistway doors shall be considered to be in the closed position under the following conditions. These dimensions apply to the doors in their normal operating condition (see 2.14.4.11):

(a) for horizontally sliding or swinging doors, when the leading edge of the door is within 10 mm (0.375 in.) of the nearest face of the jamb or when the panels of center-opening doors are within 10 mm (0.375 in.) of contact with each other

(b) for vertically sliding counterweighted doors, when the leading edge of the door is within 10 mm (0.375 in.) of the sill for doors which slide up to open, or 10 mm (0.375 in.) of the lintel for doors that slide down to open

(c) for vertically sliding biparting counterbalanced doors, when the astragal on the upper panel is within 19 mm (0.75 in.) of the lower panel

2.12.2.3 Operation of the Driving Machine With a Hoistway Door Unlocked or Not in the Closed Position.

Operation of the driving machine when a hoistway door is unlocked or not in the closed position (see 2.12.2.2) shall be permitted under one of the following conditions:

(a) by a car leveling or truck zoning device (see 2.26.1.6) *(b)* when a hoistway access switch is operated (see 2.12.7)

(c) when a bypass switch is activated (see 2.26.1.5)

2.12.2.4 General Design Requirements. Interlocks shall conform to 2.12.2.4.1 through 2.12.2.4.7.

2.12.2.4.1 Interlock contacts shall be positively opened by the locking member or by a member connected to and mechanically operated by the locking member, and the contacts shall be maintained in the open position by the action of gravity, or by a restrained compression spring, or by both, or by means of the opening member (see 2.26.2.14). Contacts shall be open when the hoistway door interlock is unlocked. If the contacts are maintained in the open position by other than the locking member, the interlock shall be located such that the contacts cannot be closed by hand from the car or landing when the doors are open.

The electrical contact bridging means shall withstand a separating force of 200 N (45 lbf) in any direction from the locking member.

2.12.2.4.2 The locking member of the interlock shall hold the door in the locked position by means of gravity, or by a restrained compression spring, or by both, or by means of a positive linkage.

2.12.2.4.3 The interlock shall lock the door in the closed position with a minimum engagement of 7 mm (0.28 in.) of the locking members before the interlock contacts are closed and before the driving machine can be operated, except as permitted in 2.12.2.3.

Devices that permit operation of the driving machine by the normal operating device when the door is closed but before it is locked are not interlocks and are not permitted where interlocks are required by this Code.

2.12.2.4.4 Interlocks, used with multisection doors, shall conform to the following requirements:

(a) They shall lock all sections of the door, but shall be permitted to be applied to only one section of the door, provided the device used to interconnect the door sections is so arranged that locking one section will prevent the opening of all sections.

(b) Where used with vertically sliding biparting counterbalanced doors, they shall be so arranged that the interlock contacts are mechanically held in the open position by the door or devices attached thereto, unless the door is in the closed position.

(c) Where used with center-opening horizontally swinging doors, either

(1) both door panels shall be equipped with interlocks; or

(2) where the door panels are so arranged that one panel can be opened only after the other panel has been opened, the interlock is not required on the section that opens last, if that door panel is provided with a door electric contact conforming to 2.14.4.2.3, 2.14.4.2.5, and 2.26.2.15, except that terms "door or gate" and

"car door or gate" shall be replaced with the "hoistway door" or "hoistway door section" and the term "accessible from inside the car panel" with the term "accessible from the landing side when the hoistway doors are closed."

(d) Where used with combination horizontally sliding and swinging doors, either

(1) the sliding and swinging panels shall both be equipped with interlocks; or

(2) where the sliding and swinging panels are interconnected in conformity with the requirements of 2.11.13.5, the interlock is not required on the swinging panel, provided that the interlock on the sliding panel is so designed and installed that the car cannot be operated unless the sliding and swinging panels are both locked in the closed position, as defined in 2.12.2.2.

(e) Where a door closer, used with a combination sliding and swinging door, is arranged to be disconnected to allow the sliding panel to swing, it shall be so designed and installed that it shall not make the interlock contact when disconnected and released.

2.12.2.4.5 Interlock systems employing a single master switch for more than one door are prohibited.

2.12.2.4.6 The locking member shall not disengage when the door is subjected to a repetitive force of 450 N (100 lbf) in the direction of opening and at a right angle.

2.12.2.4.7 Mercury tube switches shall not be used.

2.12.2.5 Interlock Retiring Cam Device. Retiring cams used to actuate an interlock shall exert a force at least double the average force required to operate the interlock and shall have a movement at least 13 mm (0.5 in.) more than the average movement required to operate the interlock.

An interlock retiring cam device shall be permanently marked by the manufacturer with its rated horizontal force and rated horizontal movement.

The rated horizontal force shall be the static force exerted by a retiring cam device in the horizontal direction when extended a distance equal to 75% of its rated horizontal movement. The rated horizontal movement shall be the horizontal distance traveled by the retiring cam device from the fully retired position to the fully extended position.

2.12.2.6 Location. Interlocks shall be so located that they are not accessible from the landing side when the hoistway doors are closed.

2.12.3 RESERVED

2.12.4 Listing/Certification Door Locking Devices and Door or Gate Electric Contacts

2.12.4.1 Type tests. Each type and make of hoistway-door interlock, electric contact, and door or gate electric contact must be of an approved type. Hoistway-door combination mechanical locks and electrical contacts are not permitted.

2.12.4.2 Listing/Certification. Each type and make of hoistway door interlock, hoistway door combination mechanical lock and electric contact, and door or gate electric contact shall conform to the general requirements for tests and certification specified in 8.3.1.

2.12.4.3 Identification Marking. Each listed/certified device shall be labeled. It shall be permanently attached to the device, and shall be so located as to be readily visible when the device is installed in its operating position. The labels shall include the following data:

(a) the name, trademark, or certifying organization file number by which the organization that manufactured the product can be identified

(b) Identification marking. The approved agency's name, date of approval and identifying number or symbol.

(c) statement of compliance with ASME A17.1 or CSA B44

(d) a distinctive type, model, or style letter or number

(e) rated voltage and current, and whether AC or DC

(f) rated test force and rated test movement when the device is of a type released by an interlock retiring cam (see 8.3.3.4.7)

(g) date (month and year) devices subjected to type test specified in 2.12.4.1

(h) if the device has only been type tested and listed/certified for use on a private residence elevator, the label shall indicate the restricted use

2.12.5 Restricted Opening of Hoistway or Car Doors

Hoistway and car doors of passenger elevators shall conform to 2.12.5.1 through 2.12.5.3.

2.12.5.1 When a car is outside the unlocking zone, the hoistway doors or car doors shall be so arranged that the hoistway doors or car doors cannot be opened more than 100 mm (4 in.) from inside the car.

2.12.5.2 When the car doors are so arranged that they cannot be opened when the car is outside the unlocking zone, the car doors shall be openable from outside the car without the use of a special tool(s).

2.12.5.3 The doors shall be openable from within the car (see 2.14.5.7) when the car is within the unlocking zone.

NOTE (2.12.5): See also 2.12.1 and Nonmandatory Appendix B, Unlocking Zone.

2.12.6 Hoistway Door Unlocking Devices

2.12.6.1 General. Except in jurisdictions that limit the use of hoistway door unlocking devices, they shall be provided for use by elevator and emergency personnel for each elevator at every landing where there is an entrance.

2.12.6.2 Location and Design. Hoistway door unlocking devices shall conform to 2.12.6.2.1 through 2.12.6.2.5.

2.12.6.2.1 The device shall unlock and permit the opening of a hoistway door from a landing irrespective of the position of the car.

2.12.6.2.2 The device shall be designed to prevent unlocking the door with common tools.

2.12.6.2.3 Where a hoistway unlocking device consists of an arrangement whereby a releasing chain, permanently attached to a door locking mechanism, is kept under a locked panel adjacent to the landing door, such a panel shall be self-closing and self-locking and shall not have identifying markings on its face.

2.12.6.2.4 The operating means for unlocking the door shall be Group 1 Security (see 8.1). The operating means shall also be made available to emergency personnel during an emergency.

2.12.6.2.5 The unlocking device keyway and locked panel (see 2.12.6.2.3), if provided, shall be located at a height not greater than 2 100 mm (83 in.) above the landing.

2.12.7 Hoistway Access Switches

2.12.7.1 General

2.12.7.1.1 Hoistway access switches shall be provided when the rated speed is greater than 0.75 m/s (150 ft/min) at

(a) the lowest landing for access to the pit, when a separate pit access door is not provided

(b) the top landing for access to the top of the car

2.12.7.1.2 For elevators with a speed of 0.75 m/s (150 ft/min) or less, hoistway access switches shall be provided at the top landing when the distance from the top of the car to the landing sill exceeds 900 mm (35 in.) when the car platform is level with the landing immediately below the top landing.

2.12.7.2 Location and Design. Hoistway access switches shall conform to 2.12.7.2.1 through 2.12.7.2.3.

2.12.7.2.1 The switch shall be installed adjacent to the hoistway entrance at the landing with which it is identified.

2.12.7.2.2 The switch shall be of the continuous pressure spring-return type, and shall be operated by a cylinder-type lock having not less than a five-pin or five disk combination, with the key removable only when the switch is in the "OFF" position. The key shall be Group 1 Security (see 8.1).

2.12.7.2.3 The electric contacts in the switch shall be positively opened mechanically; their openings shall not be solely dependent on springs.

2.12.7.3 Operating Requirements. The operation of the switch shall permit movement of the car with the hoistway door at this landing unlocked or not in the closed position, and with the car door or gate not in the closed position, subject to the requirements of 2.12.7.3.1 through 2.12.7.3.8.

2.12.7.3.1 The operation of the switch shall not render ineffective the hoistway-door interlock or electric contact at any other landing, nor shall the car move if any other hoistway door is unlocked.

2.12.7.3.2 The car cannot be operated at a speed greater than 0.35 m/s (75 ft/min).

2.12.7.3.3 For automatic and continuous-pressure operation elevators, provided that

(a) car and landing operating devices are first made inoperative by means within the car. This means shall enable the hoistway access switches and shall be key operated or behind a locked cover. The key shall be Group 1 Security (see 8.1).

(b) power operation of the hoistway door and/or car door or gate is inoperative.

2.12.7.3.4 Automatic operation by a car-leveling device is inoperative.

2.12.7.3.5 Both top-of-car inspection operation (see 2.26.1.4.2) and in-car inspection operation (see 2.26.1.4.3) are not in effect.

2.12.7.3.6 The movement of the car initiated and maintained by the access switch at the lowest landing, if this landing is the normal means of access to the pit, shall be limited in the up direction to the point where the bottom of the platform guard is even with hoistway entrance header.

2.12.7.3.7 The movement of the car initiated and maintained by the upper access switch shall be limited in the down direction to a travel not greater than the height of the car crosshead above the car platform, and limited in the up direction to the distance the platform guard extends below the car platform.

2.12.7.3.8 The access switch shall only control the movement of the car within the zone specified in

2.12.7.3.6 or 2.12.7.3.7. Control circuits related to, or operated by, the hoistway access switches shall comply with 2.26.9.3(c), (d), and (e) and 2.26.9.4.

SECTION 2.13
POWER OPERATION OF HOISTWAY DOORS AND CAR DOORS

2.13.1 Types of Doors and Gates Permitted

Where both a hoistway door and a car door or gate are opened and/or closed by power, the hoistway door and the car door or gate shall both be either of the horizontally sliding type or vertically sliding type.

2.13.2 Power Opening

2.13.2.1 Power Opening of Car Doors or Gates. Power opening of a car door or gate shall be subject to the requirements of 2.13.2.1.1 and 2.13.2.1.2.

2.13.2.1.1 Power opening shall occur only at the landing where the car is stopping, or is leveling, or at rest, and shall start only when the car is within the landing zone where an automatic car-leveling device is provided, except that on elevators with static control, power shall not be applied to open car doors until the car is within 300 mm (12 in.) of the landing.

2.13.2.1.2 Collapsible car gates must not be power opened.

2.13.2.2 Power Opening of Hoistway Doors. Power opening of a hoistway door shall conform to 2.13.2.2.1 through 2.13.2.2.3.

2.13.2.2.1 Power opening shall occur only at the landing where the car is stopping, leveling, or at rest, and shall start only when the car is within the landing zone where an automatic car leveling device is provided, except that on elevators with static control, opening shall not start until the car is within 300 mm (12 in.) of the landing.

2.13.2.2.2 Power opening shall be permitted to be initiated automatically through control circuits, provided that the car is being automatically stopped or leveled, and that, when stopping under normal operating conditions, the car shall be at rest or substantially level with the landing before the hoistway door is fully opened.

2.13.2.2.3 Sequence opening of vertically sliding hoistway doors and adjacent car doors or gates shall comply with 2.13.6.

2.13.3 Power Closing

2.13.3.1 Power Closing or Automatic Self-Closing of Car Doors or Gates Where Used With Manually Operated or Self-Closing Hoistway Doors

2.13.3.1.1 Where a car door or gate of an automatic or continuous-pressure operation passenger elevator is closed by power, or is of the automatically released self-closing type, and faces a manually operated or self-closing hoistway door, the closing of the car door or gate shall not be initiated unless the hoistway door is in the closed position, and the closing mechanism shall be so designed that the force necessary to prevent closing of a horizontally sliding car door or gate from rest is not more than 135 N (30 lbf).

2.13.3.1.2 Requirement 2.13.3.1.1 does not apply where a car door or gate is closed by power through continuous pressure of a door closing switch, or of the car operating device, and where the release of the closing switch or operating device will cause the car door or gate to stop or to stop and reopen.

2.13.3.2 Power Closing of Hoistway Doors and Car Doors or Gates by Continuous-Pressure Means. Horizontally or vertically sliding hoistway doors with manually closed, or power-operated, or power-closed car doors or gates shall be permitted to be closed by continuous pressure means, subject to the requirements of 2.13.3.2.1 through 2.13.3.2.5.

2.13.3.2.1 The release of the closing means shall cause the hoistway door, and a power-operated or power-closed car door or gate, to stop or to stop and reopen.

2.13.3.2.2 The operation of the closing means at any landing shall not close the hoistway door at any other landing, nor the car door or gate when the elevator car is at any other landing.

2.13.3.2.3 Any closing means at a landing shall close only that hoistway door and the car door or gate at the side where such means is located.

2.13.3.2.4 For elevators having more than one hoistway opening at any landing level, a separate closing means shall be provided in the car for each car door or gate and its adjacent hoistway door, except that a separate closing means need not be furnished for a horizontally sliding hoistway door and adjacent car door or gate that conform to 2.13.4.

2.13.3.2.5 For sequence closing of vertically sliding hoistway doors and adjacent car doors or gates, see 2.13.6.

2.13.3.3 Power Closing of Horizontally Sliding Hoistway Doors and Horizontally Sliding Car Doors or Gates by Momentary Pressure or by Automatic Means.

Power closing by momentary pressure or by automatic means shall be permitted only for automatic or continuous-pressure operation elevators. The closing of the doors shall be subject to the requirements of 2.13.3.3.1 and 2.13.3.3.2.

2.13.3.3.1 The closing of the doors shall conform to 2.13.4.

2.13.3.3.2 A momentary pressure switch or button shall be provided in the car, the operation of which shall cause the doors to stop or to stop and reopen. The switch or button shall be identified as required by 2.26.12.

2.13.3.4 Power Closing of Vertically Sliding Hoistway Doors and Vertically Sliding Car Doors or Gates by Momentary Pressure or by Automatic Means. Power closing by momentary pressure or by automatic means shall be permitted only for automatic or continuous-pressure operation elevators. Vertically sliding hoistway doors used with vertically sliding power-operated car doors or gates closed by momentary pressure or automatic means, shall conform to the requirements of 2.13.3.4.1 through 2.13.3.4.5.

2.13.3.4.1 A warning bell or other audible signal shall be provided on the car, which shall start to sound at least 5 s prior to the time the car door or gate starts to close and shall continue to sound until the hoistway door is substantially closed. When the doors are closed by a closing switch in the car, the 5 s time interval shall be permitted to be omitted.

2.13.3.4.2 Sequence closing of the hoistway door and adjacent car door or gate shall be provided and shall conform to 2.13.6. Sequence closing is not required when a biparting vertically sliding hoistway door faces a biparting vertically sliding car door or gate.

2.13.3.4.3 The car door or gate shall be equipped with a reopening device conforming to 2.13.5.

2.13.3.4.4 A momentary pressure switch or button shall be provided in the car and at each landing, which, when operated, shall cause the car door or gate and the hoistway door at the landing to stop or to stop and reopen.

2.13.3.4.5 The average closing speed shall not exceed 0.3 m/s (1 ft/s) for a vertically sliding counterweighted hoistway door or for each panel of a biparting counterbalanced hoistway door or car gate, and shall not exceed 0.6 m/s (2 ft/s) for a vertically sliding counterweighted car door or gate.

2.13.4 Closing Limitations for Power-Operated Horizontally Sliding Hoistway Doors and Horizontally Sliding Car Doors or Gates

2.13.4.1 Where Required. Where a power-operated horizontally sliding hoistway door or car door/gate or both is closed by momentary pressure or by automatic means (see 2.13.3.3), or is closed simultaneously with another door or car door/gate or both from one continuous-pressure means (see 2.13.3.2.3 and 2.13.3.2.4), the closing mechanism shall be designed and installed to conform to 2.13.4.2 and the reopening device shall be designed and installed to conform to 2.13.5.

2.13.4.2 Closing Mechanism

2.13.4.2.1 Kinetic Energy

(a) Where the hoistway door and the car door/gate are closed in such a manner that stopping either one manually will stop both, the kinetic energy of the closing door system shall be based upon the sum of the hoistway and the car door weights, as well as all parts rigidly connected thereto, including the rotational inertia effects of the door operator and the connecting transmission to the door panels.

(b) Where a reopening device conforming to 2.13.5 is used, the closing door system shall conform to the following requirements:

(1) The kinetic energy computed for the actual closing speed at any point in the Code zone distance defined by 2.13.4.2.2 shall not exceed 23 J (17 ft-lbf).

(2) The kinetic energy computed for the average closing speed as determined in accordance with 2.13.4.2.2 shall not exceed 10 J (7.37 ft-lbf).

(c) Where a reopening device is not used, or has been rendered inoperative (see 2.13.5), the closing door system shall conform to the following requirements:

(1) The kinetic energy computed for the actual closing speed at any point in the Code zone distance defined by 2.13.4.2.2 shall not exceed 8 J (6 ft-lbf).

(2) The kinetic energy computed for the average closing speed within the Code zone distance (see 2.13.4.2.2), or in any exposed opening width, including the last increment of door travel, shall not exceed 3.5 J (2.5 ft-lbf).

2.13.4.2.2 Door Travel in the Code Zone Distance

(a) For all side sliding doors using single or multiple speed panels, the Code zone distance shall be taken as the horizontal distance from a point 50 mm (2 in.) away from the open jamb to a point 50 mm (2 in.) away from the opposite jamb.

(b) For all center-opening sliding doors using single or multiple speed panels, the Code zone distance shall be taken as the horizontal distance from a point 25 mm (1 in.) away from the open jamb to a point 25 mm (1 in.) from the center meeting point of the doors.

(c) The average closing speed shall be determined by measuring the time required for the leading edge of the door to travel the Code zone distance.

2.13.4.2.3 Door Force. The force necessary to prevent closing of the hoistway door (or the car door or gate if power operated) from rest shall not exceed 135 N (30 lbf) (see 2.13.3.1). This force shall be measured on the leading edge of the door with the door at any point between one third and two thirds of its travel.

2.13.4.2.4 Data Plate. A data plate conforming to 2.16.3.3 shall be attached to the power door operator or to the car crosshead and shall contain the following information:

(a) minimum door closing time in seconds for the doors to travel the Code zone distance as specified in 2.13.4.2.2 corresponding to the kinetic energy limits specified in 2.13.4.2.1(b)(2)

(b) minimum door closing time in seconds for the doors to travel the Code zone distance as specified in 2.13.4.2.2 corresponding to the kinetic energy limits specified in 2.13.4.2.1(c)(2), if applicable [see 2.27.3.1.6(e)]

(c) where heavier hoistway doors are used at certain floors, the minimum door closing time in seconds corresponding to the kinetic energy limits specified in 2.13.4.2.1(b)(2) and 2.13.4.2.1(c)(2), if applicable, for the corresponding floors shall be included on the data plate

2.13.5 Reopening Device for Power-Operated Car Doors or Gates

2.13.5.1 Where required by 2.13.3.4 or 2.13.4, a power-operated car door shall be provided with a reopening device that will function to stop and reopen a car door and the adjacent landing door sufficiently to permit passenger transfer in the event that the car door or gate is obstructed while closing. If the closing kinetic energy is reduced to 3.5 J (2.5 ft-lb) or less, the reopening device shall be permitted to be rendered inoperative. The reopening device used shall be effective for substantially the full vertical opening of the door (see 2.13.4.2).

2.13.5.2 For center-opening doors, the reopening device shall be so designed and installed that the obstruction of either door panel when closing will cause the reopening device to function.

2.13.5.3 For vertically sliding doors or gates, reopening devices shall respond to any obstruction within the width of the opening to a point 125mm(5 in.) maximum from each side of the opening.

2.13.5.4 Where Phase I Emergency Recall Operation by a fire alarm initiating device (see 2.27.3.2.3) is not provided, door reopening devices that can be affected by smoke or flame shall be rendered inoperative after the doors have been held open for 20 s. Door closing for power-operated doors shall conform to 2.13.5.

2.13.6 Sequence Operation for Power-Operated Hoistway Doors With Car Doors or Gates

2.13.6.1 Where Required

2.13.6.1.1 Sequence opening and closing shall be provided between hoistway doors and car doors or gates on passenger elevators and freight elevators permitted to carry passengers (see 2.16.4) when the elevator is equipped with power-operated vertically sliding slide up-to-open type car doors or gates and

(a) power-operated vertically sliding biparting counterbalanced hoistway doors; or

(b) power-operated vertically sliding counterweighted hoistway doors that slide down to open.

2.13.6.1.2 Sequence opening and/or closing shall be permitted for vertically sliding power-operated hoistway doors and car doors or gates that are closed by continuous pressure means.

2.13.6.2 Operating Requirements. The sequence operation of a hoistway door and adjacent power-operated vertically sliding car door or gate shall conform to 2.13.6.2.1 and 2.13.6.2.2.

2.13.6.2.1 In opening, the hoistway door shall be opened at least two-thirds of its travel before the car door or gate can start to open.

2.13.6.2.2 In closing, the car door or gate shall be closed at least two-thirds of its travel before the hoistway door can start to close.

SECTION 2.14
CAR ENCLOSURES, CAR DOORS AND GATES, AND CAR ILLUMINATION

2.14.1 Passenger and Freight Enclosures, General

2.14.1.1 Enclosure Required. Elevators shall be equipped with a car enclosure.

2.14.1.2 Securing of Enclosures

2.14.1.2.1 The enclosure shall be securely fastened to the car platform and so supported that it cannot loosen or become displaced in ordinary service, on the application of the car safety, on buffer

engagement, or the application of the emergency brake (see 2.19).

2.14.1.2.2 The car enclosure shall be so constructed that removable portions cannot be dismantled from within the car.

2.14.1.2.3 Enclosure linings, decorative panels, light fixtures, suspended ceilings, and other apparatus or equipment attached within the car enclosure shall be securely fastened and so supported that they will not loosen or become displaced in ordinary service, on car safety application, or on buffer engagement.

2.14.1.2.4 Panels attached to the car enclosure for decorative or other purposes shall either

(a) not be unfastened from inside the car by the use of common tools; or

(b) be permitted to be removed from inside the car when perforations, exceeding that which would reject a ball 13 mm (0.5 in.) in diameter, in the enclosure used for panel hanging or support have permanent means to prevent straight through passage beyond the running clearance.

2.14.1.3 Strength and Deflection of Enclosure Walls. The enclosure walls shall be designed and installed to withstand a force of 330 N (75 lbf) applied horizontally at any point on the walls of the enclosure without permanent deformation and so that the deflection will not reduce the running clearance below the minimum specified in 2.5.1, nor cause the deflection to exceed 25 mm (1 in.).

2.14.1.4 Number of Compartments in Passenger and Freight Elevator Cars. Cars shall not have more than two compartments. Where elevators have two compartments, one shall be located above the other, and the elevator shall conform to 2.14.1.4.1 through 2.14.1.4.6.

2.14.1.4.1 The elevator shall be used exclusively for passengers or exclusively for freight at any one time. If freight is to be carried in only one compartment, means shall be provided to lock the other compartment out of service.

2.14.1.4.2 Each compartment shall conform to the requirements of this Section, except that a trap door in the floor of the upper compartment shall provide access to the top emergency exit for the lower compartment.

2.14.1.4.3 Where either or both compartments are intended for passenger service, the minimum rated load for each compartment shall conform to 2.16.1.

Where one compartment is intended for freight use, its minimum rated load shall conform to 2.16.1 or shall be based on the freight loads to be handled, if greater than the minimum rated load required by 2.16.1.

Where both compartments are used exclusively for freight, the minimum rated load of each compartment shall conform to 2.16.2.

The rated load of the elevator shall be the sum of the rated loads of the individual compartments.

2.14.1.4.4 An emergency stop switch, where required by 2.26.2.5, shall be provided in each compartment, and these emergency stop switches shall be so connected that the car cannot run unless both are in the run position.

2.14.1.4.5 An in-car stop switch, where required by 2.26.2.21, shall be provided in each compartment, and these switches shall be so connected that the car cannot run unless both are in the run position.

2.14.1.4.6 All hoistway doors shall be closed and locked and the car doors for each compartment closed before the car can be operated.

2.14.1.5 Top Emergency Exits. An emergency exit with a cover shall be provided in the top of all elevator cars, except cars in partially enclosed hoistways (see 2.14.1.5.2).

2.14.1.5.1 Top emergency exits shall conform to the following requirements:

(a) The top emergency exit opening shall have an area of not less than 0.26 m2 (400 in.2) and shall measure not less than 400 mm (16 in.) on any side.

(b) The top emergency exit and suspended ceiling opening, if any, shall be so located as to provide a clear passageway, unobstructed by fixed equipment located in or on top of the car. Equipment is permitted directly above the exit opening, provided that

(1) it is not less than 1 070 mm (42 in.) above the top of the car; or

(2) the exit is located to allow unobstructed passage of a parallel piped volume measuring 300mm_ 500mm by 1 500 mm (12 in. _ 20 in. _ 59 in.) at an angle not less than 60 deg from the horizontal (see Nonmandatory Appendix C).

(c) The top emergency exit cover shall open outward. It shall be hinged or securely attached with a chain when in both the open and closed positions. If a chain is used, it shall be not more than 300 mm (12 in.) in length and have a factor of safety of not less than 5. The exit cover shall only be openable from the top of the car, where it shall be openable without the use of special tools. The exit cover of the lower compartment of a multideck elevator shall be openable from both compartments. On elevators with two compartments, if the emergency exit of the lower compartment does not open directly into the upper compartment, a guarded passageway shall be provided between the lower compartment roof and the upper compartment floor.

(d) The movable portion (exit panel) of the suspended ceiling that is below the top exit opening shall be restrained from falling. It shall be permitted to be hinged upward or downward, provided that the exit permits a clear opening with the top exit opening.

(1) A minimum clear headroom of 2 030mm(80 in.) above the car floor shall be maintained when downward-swinging suspended ceiling exit panels are used.

(2) Upward-opening suspended ceiling exit panels shall be restrained from closing when in use and shall not diminish the clear opening area of the corresponding top exit opening.

(3) The movable portion and the fixed portion of a suspended ceiling shall not contain lamps that could be shattered by the rescue operation using the top emergency exit. The movable portion of the suspended ceiling shall be permitted to contain light fixtures connected to the stationary portion of the suspended ceiling wiring by means of a plug and socket or by flexible armored wiring. Flexible wiring shall not be used to support or restrain the exit opening in the suspended ceiling in the open position.

(e) Where elevators installed in enclosed hoistways are provided with special car top treatments such as domed or shrouded canopies, the exit shall be made accessible, including the car top refuge space as specified in 2.4.12.

(f) Immediately adjacent to the top emergency exit there shall be a space available for standing when the emergency exit cover is open. This space shall be permitted to include a portion of the refuge area (see 2.4.12). All exit covers shall be provided with a car top emergency exit electrical device (see 2.26.2.18) that will prevent operation of the elevator car if the exit cover is open more than 50 mm (2 in.), and the device shall be so designed that it

(1) is positively opened

(2) cannot be closed accidentally when the cover is removed

(3) must be manually reset from the top of the car and only after the cover is within 50 mm (2 in.) of the fully closed position

(4) shall be protected against mechanical damage

2.14.1.5.2 On elevators in partially enclosed hoistways, means shall be provided to facilitate emergency evacuation of passengers. Such means shall not require a top emergency exit. A top emergency exit shall be permitted.

2.14.1.6 Car Enclosure Tops. Tops of car enclosures shall be so designed and installed as to be capable of sustaining a load of 135 kg (300 lb) on any area 600 mm X 600mm(24 in. X 24 in.), or 45 kg (100 lb) applied to any point, without permanent deformation. The resulting deflection under these loads shall be limited to prevent damage to any equipment, devices, or lighting assemblies fastened to or adjacent to the car enclosure top.

2.14.1.7 Railing and Equipment on Top of Cars

2.14.1.7.1 A standard railing conforming to 2.10.2 shall be provided on the outside perimeter of the car top on all sides where the perpendicular distance between the edges of the car top and the adjacent hoistway enclosure exceeds 300 mm (12 in.) horizontal clearance. The forces specified in 2.10.2.4 shall not deflect the railing beyond the perimeter of the car top.

The top of car enclosure, or other surface specified by the elevator installer, shall be the working surface referred to in 2.10.2.

2.14.1.7.2 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.

2.14.1.7.3 Devices that detect unauthorized access to the top of the car shall be permitted. These devices shall only be permitted to initiate an alarm. Audible alarms shall not exceed 90 dBA measured 1 m from the source.

2.14.1.8 Glass in Elevator Cars

2.14.1.8.1 Where enclosures include panels of glass, or transparent or translucent plastic, the panels shall

(a) be constructed of laminated glass that complies with the requirements of 16 CFR Part 1201, Sections 1201.1 and 1201.2; or be constructed of laminated glass, safety glass, or safety plastic that comply with CAN/CGSB-12.1, CAN/CGSB-12.11, or CAN/CGSB-12.12; whichever is applicable (see Part 9)

(b) be provided with a handrail or framing designed to guard the opening should the panel become detached, where wall panels are wider than 300 mm (12 in.)

(c) be mounted in the structure so that the assembly shall withstand the required elevator tests without damage (see 2.14.1.2)

2.14.1.8.2 Glass used for lining walls or ceilings shall conform to 2.14.1.8.1(a) and (c), except that tempered glass shall be permitted, provided that

(a) it conforms to ANSI Z97.1, 16 CFR Part 1201, Sections 1201.1 and 1201.2, or CAN/CGSB-12.1; whichever is applicable (see Part 9)

(b) the glass is not subjected to further treatment such as sandblasting, etching, heat treatment, painting, etc., that could alter the original properties of the glass

(c) the glass is bonded to a nonpolymeric coating, sheeting, or film backing having a physical integrity to hold the fragments when the glass breaks

(d) the glass is tested and conforms to the acceptance criteria for laminated glass as specified in ANSI Z97.1, or 16 CFR Part 1201, Section 1201.4, or CAN/CGSB-12.11, whichever is applicable (see Part 9)

2.14.1.8.3 In jurisdictions enforcing the NBCC, type 3C film reinforced silvered mirror glass that conforms to CAN/CGSB-12.5 shall be permitted for lining walls or ceilings.

2.14.1.8.4 Markings as specified in the applicable glazing standard shall be on each separate piece, and shall remain visible after installation.

2.14.1.9 Equipment Inside Cars

2.14.1.9.1 Apparatus or equipment not used in connection with the function or use of the elevator shall not be installed inside of any elevator car, except as follows:

(a) Support rails (handrails) are permitted.

(b) Fastening devices for padded protective linings are permitted.

(c) Lift hooks, conveyor tracks, and support beams for freight handling, mounted in the ceiling of passenger elevator, shall clear the car floor to a height of 2 450 mm (96 in.) (see 2.16.9).

(d) Picture frames, graphic display boards, plaques, and other similar visual displays shall be mounted to withstand the required elevator tests without damage. All edges shall be beveled or rounded. The material shall conform to 2.14.1.2 and 2.14.2.1. When attached to the car wall less than 2 130 mm (84 in.) above the floor, projections from the car wall, excluding support rails, shall not be greater than 38 mm (1.5 in.).

(e) Conveyor tracks shall be permitted in freight elevators cars.

(f) Heating equipment, ventilating fans, and air-conditioning equipment, if used, shall be securely fastened in place and located above the car ceiling or outside the enclosure.

2.14.1.9.2 Passenger car floors shall have no projections or depressions greater than 6 mm (0.25 in.).

2.14.1.10 Side Emergency Exits. Side emergency exits are prohibited.

2.14.2 Passenger-Car Enclosures

2.14.2.1 Material for Car Enclosures, Enclosure Linings, and Floor Coverings. All materials exposed to the car interior and the hoistway shall be metal, glass, or shall conform to 2.14.2.1.1 through 2.14.2.1.6.

2.14.2.1.1 Materials in their end use configuration, other than those covered by §2.14.2.1.2 through §2.14.2.1.6, must conform to the following requirements, based on the tests conducted in accordance with the requirements of ASTM E 84, UL 723, or NFPA 255:

(a) Flame spread rating of 0 to 50.

(b) Smoke development of 0 to 100.

2.14.2.1.2 In jurisdictions enforcing the NBCC materials in their end-use configuration, where the elevator is designed as a firefighters' elevator, shall have

(a) a flame spread rating for walls and ceiling of 0 to 25 with smoke development of 0 to 100 based on the test conducted in accordance with the requirements of CAN/ULC-S102

(b) a flame spread rating for floor surfaces of 0 to 300 with smoke development of 0 to 300, based on the test conducted in accordance with the requirements of CAN/ULC-S102.2

2.14.2.1.3 Napped, tufted, woven, looped, and similar materials in their end-use configuration on car enclosure walls shall conform to 8.3.7 or the NBCC and National Fire Code of Canada, whichever is applicable. The enclosure walls to which this material is attached shall conform to 2.14.2.1.1.

2.14.2.1.4 Padded protective linings, for temporary use in passenger cars during the handling of freight, shall be of materials conforming to either 2.14.2.1.1 or 2.14.2.1.3, whichever is applicable. The protective lining shall clear the floor by not less than 100 mm (4 in.).

2.14.2.1.5 Floor covering, underlayment, and its adhesive shall have a critical radiant flux of not less than 0.45 W/cm2, as measured by ASTM E 648 or conform to the requirements of the NBCC and ULC standard CAN/ULC-S102.2, whichever is applicable.

2.14.2.1.6 Handrails, operating devices, ventilating devices, signal fixtures, audio and visual communication devices, and their housings are not required to conform to 2.14.2.1.1 through 2.14.2.1.4.

2.14.2.2 Openings Prohibited. Openings or hinged or removable panels in an enclosure are prohibited, other than as required for the following:

(a) signal, operating, and communication equipment

(b) entrances

(c) vision panels

(d) top emergency exit

(e) ventilation

(f) access panels for cleaning of glass on observation elevators (see 2.14.2.6)

(g) equipment access panels for maintenance and inspection of equipment shall conform to the following requirements (see also 2.7.5.1.4):

(1) be of hinged type.

(2) open only into the car.

(3) be provided with a lock so arranged that the door shall be openable from inside the car only by a specially shaped removable key. Locks shall be so designed that they cannot be opened from the inside by the use of ordinary tools or instruments. Keys shall be Group 1 Security (see 8.1).

(4) be provided with electric contacts that conform to 2.14.4.2.3(b) through (e) and 2.26.2.35, and are located so as to be inaccessible from the inside of the car. When opened, the contact shall cause power to be removed from the driving-machine motor and brake.

(5) be of the same material and construction as required for the enclosure.

2.14.2.3 Ventilation

2.14.2.3.1 Natural ventilation openings conforming to the following shall be provided in car enclosures:

(a) Openings exposed to the inside of the car shall not be located in the portion of the enclosure walls extending from a point 300 mm (12 in.) above the floor to a point 1 825 mm (72 in.) above the floor.

(b) Openings less than 300mm(12 in.) above the floor shall reject a ball 25 mm (1 in.) in diameter and be guarded to prevent straight-through passage.

(c) Openings above the 1 825 mm (72 in.) level shall reject a ball 50 mm (2 in.) in diameter and be guarded to prevent straight-through passage.

(d) Openings in the car ceiling shall be protected and shall conform to 2.14.1.6.

(e) The total area of natural ventilation openings shall be not less than 3.5% of the inside car floor area divided equally between the bottom and top of the car enclosure.

(f) The total unrestricted opening in or around the car doors or gates shall be permitted to be included as part of the total natural ventilation required.

(g) The unrestricted opening provided by forced ventilation systems shall be permitted to be part of the natural ventilation area on the part of the car in which it is located.

2.14.2.3.2 Ventilating fans or blowers, if used, shall be located above the car ceiling or outside the enclosure and shall be securely fastened in place.

2.14.2.3.3 Forced ventilation conforming to the following shall be provided on observation elevators with glass walls exposed to direct sunlight:

(a) There shall be a minimum air handling capacity to provide one air change per minute based on net inside car volume.

(b) An auxiliary power source capable of providing the minimum air handling capacity for a continuous period of at least 1 h shall be provided on each elevator car.

NOTE (2.14.2.3.3): Special consideration should be given to elevators such as observation and parking garage elevators, when they are exposed to the elements. In extreme cases, emergency power may be required for this purpose.

2.14.2.4 Headroom in Elevator Cars. A minimum clear headroom of 2 025 mm (80 in.) above the car floor shall be provided.

2.14.2.5 Vision Panels. Vision panels are not required, but where used, shall

(a) be of a total area of not more than 0.1 m2 (155 in.2) and contain no single glass panel having a width exceeding 150 mm (6 in.).

(b) be provided with wire-glass panels or laminated glass panels conforming to 16 CFR Part 1201 or CAN/CGSB-12.11, whichever is applicable (see Part 9). Markings as specified in the applicable standard shall be on each separate piece of laminated glass, and shall remain visible after installation.

(c) be located in the car door or in the front return panel of the car enclosure.

(d) have the inside face of a car door vision panel, grille, or cover located substantially flush with the inside surface of the car door.

(e) have fasteners that are located on the hoistway side. It shall not be possible to remove the fasteners with common tools.

2.14.2.6 Access Panels. Nonremovable sliding or swing panels shall be permitted for access to the car or hoistway transparent enclosures for cleaning purposes. Such panels or doors shall

(a) if hinged, open only into the car

(b) be provided with cylinder-type locks, having not less than a five-pin or a five-disc combination, or a lock that provides equivalent security, arranged so that they can be unlocked with a key from the car side, and the key shall be Group 2 Security (see 8.1)

(c) be openable by hand from the hoistway side

(d) be self-locking

(e) be provided with a device arranged so that the panel must be in the closed and locked position (see 2.26.2.31) before the elevator can operate

(f) have a bottom edge a minimum of 1 070 mm (42 in.) from the floor in cases where the adjacent hoistway wall is more than 140 mm (5.5 in.) from the car enclosure or where there is no adjacent hoistway wall

2.14.3 Freight-Car Enclosure

2.14.3.1 Enclosure Material. Enclosures shall be of metal without perforations to a height of not less than 1 825 mm (72 in.) above the floor.

Above the 1 825 mm (72 in.) level, the walls and top of the enclosure shall be metal with or without perforations, except that portion of the enclosure wall in front of and extending 150 mm (6 in.) on each side of the counterweight, which shall be without perforations. Perforated portions of enclosures shall reject a ball 25 mm (1 in.) in diameter. Freight elevators that are permitted to carry passengers (see 2.16.4) shall conform to 2.14.2.2.

2.14.3.2 Openings in Car Tops. Hinged or removable panels shall not be provided in car tops, except those required for emergency exit, and for equipment access (see 2.7.5.1.4).

2.14.3.3 Ventilation. If ventilating grilles or Louvers are provided in the enclosure below the 1 825mm(72 in.) level, they shall be located not more than 300mm (12 in.) above the floor and shall reject a ball 50 mm (2 in.) in diameter.

2.14.4 Passenger and Freight Car Doors and Gates, General Requirements

2.14.4.1 Where Required. A door shall be provided at each entrance to a passenger car and a door or gate shall be provided at each entrance to a freight car.

2.14.4.2 Door and Gate Electric Contacts and Door Interlocks

2.14.4.2.1 Each car door or gate shall be provided with a door or gate electric contact conforming to 2.26.2.15, 2.14.4.2.3, and 2.14.4.2.5, or a car-door interlock conforming to 2.26.2.28, 2.14.4.2.4, and 2.14.4.2.5.

2.14.4.2.2 A car door interlock shall be required for

(a) car doors of elevators where the clearance between the loading side of the car platform and hoistway enclosure exceeds the maximum specified in 2.5.1.5

(b) car doors of elevators that face an unenclosed portion of the hoistway during the travel of the car

2.14.4.2.3 Car door and gate electric contacts shall

(a) prevent operation of the driving machine when the car door or gate is not in the closed position, except under one of the following conditions:

(1) when a hoistway access switch is operated (see 2.12.7)

(2) when a car-leveling or truck-zoning device is operated (see 2.26.1.6)

(3) when a bypass switch is activated (see 2.26.1.5)

(b) be positively opened by a lever or other device attached to and operated by the door or gate

(c) be maintained in the open position by the action of gravity or by a restrained compression spring, or by both, or by positive mechanical means

(d) be so designed or located that they shall not be accessible from within the car

(e) not utilize mercury tube switches

2.14.4.2.4 Car door interlocks shall

(a) prevent operation of the driving machine when the car door is not in the closed and locked position, except

(1) when the car is within the unlocking zone for that entrance

(2) under the conditions specified in 2.14.4.2.3(a)

(b) prevent opening of the car door from within the car, except when the car is in the unlocking zone for that entrance

(c) hold the car door in the locked position by means of gravity or by a restrained compression spring, or by both, or by means of a positive linkage

(d) be so located that they are not accessible from within the car when the car doors are closed

(e) be designed in accordance with 2.12.2.4

2.14.4.2.5 Each type and make of car door electric contact, car gate electric contact, and car door interlock shall

(a) be type tested in conformance with 2.12.4.1

(b) be listed/certified in conformance with 2.12.4.2

(c) be marked in conformance with 2.12.4.3

2.14.4.3 Type and Material for Doors. Doors shall be of the horizontally or vertically sliding type and of material conforming to 2.14.2.1.

2.14.4.4 Type of Gates. Gates, where permitted, shall be of the horizontally sliding or vertically sliding type, conforming to 2.14.4.7, 2.14.5, and 2.14.6.

2.14.4.5 Location

2.14.4.5.1 Doors or gates for automatic or continuous-pressure operation elevators, except

freight elevators equipped with horizontally swinging doors and not accessible to the general public, located in factories, warehouses, garages, and similar buildings, shall be so located that the distance from the face of the car door or gate to the face of the hoistway door shall be not more than the following:

(a) where a swinging-type hoistway door and a car gate are used, 100 mm (4 in.)

(b) where a swinging-type hoistway door and a car door are used, 140 mm (5.5 in.)

(c) where a sliding-type hoistway door and a car door or gate are used, 140 mm (5.5 in.)

(d) on freight elevators that are equipped with horizontally swinging doors and that are not accessible to the general public (i.e., located in factories, warehouses, garages, and similar buildings), the distance specified in 2.14.4.5.1(a), (b), and (c) shall be not more than 165mm (6.5 in.)

2.14.4.5.2 The distances specified shall be measured as follows:

(a) where a multisection car door and multisection hoistway door are used, or where one of these doors is multisection and the other is single section, between the sections of the car door and the hoistway door nearest to each other

(b) where a multisection car door and a swinging type hoistway door are used, between the hoistway door and the section of the car door farthest from it

(c) where a car gate is used, between the car gate and that section of the hoistway door nearest to the car gate

2.14.4.6 Strength of Doors, Gates, and Their Guides, Guide Shoes, Tracks, and Hangers. Doors and gates and their guides, guide shoes, tracks, and hangers shall be so designed, constructed, and installed that when the fully closed door or gate is subjected to a force of 335 N (75 lbf), applied on an area 300 mm (12 in.) square at right angles to and approximately at the center of the door or gate, it will not deflect beyond the line of the car sill.

When subjected to a force of 1 100N(250 lbf) similarly applied, doors and vertically sliding gates shall not break or be permanently deformed and shall not be displaced from their guides or tracks.

Where multisection doors or gates are used, each panel shall withstand the forces specified.

2.14.4.7 Vertically Sliding Doors and Gates. Vertically sliding doors or gates shall conform to 2.14.4.7.1 through 2.14.4.7.5.

2.14.4.7.1 They shall be of the balanced counterweighted type or the biparting counterbalanced type.

2.14.4.7.2 Gates shall be constructed of wood or metal, and shall be of a design that will reject a ball 50 mm (2 in.) in diameter, except that if multisection vertical lift gates are used, the panel shall be designed to reject a ball 10 mm (0.375 in.) in diameter.

2.14.4.7.3 Doors shall be constructed of material conforming to 2.14.2.1.

2.14.4.7.4 Doors or gates shall guard the full width of the car entrance openings, and their height shall conform to 2.14.5.4 or 2.14.6.2.3.

2.14.4.7.5 Balanced counterweighted doors or gates shall be either single or multiple section, and shall slide either up or down to open, conforming to 2.14.5.3 and 2.14.6.2.

2.14.4.8 Weights for Closing or Balancing Doors or Gates. Weights used to close or balance doors or gates shall be located outside the car enclosure and shall be guided or restrained to prevent them from coming out of their runway.

The bottom of the guides or other restraining means shall be so constructed as to retain the weights if the weight suspension means breaks. Weights that extend beyond the hoistway side of the car door or gate guide rail shall be guarded to prevent accidental contact.

2.14.4.9 Factor of Safety for Suspension Members. Suspension members of vertically sliding car doors or gates, and of weights used with car doors or gates, shall have a factor of safety of not less than 5. At least two independent suspension means shall be provided so that the failure of one suspension means shall not permit the car doors or gates to fall; or a safety device shall be provided to prevent the doors or gates from falling, if the suspension means fails.

2.14.4.10 Power-Operated and Power-Opened or Power-Closed Doors or Gates. The operation of power operated and power-opened or power-closed doors or gates shall conform to 2.13.

2.14.4.11 Closed Position of Car Doors or Gates. Car doors or gates shall be considered to be in the closed position under the following conditions:

(a) for horizontally sliding doors or gates, when the clear open space between the leading edge of the door or gate and the nearest face of the jamb does not exceed 50 mm (2 in.) except where car doors are provided with a car door interlock(s), 10 mm (0.375 in.)

(b) for vertically sliding counterweighted doors or gates, when the clear open space between the leading edge of the door or gate and the car platform sill does not exceed 50 mm (2 in.)

(c) for horizontally sliding center-opening doors, or vertically sliding biparting counterbalanced doors, when the door panels are within 50 mm (2 in.) of

contact with each other, except where horizontally sliding center-opening car doors are provided with a car door interlock(s), 10 mm (0.375 in.)

2.14.5 Passenger Car Doors

2.14.5.1 Number of Entrances Permitted. There shall be not more than two entrances to the car, except in existing buildings where structural conditions make additional entrances necessary.

2.14.5.2 Type Required. Horizontally or vertically sliding doors subject to the restrictions of 2.14.5.3 shall be provided at each car entrance.

2.14.5.3 Vertically Sliding Doors. Vertically sliding doors shall be

(a) of the balanced counterweighted type that slide in the up direction to open

(b) power operated where facing a power-operated vertically sliding counterbalanced or a vertically sliding down-to-open hoistway door

2.14.5.4 Dimensions of Doors. Doors, when in the fully closed position, shall protect the full width and height of the car entrance opening.

2.14.5.5 Openings in Doors. There shall be no openings in doors, except where vision panels are used.

2.14.5.6 Door Panels

2.14.5.6.1 Door panels shall have a flush surface on the side exposed to the car interior. The panels shall have no area or molding depressed or raised more than 3 mm (0.125 in.) and areas raised or depressed shall be beveled at not more than 30 deg to the panel surface.

2.14.5.6.2 Panels shall overlap the top and sides of the car entrance opening by not less than 13 mm (0.5 in.) when in the closed position.

2.14.5.6.3 The vertical clearance between a panel and the sill, or in the case of a vertically sliding door the vertical clearance between the leading edge and the sill, shall not exceed 10 mm (0.375 in.) when in the fully closed position.

2.14.5.6.4 The horizontal clearance shall not exceed 13 mm (0.5 in.) for horizontally sliding panels and 25 mm (1 in.) for vertically sliding panels between

(a) the car side of a panel and the related car entrance jamb

(b) related panels of multispeed entrances

(c) the car side of the panel and the related car head jamb

2.14.5.6.5 The leading edges of doors shall be free of sharp projections.

2.14.5.6.6 The meeting panel edges of center opening entrances shall be protected with not less than one resilient male member extending the full height of the panel. The meeting edges shall be permitted to interlock by not more than 10 mm (0.375 in.). When in the closed position, the distance between the metal parts of the meeting panels shall not exceed 13 mm (0.5 in.).

2.14.5.6.7 The clearance between the leading edge of the trailing panel of multiple-speed panels and the jamb shall not exceed

(a) 13 mm (0.5 in.) for horizontal slide

(b) 25 mm (1 in.) for vertical slide

2.14.5.7 Manual Opening of Car Doors. Car doors shall be so arranged that when the car is stopped within the unlocking zone (see 2.12.5.3) and power to the door operator is cut off, they and the mechanically related hoistway door, if any, shall be movable by hand from inside the car. The force required at the edge of sliding doors to move them shall not exceed 330 N (75 lbf).

2.14.5.8 Glass in Car Doors

2.14.5.8.1 Vision panels, where provided, shall conform to 2.14.2.5.

2.14.5.8.2 Glass doors, where provided, shall conform to the following requirements:

(a) The glass shall be laminated glass conforming to the requirements of 16 CFR Part 1201, or be laminated glass, safety glass, or safety plastic conforming to the requirements of CAN/CGSB-12.1, whichever is applicable (see Part 9). Markings as specified shall be on each separate piece, and shall remain visible after installation.

(b) The glass shall be not less than 60% of the total visible door panel surface area as seen from the car side of the doors. Door lap shall not be used in calculating glass size.

(c) In power-operated doors, the glass panel shall be substantially flush with the surface of the car side of the door.

(d) The glass shall conform to the applicable strength requirements of 2.14.4.6.

(e) The glass shall be so mounted that it, and its mounting structure, will withstand the required elevator tests without becoming damaged or dislodged.

(f) A nonglass edge shall be provided on the leading edge of the door panel.

2.14.6 Freight Elevator Car Doors and Gates

2.14.6.1 Type of Gates

2.14.6.1.1 For elevators designed for Class A loading (see 2.16.2.2), car gates shall be either of the vertically sliding type (see 2.14.6.2) or the horizontally sliding collapsible type (see 2.14.6.3).

2.14.6.1.2 For elevators designed for Class B or Class C loading (see 2.16.2.2), car gates shall be of the vertically sliding type (see 2.14.6.2).

2.14.6.2 Vertically Sliding Doors and Gates

2.14.6.2.1 On elevators used exclusively for freight, car doors and gates shall be either of the balanced counterweighted type that slide up or down to open, or of the biparting counterbalanced type. They shall be manually operated or power operated.

2.14.6.2.2 Where used on freight elevators permitted to carry passengers (see 2.16.4), car doors shall conform to 2.14.5.

2.14.6.2.3 Car doors and gates shall protect the full width of the car entrance opening, and their height shall be determined as follows:

(a) car doors and gates shall extend from a point not more than 25 mm (1 in.) above the car floor to a point not less than 1 825 mm (72 in.) above the car floor

(b) where a vertically sliding car gate with a door reopening device is provided, the 25 mm (1 in.) maximum dimension specified shall be measured from the car floor to the bottom of the leading member

2.14.6.2.4 The horizontal clearance between the car side of a panel and the related car entrance jamb or between related panels of multispeed doors or gates shall not exceed 25 mm (1 in.).

2.14.6.3 Collapsible-Type Gates

2.14.6.3.1 Collapsible-type gates shall protect the full width of the car entrance opening, and they shall extend from the car floor to a height of not less than 1 825 mm (72 in.) when fully closed.

2.14.6.3.2 When in the fully closed (extended) position, the opening between vertical members shall not be more than 115 mm (4.5 in.).

2.14.6.3.3 Every vertical member shall be restricted from moving perpendicular to the direction of travel more than 13 mm (0.5 in.).

2.14.6.3.4 They shall not be power opened, except as permitted by 2.13.2.1.2.

2.14.6.3.5 When in the fully opened (collapsed) position, collapsible gates shall be permitted to be arranged to swing inward.

2.14.6.3.6 Handles of manually operated collapsible gates nearest the car operating device on elevators operated from the car only shall be so located that the nearest handle is not more than 1 225 mm (48 in.) from the car operating device when the gate is closed (extended position), and not more than 1 225mm(48 in.) above the car floor. Gate handles shall be provided with finger guards.

2.14.7 Illumination of Cars and Lighting Fixtures

2.14.7.1 Illumination and Outlets Required. Cars shall be provided with an electric light or lights conforming to 2.14.7.1.1 through 2.14.7.1.4.

2.14.7.1.1 Not less than two lamps shall be provided.

2.14.7.1.2 The minimum illumination at the car threshold, with the door closed, shall be not less than

(a) 50 lx (5 fc) for passenger elevators

(b) 25 lx (2.5 fc) for freight elevators

2.14.7.1.3 Each elevator shall be provided with auxiliary lighting having its power source located on the car. It shall conform to the following:

(a) The intensity of auxiliary lighting illumination shall be not less than 2 lx (0.2 fc), measured approximately 1 225 mm(48 in.) above the car floor and 300mm (12 in.) centered horizontally in front of a car operating panel containing any of the following:

(1) car operating device(s)

(2) door open button

(3) rear or side door open button

(4) door close button

(5) rear or side door close button

(6) "HELP" button and operating instructions, or

(7) "ALARM" switch

(b) Illumination is not required in front of additional car operating panels where the devices listed in 2.14.7.1.3(a) are duplicated.

(c) Auxiliary lights shall be automatically turned on in all elevators in service after normal car lighting power fails.

(d) The power system shall be capable of maintaining the light intensity specified in 2.14.7.1.3(a) for a period of at least 4 h.

(e) Not less than two lamps of approximately equal wattage shall be used.

(f) Battery-operated units, where provided, shall

(1) comply with CSA C22.2 No. 141 (see Section 4)

(2) have a 4 h rating minimum

(3) be permanently connected to the car light branch circuit

(4) have an output rating that includes the auxiliary lights and if connected, the emergency signaling device (see 2.27.1.1.3)

2.14.7.1.4 Each elevator must be provided with a guarded electric light and convenience outlet fixture on the car top and under the car platform.

2.14.7.2 Light Control Switches

2.14.7.2.1 Light control switches for in-car lighting shall be permitted. When provided, they shall

(a) be located in or adjacent to the operating device in the car.

(b) in elevators having automatic operation, be of the key-operated type or located in a fixture with a locked cover. The key shall be Group 2 Security (see 8.1).

2.14.7.2.2 Automatic operation of the car lights shall be permitted. When provided, the operating circuit shall be arranged to turn off the lights only when the following conditions exist for not less than 5 min:

(a) the car is at a floor

(b) the doors are closed

(c) there is no demand for service

(d) the car is on automatic operation

Momentary interruption of any of the above conditions shall cause the car lights to turn on.

2.14.7.3 Car Lighting Devices

2.14.7.3.1 Glass used for lighting fixtures shall conform to 2.14.1.8.

2.14.7.3.2 Suspended glass used in lighting fixtures shall be supported by a metal frame secured at not less than three points.

2.14.7.3.3 Fastening devices shall not be removable from the fixture.

2.14.7.3.4 Glass shall not be drilled for attachment.

2.14.7.3.5 Light troughs supporting wiring raceways and other auxiliary lighting equipment, where used, shall be of metal, except where lined with noncombustible materials.

2.14.7.3.6 Materials for light diffusion or transmission shall be of metal, glass, or materials conforming to 2.14.2.1.1 and shall not come in contact with light bulbs and tubes.

2.14.7.4 Protection of Light Bulbs and Tubes. Light bulbs and tubes within the car shall

(a) be equipped with guards, be recessed, or be mounted above a drop ceiling to prevent accidental breakage. Cars that operate with the drop ceiling removed shall have a permanent separate guard for the light bulb or tube.

(b) be so mounted in the structure that the structure and the bulb or tube will withstand the required elevator tests without being damaged or becoming dislodged.

SECTION 2.15
CAR FRAMES AND PLATFORMS

2.15.1 Car Frames Required

Every elevator shall have a car frame (see 1.3).

2.15.2 Guiding Members

Car frames shall be guided on each guide rail by upper and lower guiding members attached to the frame.

Retention means shall be provided to prevent the car from being displaced by more than 13 mm (0.5 in.) from its normal running position should any part of the guiding means fail, excluding the guiding member base and its attachment to the frame. The retention means shall be permitted to be integral with the base.

2.15.3 Design of Car Frames and Guiding Members

The frame and its guiding members shall be designed to withstand the forces resulting under the loading conditions for which the elevator is designed and installed (see 2.16).

2.15.4 Underslung or Sub-Post Frames

The vertical distance between the centerlines of the top and bottom guide shoes of an elevator car having a sub-post car frame or having an underslung car frame located entirely below the car platform shall be not less than 40% of the distance between guide rails.

2.15.5 Car Platforms

2.15.5.1 Every elevator car shall have a platform consisting of a nonperforated floor attached to a platform frame supported by the car frame, and extending over the entire area within the car enclosure.

2.15.5.2 The platform frame members and the floor shall be designed to withstand the forces developed under the loading conditions for which the elevator is designed and installed.

2.15.5.3 Platform frames are not required where laminated platforms are provided.

2.15.5.4 Laminated platforms shall be permitted to be used for passenger elevators having a rated load of 2 300 kg (5,000 lb) or less.

2.15.5.5 The deflection at any point of a laminated platform, when uniformly loaded to rated capacity, shall not exceed 1/960 of the span. The stresses in the steel facing shall not exceed one-fifth of its ultimate strength, and the stresses in the plywood core shall not exceed 60% of the allowable stresses in Section 3.14 of the American Plywood Association Plywood Design Specification or CSA O86.1, as applicable (see Part 9).

2.15.6 Materials for Car Frames and Platform Frames

2.15.6.1 Materials Permitted. Materials used in the construction of car frames and platforms shall conform to 2.15.6.1.1 through 2.15.6.1.4.

2.15.6.1.1 Car frames and outside members of platform frames shall be made of steel or other metals.

2.15.6.1.2 Platform stringers of freight elevators designed for Class B or Class C loading shall be of steel or other metals.

2.15.6.1.3 Platform stringers of passenger elevators and of freight elevators designed for Class A loading shall be made of steel or other metals, or of wood.

2.15.6.1.4 Cast iron shall not be used for any part subject to tension, torsion, or bending, except for guiding supports and guide shoes.

2.15.6.2 Requirements for Steel. Steel used in the construction of car frames and platforms shall conform to 2.15.6.2.1 through 2.15.6.2.3.

2.15.6.2.1 Car-Frame and Platform-Frame Members.

Steel shall be rolled, formed, forged, or cast, conforming to the requirements of the following specifications:

(a) Rolled and Formed Steel. ASTM A 36 or ASTM A 283 Grade D or CAN/CSA-G40.21.

(b) Forged Steel. ASTM A 668 Class B.

(c) Cast Steel. ASTM A 27 Grade 60/30.

2.15.6.2.2 Rivets, Bolts, and Rods. Steel used for rivets, bolts, and rods shall conform to the following specifications:

(a) ASTM A 502, Rivets

(b) ASTM A 307, Bolts and Rods

2.15.6.2.3 Steels of Other Strength. Steels of greater or lesser strength than those specified by 2.15.6.2.1 shall be permitted to be used, provided they have an elongation of not less than 20% in a length of 50 mm (2 in.) when tested in accordance with ASTM E8, and provided that the stresses and deflections conform to 2.15.10 and 2.15.11, respectively.

Rivets, bolts, and rods made of steel having greater strength than specified by ASTM A 307 and ASTM A 502 shall be permitted to be used and the maximum allowable stresses increased proportionally, based on the ratio of the ultimate strengths. Elongation shall conform to the requirements of the corresponding ASTM specifications.

2.15.6.3 Requirements for Metals Other Than Steel. Metals other than steel shall be permitted to be used in the construction of car frames and platforms, provided the metal used has 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 2.15.10 and 2.15.11, respectively.

2.15.6.4 Requirements for Wood Used for Platform Floors and Stringers. Wood used for platform stringers and platform floors and sub-floors shall be of structural quality lumber or exterior-type plywood conforming to the requirements of the following:

(a) ASTM D 245, Structural Grades of Lumber

(b) ASTM D 198, Static Tests of Structural Timbers

(c) ANSI Voluntary Product Standard PS 1-74 or CSA O151, Softwood Plywood, Construction and Industrial

2.15.7 Car Frame and Platform Connections

2.15.7.1 Internal Connections. Connections between members of car frames and platforms shall be riveted, bolted, or welded, and shall conform to 2.15.7.3.

2.15.7.2 Connection Between Car Frame and Platform. The attachment of the platform to the car frame shall be done in accordance with good engineering practice and shall develop the required strength to transmit the forces safely from the platform to the car frame in accordance with 2.15.10. Bolts, nuts, and welding, where used, shall conform to 2.15.7.3.

2.15.7.3 Bolts, Nuts, and Welding

2.15.7.3.1 Bolts, where used through greater than 5 deg sloping flanges of structural members, shall have bolt heads of the tipped-head type or shall be fitted with beveled washers.

2.15.7.3.2 Nuts used on greater than 5 deg sloping flanges of structural members shall sit on beveled washers.

2.15.7.3.3 All welding shall conform to 8.8.

2.15.8 Protection of Platforms Against Fire

All platform materials exposed to the hoistway shall be either of the following:

(a) metal

(b) other materials that, in their end-use configuration, conform to the following requirements, based on the tests conducted in accordance with the requirements of ASTM E 84, UL 723, NFPA 255, or CAN/ULC-S102.2, whichever is applicable (see Part 9):

(1) flame spread rating of 0 to 75

(2) smoke development of 0 to 450

2.15.9 Platform Guards (Aprons)

The entrance side of the platform of passenger and freight elevators shall be provided with smooth metal guard plates of not less than 1.5 mm (0.059 in.) thick steel, or material of equivalent strength and stiffness, adequately reinforced and braced to the car platform and conforming to 2.15.9.1 through 2.15.9.4.

2.15.9.1 The guard plate shall extend not less than the full width of the widest hoistway-door opening.

2.15.9.2 The guard plate shall have a straight vertical face, extending below the floor surface of the platform, conforming to one of the following:

(a) where the elevator is required to conform to 2.19.2.2(b) the depth of the truck zone, where provided, plus 75 mm (3 in.), but in no case less than 1 220 mm (48 in.)

(b) where the elevator is not required to conform to 2.19.2.2(b) the depth of the leveling zone or truck zone, where provided, plus 75 mm (3 in.); but in no case less than 525 mm (21 in.)

2.15.9.3 The lower portion of the guard shall be bent back at an angle of not less than 60 deg nor more than 75 deg from the horizontal.

2.15.9.4 The guard plate shall be securely braced and fastened in place to withstand a constant force of not less than 650 N (145 lbf) applied at right angles to and at any position on its face without deflecting more than 6 mm (0.25 in.), and without permanent deformation.

Where the car entrance on the truck loading side is provided with a collapsible-type gate and the height of the hoistway door opening is greater than the distance from the car floor to the car top, a head guard extending the full width of the door opening shall be provided on the car to close the space between the car top and the soffit of the hoistway-door opening when the car platform is level with the floor at the truck loading landing entrance.

2.15.10 Maximum Allowable Stresses in Car Frame and Platform Members and Connections

2.15.10.1 The stresses in car frame and platform members and their connections, based on the static load imposed upon them, shall not exceed the following:

(a) for steels meeting the requirements of 2.15.6.2.1 and 2.15.6.2.2, as listed in Table 2.15.10.1

(b) for steels of greater or lesser strength, as permitted by 2.15.6.2.3, the allowable stresses listed in Table 2.15.10.1 are to be adjusted proportionally, based on the ratio of the ultimate strengths

(c) for metals other than steel, as permitted by 2.15.6.3, the allowable stresses listed in Table 2.15.10.1 are to be adjusted proportionally, based on the ratio of the ultimate strengths

2.15.10.2 Car frame members, brackets, and their connections subject to forces due to the application of the emergency brake (see 2.19.4) shall be designed to withstand the maximum forces developed during the retardation phase of the emergency braking so that the resulting stresses due to the emergency braking and all other loading acting simultaneously, if applicable, shall not exceed 190 MPa (27,500 psi).

2.15.11 Maximum Allowable Deflections of Car Frame and Platform Members

The deflections of car frame and platform members based on the static load imposed upon them shall be not more than the following:

(a) for crosshead, plank, and platform frame members, 1/960 of the span

(b) for uprights (stiles), as determined by 8.2.2.5.3

2.15.12 Car Frames With Sheaves

Where a hoisting rope sheave is mounted on the car frame, the construction shall conform to 2.15.12.1 through 2.15.12.3.

2.15.12.1 Where multiple sheaves mounted on separate sheave shafts are used, provision shall be made to take the compressive forces, developed by tension in the hoisting 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 sheave shafts.

2.15.12.2 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. The bearing pressure shall in no case be more than that permitted in Table 2.15.10.1 for bolts in clearance holes.

2.15.12.3 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 requirements of 2.15.12.3.1 and 2.15.12.3.2 shall be conformed to.

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

2.15.12.3.2 The means for fastening the single threaded rod, member, or members to the car frame shall conform to 2.15.13.

Table 2.15.10.1 Maximum Allowable Stresses in Car Frame and Platform Members and Connections, for Steels Specified in 2.15.6.2.1 and 2.15.6.2.2

Member Type	Stress Type	Maximum Stress, MPa (psi)	Area Basis
Car crosshead	Bending	95 (14,000)	Gross section
Car frame plank (normal loading)	Bending	95 (14,000)	Gross section
Car frame plank (buffer reaction)	Bending	190 (27,500)	Gross section
Car frame uprights (stiles)	Bending plus tension	115 (17,000)	Gross section
		140 (20,200)	Net section
Hoisting rope hitch plate and shapes	Bending plus tension	75 (11,000)	Net section
Platform framing	Bending	95 (14,000)	Gross section
Platform stringers	Bending	115 (17,000)	Gross section
Threaded brace rods and other tension members except bolts	Tension	60 (9,000)	Net section
Bolts	Tension	55 (8,000)	Net section
Bolts in clearance holes	Shear	55 (8,000)	Actual area in shear plane
	Bearing	120 (17,500)	Gross section
Rivets or light body-fit bolts	Shear	75 (11,000)	Actual area in shear plane
	Bearing	140 (20,000)	Gross section
Any framing member normal loading	Compression	Note (1)	Gross section

NOTE:
(1) The maximum allowable compressive stress in any member at normal loading shall not exceed 60% of those permitted for static loads by the AISC #5326 or CSA S16.1.

2.15.13 Suspension-Rope Hitch Plates or Shapes

Where cars are suspended by hoisting ropes attached to the car frame or to the overhead supporting beams 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 so located that the tensions in the hoisting ropes will not develop direct tension in the bolts or rivets.

The stresses shall not exceed those permitted by 2.9.3.3.

2.15.14 Calculation of Stresses in Car-Frame and Platform-Frame Members

The calculation of the stresses and deflection in the car-frame plank and uprights and platform frames shall be based on the formulas and data in 8.2.2.

2.15.15 Platform Side Braces

Where side bracing and similar members are attached to car-frame uprights, the reduction in area of the upright shall not reduce the strength of the upright below that required by 2.15.

2.15.16 Hinged Platform Sills

Hinged platform sills, where used, shall conform to 2.15.16.1 through 2.15.16.3.

2.15.16.1 Hinged platform sills shall be provided with electric contacts conforming to 2.12.5, which will prevent operation of the elevator by the normal operating device unless the hinged sill is within 50 mm (2 in.) of its fully retracted position, provided that when in this position, the sill does not reduce the clearance specified in 2.5.1.4.

2.15.16.2 The elevator shall be permitted to be operated by the leveling device in the leveling zone with the sill in any position.

2.15.16.3 The strength of the sills shall conform to 2.11.11.1.

2.15.17 Fastening of Compensation Means

Fastenings to the car of the suspension ropes' compensation means shall conform to 2.21.4.

SECTION 2.16
CAPACITY AND LOADING

2.16.1 Minimum Rated Load for Passenger Elevators

2.16.1.1 Minimum Load Permitted. The rated load in kg (lb) for passenger elevators shall be based on the inside net platform area, and shall be not less than shown by Fig. 8.2.1.2 (see Nonmandatory Appendix D and 2.26.11).

The inside net platform area shall be determined at a point 1 000 mm (39 in.) above the floor and inside of any panels or wall surfaces, but exclusive of any handrails and space for doors as shown in Fig. 2.16.1.1. To allow for variations in car designs, an increase in the maximum inside net area not exceeding 5% shall be permitted for the various rated loads. See Table 2.16.1.1.

2.16.1.2 Use of Partitions for Reducing Inside Net Platform Area. Where partitions are installed in elevator cars for the purpose of restricting the platform net area for passenger use, they shall be permanently bolted, riveted, or welded in place. Gates, doors, or handrails shall not be used for this purpose. Partitions shall be so installed as to provide for approximately symmetrical loading.

2.16.1.3 Carrying of Freight on Passenger Elevators. When freight is to be carried on a passenger elevator, the requirements of 2.16.1.3.1 and 2.16.1.3.2 shall be conformed to.

2.16.1.3.1 The minimum rated load shall conform to 2.16.1 or 2.16.2, whichever is greater.

2.16.1.3.2 The elevator shall be designed for applicable class of freight elevator loading.

2.16.2 Minimum Rated Load for Freight Elevators

2.16.2.1 Minimum Load Permitted. The minimum rated load for freight elevators in pounds shall be based on the weight and class of the load to be handled, but shall in no case be less than the minimum specified in 2.16.2.2 for each class of loading based on the inside net platform area.

2.16.2.2 Classes of Loading and Design Requirements.

Freight elevators shall be designed for one of the following classes of loading.

2.16.2.2.1 Class A: General Freight Loading. Where the load is distributed, the weight of any single piece of freight or of any single hand truck and its load is not more than 25% of the rated load of the elevator, and the load is handled on and off the car platform manually or by means of hand trucks.

For this class of loading, the rated load shall be based on not less than 240 kg/m2 (49 lb/ft2) of inside net platform area.

2.16.2.2.2 Class B: Motor Vehicle Loading. Where the elevator is used solely to carry automobile trucks or passenger automobiles up to the rated capacity of the elevator.

For this class of loading, the rated load shall be based on not less than 145 kg/m2 (30 lb/ft2) of inside net platform area.

2.16.2.2.3 Class C. There are three types of Class C Loadings:

(a) Class C1: Industrial Truck Loading. Where the static load during loading and unloading does not exceed the rated load.

(b) Class C2: Industrial Truck Loading. Where the static load during loading and unloading is permitted to exceed the rated load.

(c) Class C3: Other Loading With Heavy Concentrations. Where the static load during loading and unloading does not exceed the rated load.

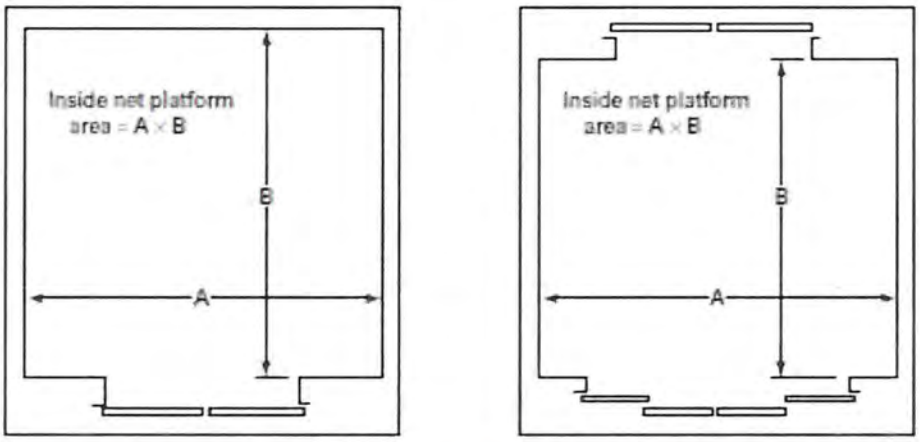


Fig. 2.16.1.1 Inside Net Platform Areas for Passenger Elevators

Table 2.16.1.1 Maximum Inside Net Platform Areas for the Various Rated Loads

SI Units		Imperial Units	
Rated Load, kg	Inside Net Platform Area, m^2	Rated Load, lb	Inside Net Platform Area, ft^2
230	0.65	500	7.0
270	0.77	600	8.3
320	0.89	700	9.6
450	1.23	1,000	13.3
550	1.45	1,200	15.6
700	1.76	1,500	18.9
800	2.05	1,800	22.1
900	2.25	2,000	24.2
1 150	2.70	2,500	29.1
1 350	3.13	3,000	33.7
1 600	3.53	3,500	38.0
1 800	3.92	4,000	42.2
2 000	4.29	4,500	46.2
2 250	4.65	5,000	50.0
2 700	5.36	6,000	57.7
3 200	6.07	7,000	65.3
3 600	6.77	8,000	72.9
4 100	7.48	9,000	80.5
4 500	8.18	10,000	88.0
5 400	9.57	12,000	103.0
7 000	11.62	15,000	125.1
8 000	13.65	18,000	146.9
9 000	14.98	20,000	161.2
11 500	18.25	25,000	196.5
13 500	21.46	30,000	231.0

GENERAL NOTE: To allow for variations in cab designs, an increase in the maximum inside net platform area not exceeding 5% shall be permitted for the various rated loads.

2.16.2.2.4 Class C loadings in 2.16.2.2.3 apply where the weight of the concentrated load including a powered industrial or hand truck, if used, is more than 25% the rated load and where the load to be carried does not exceed the rated load. (For concentrated loads exceeding the rated load, see 2.16.6.)

The following are additional requirements:

(a) For Class C1, Class C2, and Class C3 loadings, the rated load of the elevator shall be not less than the load (including any truck) to be carried, and shall in no case be less than 240 kg/m2 (49 lb/ft2) of inside net platform area.

The elevator shall be provided with a two-way automatic leveling device (see 1.3).

(b) For Class C1 and Class C2 loadings, the following additional requirements shall apply:

(1) For elevators with rated loads of 9 000 kg (20,000 lb) or less, the car platform shall be designed for a loaded truck of weight equal to the rated load or for the actual weight of the loaded truck to be used, whichever is greater.

(2) For elevators with rated loads exceeding 9 000 kg (20,000 lb), the car platform shall be designed for a loaded truck weighing 9 000 kg (20,000 lb), or for the actual weight of the loaded truck to be used, whichever is greater.

(c) For Class C2 loading, the following requirements shall apply:

(1) The maximum load on the car platform during loading or unloading shall not exceed 150% of rated load.

(2) For any load in excess of rated load on elevators with a rated load of 9 000 kg (20,000 lb) or less, the driving-machine motor, brake, and traction relation shall be adequate to sustain and level the full 150% of rated load.

(3) For any load in excess of the rated load on elevators with a rated load exceeding 9 000 kg (20,000 lb), the driving machine motor, brake, and traction relation shall be adequate to sustain and level the rated load plus either 4 500 kg (10,000 lb), or the weight of the unloaded truck to be used, whichever is greater.

NOTES (2.16.2):

(1) When the entire rated load is loaded or unloaded in increments by an industrial truck, the load imposed on the car platform, while the last increment is being loaded or the first increment unloaded, will exceed the rated load by part of the weight of the empty industrial truck.

(2) Requirement 2.16.2 does not prohibit the carrying of an industrial truck on a freight elevator of Class C2 or Class C3 loading, provided that the total weight on the elevator does not exceed the rated load of the elevator, and the elevator is designed to meet the requirements of 8.2.2 and 8.2.9, as appropriate, for the load involved.

2.16.3 Capacity and Data Plates

2.16.3.1 Plates Required and Locations. Every elevator shall be provided with a capacity plate and a data plate permanently and securely attached.

The capacity plate shall be located in a conspicuous position inside the car.

The data plate shall be located on the car crosshead, or inside the car for underslung elevators having no crosshead.

2.16.3.2 Information Required on Plates

2.16.3.2.1 Capacity plates shall indicate the rated load of the elevator in kilograms or pounds or both (see Nonmandatory Appendix D), and, in addition, this plate or a separate plate shall indicate

(a) the capacity lifting one-piece loads where the elevator conforms to 2.16.7

(b) for freight elevators designed for Class C2 loading, the maximum load the elevator is designed to support while being loaded or unloaded [see 2.16.2.2.4(c)]

2.16.3.2.2 Data plates shall indicate

(a) the weight of the complete car, including the car safety and all auxiliary equipment attached to the car

(b) the rated load and speed

(c) the wire rope data required by 2.20.2.1

(d) the name or trademark of the manufacturer and year manufactured

(e) rail lubrication instructions (see 2.17.16)

2.16.3.3 Material and Marking of Plates. Plates shall be of such material and construction that the letters and figures stamped, etched, cast, or otherwise applied to the faces shall remain permanently and readily legible.

The height of the letters and figures shall be not less than

(a) 6 mm (0.25 in.) for passenger elevator capacity plates

(b) 25 mm (1 in.) for freight elevator capacity plates

(c) 3 mm (0.125 in.) for data plates

2.16.4 Carrying of Passengers on Freight Elevators

Freight elevators conforming to 2.16.4.1 through 2.16.4.9 shall be permitted to carry passengers.

2.16.4.1 The elevator shall not be accessible to the general public.

2.16.4.2 The rated load shall not be less than that required by 2.16.1.

2.16.4.3 The elevator shall conform to 2.16.8.

2.16.4.4 Hoistway entrances shall conform to 2.12.1.1 and 2.11.2.1, or shall be power-operated doors conforming to 2.11.2.2(e).

2.16.4.5 Car doors shall be provided, and shall conform to 2.14.5.

2.16.4.6 Openings in car enclosures shall conform to 2.14.2.2.

2.16.4.7 Hoistway doors and/or car doors shall conform to 2.12.5.

2.16.4.8 The factors of safety for suspension wire ropes shall conform to Table 2.20.3 for passenger elevators.

2.16.4.9 Power-operated vertically sliding doors shall be power closed conforming to the following:

(a) requirements 2.13.3.2 or 2.13.3.4.

(b) shall be provided with a reopening device conforming to 2.13.5. The reopening device shall detect obstruction in the path of closing door travel without the necessity of physical contact. This can be provided by mounting the protection device(s) on the car door itself or on the car or door jamb.

(c) vertically sliding hoistway and car doors shall conform to 2.13.6.

(d) supporting chains, cables, or ropes shall not be exposed to the car interior.

(e) when closed by automatic means, shall be provided with a visual warning to function over the same period as the audible signal in 2.13.3.4.1.

2.16.5 Signs Required in Freight Elevator Cars

2.16.5.1 Signs Required. Signs, in addition to the capacity and data plates required by 2.16.3.1, shall be provided inside the car and shall be located in a conspicuous position and permanently and securely fastened to the car enclosure, subject to the requirements of 2.16.5.1.1 through 2.16.5.1.3.

2.16.5.1.1 For every freight elevator, the sign shall specify the type of loading (see 2.16.2.2) for which the elevator is designed and installed, with one of the following markings.

(a) "CLASS A LOADING. ELEVATOR TO BE LOADED OR UNLOADED MANUALLY OR BY MEANS OF HAND TRUCKS ONLY. NO SINGLE PIECE OF FREIGHT OR SINGLE HAND TRUCK AND ITS LOAD SHALL EXCEED _____KG (_____LB)."

(b) "CLASS B LOADING. THIS ELEVATOR DESIGNED TO TRANSPORT MOTOR VEHICLES HAVING A MAXIMUM GROSS WEIGHT NOT TO EXCEED _____KG (_____LB)."

(c) "CLASS C1 LOADING. THIS ELEVATOR DESIGNED TO TRANSPORT LOADED INDUSTRIAL TRUCK. MAXIMUM COMBINED WEIGHT OF INDUSTRIAL TRUCK AND LOAD NOT TO EXCEED _____KG (_____LB)."

(d) "CLASS C2 LOADING. THIS ELEVATOR DESIGNED FOR LOADING AND UNLOADING BY INDUSTRIAL TRUCK. MAXIMUM LOADING AND UNLOADING WEIGHT WHILE PARKED NOT TO EXCEED _____KG (_____LB). MAXIMUM WEIGHT TRANSPORTED NOT TO EXCEED _____KG (_____LB)."

(e) "CLASS C3 LOADING. THIS ELEVATOR DESIGNED TO TRANSPORT CONCENTRATED LOADS NOT TO EXCEED _____KG (_____LB)."

2.16.5.1.2 For elevators not permitted to carry passengers, the sign shall read: "THIS IS NOT A PASSENGER ELEVATOR. NO PERSONS OTHER THAN THE OPERATOR AND FREIGHT HANDLERS ARE PERMITTED TO RIDE ON THIS ELEVATOR."

2.16.5.1.3 For freight elevators permitted to carry passengers (see 2.16.4), a sign reading "PASSENGERS ARE PERMITTED TO RIDE THIS ELEVATOR."

2.16.5.2 Material and Marking of Signs. The material and marking of all signs shall conform to 2.16.3.3, except that the letters shall be not less than 13mm(0.5 in.) high.

2.16.6 Overloading of Freight Elevators

Freight elevators shall not be loaded in excess of their rated load as specified on the capacity plate required by 2.16.3, except for

(a) static loads on elevators loaded and unloaded by industrial trucks as noted on capacity or separate plate [see 2.16.2.2.3 and 2.16.3.2.1(b)]

(b) elevators designed and installed to conform to 2.16.7 to carry one-piece loads exceeding their rated load

2.16.7 Carrying of One-Piece Loads Exceeding the Rated Load

Passenger and freight elevators shall be permitted to be used, where necessary, to carry one-piece loads greater than their rated load, provided they are designed, installed, and operated to conform to 2.16.7.1 through 2.16.7.11.

2.16.7.1 A locking device shall be provided that will hold the car at any landing, independently of the hoisting ropes, while the car is being loaded or unloaded.

2.16.7.2 The locking device shall be so designed that it cannot be unlocked until the entire weight of the car and load is suspended on the ropes.

2.16.7.3 A removable wrench or other device shall be provided to operate the locking device.

2.16.7.4 The locking device shall be so designed that the locking bars will be automatically withdrawn should they come into contact with the landing locks when the car is operated in the up direction.

2.16.7.5 A special capacity plate shall be provided inside the elevator car and located in a conspicuous place that shall bear the words "CAPACITY LIFTING ONE-PIECE LOADS" in letters, followed by figures giving the special capacity in kilograms (pounds) for lifting one-piece loads for which the machine is designed. For material and size of letters, see 2.16.3.3.

2.16.7.6 The car frame, car platform, sheaves, shafts, ropes, and locking devices shall be designed for the specified "Capacity Lifting One-Piece Loads," provided that

(a) in the design of the car frame, platform, sheaves, shafts, and ropes, the allowable stress is permitted to be 20% higher than those permitted for normal loading

(b) the factor of safety for the locking device is not less than 5

2.16.7.7 The car safeties shall be designed to stop and hold the specified "Capacity Lifting One-Piece Loads" with the ropes intact. The safety is not required to conform to the safety stopping distances specified in Table 2.17.3 if applied while the elevator is carrying a one-piece load exceeding the rated load.

2.16.7.8 Where there is an occupied space, or an unoccupied space not secured against unauthorized access (see 2.6), under the hoistway, the requirements of 2.16.7.8.1 through 2.16.7.8.4 shall be conformed to.

2.16.7.8.1 The machine shall be designed to operate the "Capacity Lifting One-Piece Loads" at slow speed.

2.16.7.8.2 The car safety shall be designed to stop and hold the car with this load, independently of the hoisting ropes.

2.16.7.8.3 The counterweight safety, where required by 2.6, shall be designed to stop and hold the entire weight of the counterweight, independently of the ropes.

2.16.7.8.4 Under the conditions described in 2.16.7.8.2 and 2.16.7.8.3, the car and counterweight safeties are not required to conform to the safety stopping distances specified in Table 2.17.3 when the elevator is carrying a one-piece load exceeding the rated load and the counterweight is provided with additional weight as required by 2.16.7.9.

2.16.7.9 For traction machines, where it is necessary to secure adequate traction, an additional counterweight shall be added during the period of use with one-piece loads so that the total overbalance is at least equal to 45% of the "Capacity Lifting One-Piece Loads."

2.16.7.10 A special operating device of the car switch or continuous-pressure type shall be provided in a machine room, control space located outside the hoistway, or control room to operate the elevator.

Means shall be provided to visually observe the driving machine when this special operating device is operated. When this device is operative, all other operating devices shall be inoperative (see 2.26.1.3).

2.16.7.11 The "Capacity Lifting One-Piece Loads" of any passenger traction elevator shall not exceed 1.33 times the rated load of the elevator.

2.16.8 Additional Requirements for Passenger Overload in the Down Direction

Passenger elevators and freight elevators permitted by 2.16.4 to carry passengers shall be designed and installed to safely lower, stop, and hold the car with an additional load up to 25% in excess of the rated load.

The elevator is not required to attain rated load performance under the passenger overload conditions specified but shall conform to

(a) requirement 2.17.2, except that 125% of the rated load shall be used in place of the rated load.

(b) requirement 2.17.3, except that 125% of the rated load shall be used in the first paragraph in place of the rated load. Second paragraph of 2.17.3, except that 125% of the rated load shall be used in place of the rated load, and the rated load performance including safety stopping distance is not required.

(c) requirement 2.24.2.3, except that 125% of rated load shall be used in place of the rated load.

(d) requirement 2.24.8, except that 125% of the rated load shall be used in place of the rated load.

(e) requirement 2.25.2.1, except that 125% of the rated load shall be used in place of the rated load.

(f) requirement 2.26.9.8, except that 125% of the rated load shall be used in place of the rated load.

(g) requirement 2.26.10, except that 125% of the rated load shall be used in place of the rated load.

(h) requirement 2.19.2.2(b), except that 125% of the rated load shall be used in place of the rated load.

(i) requirement 2.27.2.1, except that 125% of rated load shall be used in place of rated load.

(j) requirement 2.7.5.1.2(b), except that 125% of rated load shall be used in place of rated load.

2.16.9 Special Loading Means

Where special means (lift hooks, conveyor tracks, and support beams) that exert loads upon the car frame or platform, or both, are used to carry loads other than as described in 2.16.2.2, the effects of their loading on the car frame and platform shall be considered in accordance with 8.2.2.1 and 8.2.9.1. The allowable stresses and deflections shall be as specified in 2.15.10 and 2.15.11. The connections shall conform to 2.15.7.

SECTION 2.17
CAR AND COUNTERWEIGHT SAFETIES

2.17.1 Where Required and Location

The car of every elevator suspended by wire ropes shall be provided with one or more car safety devices of one of the types identified in 2.17.5. The safeties shall be attached to the car frame, and one safety shall be located within or below the car frame.

All car safeties shall be mounted on a single car frame and shall operate only on one pair of guide rails between which the frame is located.

2.17.2 Duplex Safeties

Where duplex (two) safeties are provided, the lower safety device shall be capable of developing not less than one-half of the force required to stop the entire car with rated load (see 2.16.8). Duplexed safety devices shall be arranged so as to function approximately simultaneously.

Type A or Type C safety devices (see 2.17.5) shall not be used in multiple (duplexed).

2.17.3 Function and Stopping Distance of Safeties

The safety device, or the combined safety devices, where furnished, shall be capable of stopping and sustaining the entire car with its rated load from governor tripping speed (see also 2.16.8).

Type B safeties 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 formulas in 8.2.6. Table 2.17.3 and Fig. 8.2.6 show the maximum and minimum stopping distances for various governor tripping speeds, when tested in conformance with 8.10 and 8.11.

2.17.4 Counterweight Safeties

Counterweight safeties, where furnished [see 2.6 and 2.19.3.2(a)(1)], shall conform to the requirements for car safeties, except as specified in 2.17.7 and 2.18.1.

2.17.5 Identification and Classification of Types of Safeties

Car safety devices (safeties) are identified and classified on the basis of performance characteristics after the safety begins to apply pressure on the guide rails. On this basis, there are three types of safeties.

2.17.5.1 Type A Safeties. Safeties that develop a rapidly increasing pressure on the guide rails 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 rails through eccentrics, rollers, or similar devices, without any flexible medium purposely introduced to limit the retarding force and increase the stopping distance.

2.17.5.2 Type B Safeties. Safeties that apply limited pressure on the guide rails during the stopping interval, and which 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. Safeties that require or do not require continuous tension in the governor rope to operate the safety during the entire stopping interval shall be permitted. Minimum and maximum distances are specified on the basis of governor tripping speed (see 2.17.3).

2.17.5.3 Type C Safeties (Type A With Oil Buffers). Safeties that 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 rails. The stopping distance is equal to the effective stroke of the buffers.

2.17.6 Reserved for Future Use

2.17.7 Governor-Actuated Safeties and Car Safety Mechanism Switches Required

2.17.7.1 Counterweight safeties, where provided for rated speeds over 0.75 m/s (150 ft/min), and car safeties, shall be actuated by separate speed governors.

Counterweight safeties for rated speeds of not over 0.75 m/s (150 ft/min) shall be permitted to be operated as a result of the breaking or slackening of the suspension ropes and shall be permitted to be of the inertia or other approved type without governors.

Where counterweight safeties are furnished to provide ascending car overspeed protection in accordance with 2.19.1.1, they shall be actuated by a counterweight speed governor (see 2.17.4).

2.17.7.2 Every car safety shall be provided with a switch, operated by the car safety mechanism (see 2.26.2.9).

A switch operated by the safety mechanism is not required on counterweight safeties.

2.17.7.3 The car safety mechanism switch shall operate before or at the time of application of the safety.

2.17.7.4 Switches operated by the car safety mechanism shall be of a type that cannot be reset until the car safety mechanism has been returned to the unapplied position.

2.17.8 Limits of Use of Various Types of Safeties

2.17.8.1 Type A (Instantaneous) Safeties. Type A safeties shall be permitted on elevators having a rated speed of not more than 0.75 m/s (150 ft/min).

When overspeed occurs, with the hoisting rope intact, such safeties shall be actuated by the governor.

On the parting of the hoisting ropes (free fall), Type A governor-operated safeties shall apply without appreciable delay, and their application shall be independent of the speed action of the governor and of the location of the break in the hoisting ropes (inertia application), and shall be permitted to be accomplished by the use of a governor and governor rigging having a sufficiently high value of inertia to apply the safety on free fall independently of the speed action of the governor (see 8.10 for inertia-application test of car safety).

2.17.8.2 Type C (Combination Instantaneous and Oil-Buffer Safety). Type C safeties shall be permitted subject to the requirements of 2.17.8.2.1 through 2.17.8.2.8.

2.17.8.2.1 The rated speed shall be not more than 2.5 m/s (500 ft/min).

2.17.8.2.2 The oil buffers shall conform to all requirements specified in 2.22 for oil buffers, except that the stroke shall be based on governor tripping speed and on an average retardation not exceeding 9.81 m/s2 (32.2 ft/s2).

2.17.8.2.3 After the buffer stroke, as defined in 2.17.8.2.2, has been completed, provision shall be made for an additional travel of the plunger or piston of not less than 10% of the buffer stroke, to prevent excessive impact on the buffer parts and the auxiliary safety plank.

2.17.8.2.4 Where the distance between guide rails exceeds 2 450 mm (96 in.), the safety shall be provided with two oil buffers of substantially identical calibration, and the buffers shall be so located as to develop minimum stresses in the auxiliary safety plank during safety operation.

Buffers shall be located in line with and symmetrically between the guide rails.

2.17.8.2.5 The auxiliary safety plank shall be so supported and guided below the car frame that the clearances specified in 2.17.10 for the safety parts are maintained during normal operation.

The auxiliary safety plank shall be so designed that the maximum stresses in the plank shall not exceed those specified for similar car-frame members in 2.15.

2.17.8.2.6 The rail-gripping device of the auxiliary safety plank shall be so arranged and connected as to prevent the plank from being out of level more than 13 mm (0.5 in.) in the length of the plank when the safety is operated to stop the car.

2.17.8.2.7 An electric switch shall be provided and so arranged and connected that the elevator cannot be operated by means of the normal operating device if any buffer is compressed more than 10% of its stroke (see 2.26.2.13).

2.17.8.2.8 Means shall be provided to prevent operation of the elevator by means of the normal operating device if the oil level in buffer is below the minimum level (see 2.26.2.13).

Table 2.17.3 Maximum and Minimum Stopping Distances for Type B Car Safeties With Rated Load and Type B Counterweight Safeties

SI Units				Imperial Units			
Rated Speed, m/s	Maximum Governor Trip Speed, m/s	Stopping Distances, mm		Rated Speed, ft/min	Maximum Governor Trip Speed, ft/min	Stopping Distances, in.	
		Min.	Max.			Min.	Max.
0–0.63	0.90	25	380	0–125	175	1	15
0.75	1.05	50	415	150	210	2	16
0.87	1.25	75	485	175	250	3	19
1.00	1.40	100	540	200	280	4	22
1.12	1.55	125	605	225	308	5	24
1.25	1.70	150	675	250	337	6	27
1.50	2.00	200	840	300	395	8	33
1.75	2.30	250	1 025	350	452	10	40
2.00	2.55	330	1 200	400	510	13	48
2.25	2.90	430	1 480	450	568	17	58
2.50	3.15	505	1 700	500	625	20	68
3.00	3.70	710	2 250	600	740	28	91
3.50	4.30	940	2 950	700	855	38	128
4.00	4.85	1 200	3 680	800	970	49	150
4.50	5.50	1 540	4 660	900	1,085	61	183
5.00	6.00	1 835	5 500	1,000	1,200	75	222
5.50	6.60	2 220	6 600	1,100	1,320	90	268
6.00	7.20	2 640	7 800	1,200	1,440	107	316
6.50	7.80	3 100	9 110	1,300	1,560	126	371
7.00	8.40	3 595	10 530	1,400	1,680	146	427
7.50	9.00	4 125	12 050	1,500	1,800	168	490
8.00	9.60	4 695	13 670	1,600	1,920	191	555
8.50	10.20	5 300	15 400	1,700	2,040	215	628
9.00	10.80	5 940	17 240	1,800	2,160	241	700
9.50	11.40	6 620	19 180	1,900	2,280	269	779
10.00	12.00	7 335	21 220	2,000	2,400	299	862

2.17.9 Application and Release of Safeties

2.17.9.1 Means of Application. Safeties shall be applied mechanically. Electric, hydraulic, or pneumatic devices shall not be used to apply the safeties required by 2.17, nor to hold such safeties in the retracted position.

2.17.9.2 Level of Car on Safety Application. The application of a Type A or Type B safety to stop the car, with its rated load centered 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 30 mm/m (0.36 in./ft) in any direction. (See 2.17.8.2.6 for Type C safeties.)

2.17.9.3 Release. When car safeties are applied, no decrease in tension in the governor rope or motion of the car in the down direction shall release the safeties, but such safeties shall be permitted to be released by the motion of the car in the up direction.

2.17.9.4 Force Providing Stopping Action to Be Compressive. Safeties shall be so designed that, on their application, the forces that provide the stopping action shall be compressive forces on each side of the guiderail section.

2.17.10 Minimum Permissible Clearance Between Rail-Gripping Faces of Safety Parts

In the normally retracted position of the safety, the distance between the rail-gripping faces of the safety parts shall be not less than the thickness of the guide rail plus 3.5 mm (0.14 in.), and the clearance on any side between the gripping face and the guide rail shall be not less than 1.5 mm (0.06 in.), as measured on the side of the rail toward which the car frame is pressed with sufficient force to take up all clearances in the guide shoe assembly. Safety jaws, while in the retracted position, shall be so restrained as to prevent a reduction of this minimum clearance.

2.17.11 Maximum Permissible Movement of Governor Rope to Operate the Safety Mechanism

For all Type B safeties, the movement of the governor rope, relative to the car or the counterweight, respectively, required to operate the safety mechanism from its fully retracted position to a position where the safety jaws begin to exert pressure against the guide rails, shall not exceed the following values based on rated speed:

(a) for car safeties

(1) 1 m/s (200 ft/min) or less, 1 070 mm (42 in.)

(2) 1.01 m/s (201 ft/min) to 1.9 m/s (375 ft/min), 915 mm (36 in.)

(3) over 1.9 m/s (375 ft/min), 756 mm (30 in.)

(b) for counterweight safeties, all speeds, 1 070 mm (42 in.)

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.

2.17.12 Minimum Factors of Safety and Stresses of Safety Parts and Rope Connections

2.17.12.1 Parts of safeties, except springs, safety rope drums, leading sheaves, and their supporting brackets and safety-jaw gibs, shall have a factor of safety of not less than 3.5, and the materials used shall have an elongation of not less than 15% in a length of 50 mm (2 in.) when tested in accordance with ASTM E 8. Forged, cast, or welded parts shall be stress relieved.

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

2.17.12.3 Safety-rope drums, leading sheaves, and their supporting brackets and safety-jaw gibs, are permitted to be made of cast iron and other metals provided such parts have a factor of safety of not less than 10.

2.17.12.4 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 9.5mm(0.375 in.) in diameter, shall be made of metal, and shall be corrosion resistant. The factor of safety of the rope shall be not less than 5. Tiller-rope construction shall not be used.

2.17.12.5 The factors of safety shall be based upon the maximum stresses developed in the parts during the operation of the safety when stopping rated load from governor tripping speed.

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

2.17.13 Corrosion-Resistant Bearings in Safeties and Safety Operating Mechanisms

Bearings in safeties and in the safety-operating mechanisms shall be of corrosion-resistant construction, with one or both members of the bearing made of, or electroplated with, a corrosion-resistant material.

2.17.14 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 6 mm (0.25 in.) in height indicating:

(a) the type of safety, based on 2.17.5

(b) the maximum tripping speed in m/s (ft/min) for which the safety is permitted

(c) the maximum weight in kg (lb), which the safety is designed and installed to stop and sustain

(d) the force in N (lbf) required to activate the safety or rope releasing carrier, if provided

(e) the manufacturer's name or trademark

2.17.15 Governor-Rope Releasing Carriers

Where a governor-rope releasing carrier is used to prevent actuation of the safety by the inertial forces of the governor-rope system, or used for any other purpose, the governor-rope releasing carrier on the car (or on the counterweight) shall be set to require a tension in the governor rope, to pull the rope from the carrier, of not more than 60% of the pull-through tension developed by the governor. The means to regulate the governor-rope pull-out force shall be mechanical and shall be sealed. The carrier shall be designed so that the pullout tension cannot be adjusted to exceed the amount specified without breaking the seal.

2.17.16 Rail Lubricants and Lubrication Plate

Rail lubricants or coatings that will reduce the holding power of the safety, or prevent its functioning as required in 2.17.3, shall not be used (see 8.7 for maintenance requirements).

A metal plate as required by 2.16.3.2 shall be securely attached to the car crosshead in an easily visible location, and, where lubricants are to be used, shall carry the notation, "CONSULT MANUFACTURER OF THE SAFETY FOR THE CHARACTERISTICS OF THE RAIL LUBRICANT TO BE USED." If lubricants are not to be used, the plate shall so state.

If lubricants other than those recommended by the manufacturer are used, a safety test shall be made to demonstrate that the safety will function as required by 2.17.3.

Table 2.17.3 Maximum and Minimum Stopping Distances for Type B Car Safeties With Rated Load and Type B Counterweight Safeties

SI Units				Imperial Units			
Rated Speed, m/s	Maximum Governor Trip Speed, m/s	Stopping Distances, mm		Rated Speed, ft/min	Maximum Governor Trip Speed, ft/min	Stopping Distances, in.	
		Min.	Max.			Min.	Max.
0–0.63	0.90	25	380	0–125	175	1	15
0.75	1.05	50	415	150	210	2	16
0.87	1.25	75	485	175	250	3	19
1.00	1.40	100	540	200	280	4	22
1.13	1.55	135	605	225	308	5	24
1.25	1.70	150	675	250	337	6	27
1.50	2.00	200	840	300	395	8	33
1.75	2.30	250	1 025	350	452	10	40
2.00	2.55	330	1 200	400	510	13	48
2.25	2.90	430	1 480	450	568	17	58
2.50	3.15	505	1 700	500	625	20	68
3.00	3.70	710	2 250	600	740	28	91
3.50	4.30	940	2 950	700	855	38	120
4.00	4.85	1 200	3 680	800	970	49	150
4.50	5.50	1 540	4 660	900	1,085	61	183
5.00	6.00	1 835	5 500	1,000	1,200	75	222
5.50	6.60	2 220	6 600	1,100	1,320	90	268
6.00	7.20	2 640	7 800	1,200	1,440	107	316
6.50	7.80	3 100	9 110	1,300	1,560	126	371
7.00	8.40	3 595	10 530	1,400	1,680	146	427
7.50	9.00	4 125	12 050	1,500	1,800	168	490
8.00	9.60	4 695	13 670	1,600	1,920	191	555
8.50	10.20	5 300	15 400	1,700	2,040	215	628
9.00	10.80	5 940	17 240	1,800	2,160	241	700
9.50	11.40	6 620	19 180	1,900	2,280	269	779
10.00	12.00	7 335	21 220	2,000	2,400	299	862

SECTION 2.18
SPEED GOVERNORS

2.18.1 Speed Governors Required and Location

2.18.1.1 Counterweight safeties, where provided with rated speeds over 0.75 m/s (150 ft/min), and car safeties shall be actuated by separate speed governors.

Where counterweight safeties are furnished to provide ascending car overspeed protection in accordance with 2.19.1.1, they shall be actuated by a counterweight speed governor (see 2.17.4.)

2.18.1.2 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.

2.18.2 Tripping Speeds for Speed Governors

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

(a) at not less than 115% of the rated speed.

(b) at not more than the tripping speed listed opposite the applicable rated speed in Table 2.18.2.1. Maximum tripping speeds for intermediate rated speeds shall be determined from Fig. 8.2.5. For rated speeds exceeding 10 m/s (2,000 ft/min), the maximum tripping speeds shall not exceed 120% of the rated speed.

2.18.2.2 Counterweight Speed Governors. Speed governors, where provided for counterweight safeties, shall be set to trip at an overspeed greater than that at which the car speed governor is to trip, but not more than 10% higher.

2.18.3 Sealing and Painting of Speed Governors

2.18.3.1 Speed governors shall have their means of speed adjustment sealed after test. If speed governors are painted after sealing, all bearing and rubbing surfaces shall be kept free or freed of paint and a hand test made to determine that all parts operate freely as intended.

2.18.3.2 Where the rope retarding means provides for adjustment of the rope pull-through force (tension), means shall be provided to seal the means of adjustment of the rope tension.

2.18.3.3 Seals shall be of a type that will prevent readjustment of the sealed governor adjustments without breaking the seal. Provision shall be made to enable affixing seals after tests.

2.18.4 Speed-Governor Overspeed Switch

2.18.4.1 Where Required and Function

2.18.4.1.1 A switch shall be provided on every car and counterweight speed governor (see 2.26.2.10).

2.18.4.1.2 The switches required in 2.18.4.1.1 shall be operated by the overspeed action of the governor, except that the counterweight governor switch shall be permitted to be operated upon activation of the counterweight governor-rope retarding means (see 2.18.6.1).

2.18.4.2 Setting of Car Speed-Governor Overspeed Switches. The setting of the car speed-governor overspeed switch shall conform to 2.18.4.2.1 through 2.18.4.2.6.

2.18.4.2.1 For rated speeds more than 0.75 m/s (150 ft/min), up to and including 2.5 m/s (500 ft/min), the car speed-governor overspeed switch shall open in the down direction of the elevator at not more than 90% of the speed at which the governor is set to trip in the down direction.

2.18.4.2.2 For rated speeds more than 2.5 m/s (500 ft/min), the car speed-governor overspeed switch shall open in the down direction of the elevator at not more than 95% of the speed at which the governor is set to trip in the down direction.

2.18.4.2.3 For elevators with static control, the car speed-governor overspeed switch shall open in the down direction of the elevator at not more than 90% of the speed at which the governor is set to trip in the down direction.

2.18.4.2.4 The switch, when set as specified in either 2.18.4.2.1, 2.18.4.2.2, or 2.18.4.2.3, shall open in the up direction at not more than 100% of the speed at which the governor is set to trip in the down direction.

2.18.4.2.5 The speed-governor overspeed switch shall be permitted to open in the down direction of the elevator at not more than 100% of the speed at which the governor is set to trip in the down direction, subject to the following requirements:

(a) A speed-reducing switch of the manually reset type is provided on the governor, which will reduce the speed of the elevator in case of overspeed, and which shall be set to open as specified in 2.18.4.2.1, 2.18.4.2.2, or 2.18.4.2.3.

(b) Subsequent to the first stop of the car following the opening of the speed-reducing switch, the car shall remain inoperative until the switch is manually reset.

2.18.4.3 Setting of the Counterweight Governor Switch. Where the counterweight governor switch is operated by the overspeed action (see 2.18.2.2), the switch shall be set to open when the counterweight is descending at a speed greater than the elevator rated speed, but not more than the speed at which the counterweight governor is set to trip.

2.18.4.4 Type of Speed-Governor Overspeed Switches and Speed-Reducing Switches. Switches used to perform the function specified shall be positively opened. Overspeed and speed-reducing switches permitted by 2.18.4.2.5 and operated by the speed governor shall remain in the open position until manually reset.

An access door is required when the governor is installed at the top of the hoistway for access to reset switches by elevator personnel. The access door must comply with Section 2.7.3.4.6.

NOTE: Manual reset is defined here as personal intervention by elevator personnel at the governor.

2.18.5 Governor Ropes

2.18.5.1 Material and factor of safety. Governor ropes must be a minimum of 6 mm (.25 in) and must comply with ASME A17.6-2010, Part 1 and ASME A17.1-2010 as referred to in A17.6-2010.

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

2.18.5.3 Governor-Rope Tag. A metal data tag shall be securely attached to the governor rope fastening. This data tag shall bear the following wire-rope data:

(a) the diameter (mm or in.)

(b) the manufacturer's rated breaking strength

(c) the grade of material used

(d) the year and month the rope was installed

(e) whether nonpreformed or preformed

(f) construction classification

(g) name of the person or organization who installed the rope

(h) name or trademark by which the manufacturer of the rope can be identified

A new tag shall be installed at each rope renewal. The material and marking of the rope data tag shall conform to 2.16.3.3, except that the height of the letters and figures shall be not less than 1.5 mm (0.06 in.).

2.18.6 Design of Governor-Rope Retarding Means for Type B Safeties

Type B car and counterweight safeties shall be activated by a speed governor with a governor-rope retarding means conforming to 2.18.6.1 through 2.18.6.5.

2.18.6.1 Upon activation at the tripping speeds given by 2.18.2, the means shall retard the rope with a force that is at least 67% greater than the force required to activate the safety or to trip the governor-rope releasing carrier, where used (see 2.17.15).

2.18.6.2 The means shall be set to allow the governor rope to slip through the speed governor at a rope tension (the governor pull-through tension) higher than required to activate the safety or to trip the releasing carrier as specified in 2.17.15. The maximum tension in the rope shall not exceed one-fifth of the rated ultimate strength of the rope.

2.18.6.3 The means shall be designed to prevent appreciable damage to, or deformation of, the governor rope resulting from its application (stopping action).

2.18.6.4 The means shall provide a continuous tension in the governor rope as required to operate the safety during the entire stopping interval in accordance with 2.17.5.2.

2.18.6.5 The governor shall be arranged to be manually tripped or activated to facilitate the tests specified in 8.10 and 8.11.

NOTE: Manually tripped or activated includes means such as but not limited to a finger, hand or cable-actuated lever, cam, etc., or some form of electromechanical actuation.

2.18.7 Design of Speed-Governor Sheaves and Traction Between Speed-Governor Rope and Sheave

2.18.7.1 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.

2.18.7.2 Where the rope force imparted to the governor rope (see 2.18.6.1) necessary to activate the safety, or to trip the releasing carrier, if used, is dependent upon the tension in the governor rope prior to governor tripping, a switch or switches mechanically opened by the governor tension sheave before the sheave reaches its upper or lower limit of travel shall be provided. This switch shall be of the manually reset type and shall conform to 2.26.4.3. Subsequent to the first stop of the car following the opening of the switch, the car shall remain inoperative until the switch is manually reset.

2.18.7.3 Governor sheave grooves shall have machine-finished surfaces. Governor tension sheaves shall have machine-finished grooves for rated car speeds of more than 0.75 m/s (150 ft/min). Machined governor sheave grooves shall have a groove diameter of not more than 1.15 times the diameter of the governor rope.

Table 2.18.7.4 Multiplier for Determining Governor Sheave Pitch Diameter

Rated Speed, m/s (ft/min)	Number of Strands	Multiplier
1.00 or less (200 or less)	6	42
1.00 or less (200 or less)	8	30
Over 1.00 (over 200)	6	46
Over 1.00 (over 200)	8	32

2.18.7.4 The pitch diameter of governor sheaves and governor tension sheaves shall be not less than the product of the diameter of the rope and the applicable multiplier listed in Table 2.18.7.4, based on the rated speed and the number of strands in the rope.

2.18.8 Factors of Safety in Load-Bearing Parts of Speed Governor

2.18.8.1 Material, except cast iron, used in loadbearing parts of speed governors shall have a factor of safety of not less than 3.5, and the materials used shall have an elongation of not less than 15% in a length of 50 mm (2 in.) when tested in accordance with ASTM E 8. Forged, cast, or welded parts shall be stress relieved. Cast iron shall have a factor of safety of not less than 10.

2.18.8.2 The factors of safety shall be based upon the maximum stresses developed in the parts during normal or governor tripping operation.

2.18.9 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 6 mm (0.25 in.) in height indicating the following:

(a) the speed in m/s (ft/min) at which the governor is set and sealed to trip the governor-rope retarding means

(b) the size, material, and construction of the governor rope on which the governor-rope retarding means were designed to operate

(c) the governor pull-through tension (force) in N(lbf) (see 2.18.6.2)

(d) manufacturer's name or trademark

(e) statement "DO NOT LUBRICATE GOVERNOR ROPE"

SECTION 2.19
ASCENDING CAR OVERSPEED AND UNINTENDED CAR MOVEMENT PROTECTION

2.19.1 Ascending Car Overspeed Protection

2.19.1.1 Purpose. Ascending car overspeed protection shall be provided to prevent the car from striking the hoistway overhead structure as a result of a failure in

(a) the electric driving-machine motor, brake, coupling, shaft, or gearing

(b) the control system

(c) any other component upon which the speed of the car depends, except the suspension ropes and the drive sheave of the traction machine

2.19.1.2 Where Required and Function. All electric traction elevators, except those whose empty car weight exceeds the total weight of the suspension ropes and counterweight, shall be provided with a device to prevent an ascending elevator from striking the hoistway overhead structure. This device (see 2.26.2.29) shall

(a) detect an ascending car overspeed condition at a speed not greater than 10% higher than the speed at which the car governor is set to trip (see 2.18.2.1).

(1) If the overspeed detection means requires electrical power for its functioning

(a) a loss of electrical power to the ascending car overspeed detection and control means shall cause the immediate activation of the emergency brake as required in 2.19.1.2(b)

(b) the occurrence of a single ground, or the failure of any mechanically operated switch that does not meet the requirements of 2.26.4.3, any single magnetically operated switch, contactor, or relay, or any single solid-state device, or a software system failure, shall not render the detection means inoperative

(2) The failure of any single mechanically operated switch that does not meet the requirements of 2.26.4.3 shall not render the detection means inoperative.

(3) When a fault specified in 2.19.1.2(a)(1)(b) or 2.19.1.2(a)(2) is detected, the car shall stop at or before the next landing for which a demand was registered, and shall not be permitted to restart.

(4) Once actuated by overspeed, the overspeed detection means shall remain actuated until manually reset, and the car shall not start or run unless the detection means is reset.

(b) decelerate the car when loaded with any load up to its rated load [see 2.16.8(h)] by applying an emergency brake conforming to 2.19.3. The car shall not start or run unless the emergency brake is reset.

2.19.2 Protection Against Unintended Car Movement

2.19.2.1 Purpose. Protection shall be provided with a device to prevent unintended car movement away from the landing with the hoistway door not in the locked position and the car door not in the closed position, as a result of failure in

(a) the electric driving-machine motor, brake, coupling, shaft, or gearing

(b) the control system

(c) any other component upon which the speed of the car depends, except the suspension ropes and the drive sheave of the traction machine

2.19.2.2 Where Required and Function. All electric traction elevators shall be provided with a device (see 2.26.2.30) that shall

(a) detect unintended car movement away from the landing with the hoistway door not in the locked position and the car door not in the closed position.

NOTE: Freight elevators provided with combination mechanical locks and contacts on the hoistway door shall detect the closed position of the hoistway door and the closed position of the car door.

(1) If the detection means requires electrical power for its functioning

(a) a loss of electrical power to the unintended movement detection and control means shall cause the immediate activation of the emergency brake as required in 2.19.2.2(b)

(b) the occurrence of a single ground, or the failure of any mechanically operated switch that does not meet the requirements of 2.26.4.3, any single magnetically operated switch, contactor, or relay, or any single solid-state device, or software system failure, shall not render the detection means inoperative

(2) The failure of any single mechanically operated switch that does not meet the requirements of 2.26.4.3, shall not render the detection means inoperative.

(3) When a fault specified in 2.19.2.2(a)(1)(b) or 2.19.2.2(a)(2) is detected, the car shall stop at or before the next landing for which a demand was registered, and shall not be permitted to restart.

(4) Once actuated by unintended movement, the detection means shall remain actuated until manually reset, and the car shall not start or run unless the detection means is reset.

(b) upon detection of unintended car movement, stop and hold the car, with any load up to rated load

[see also 2.16.8(h)], by applying an emergency brake conforming to 2.19.3, with the car movement limited in both directions, to a maximum of 1 220 mm (48 in.). The car shall not start or run unless the emergency brake provided for the unintended movement protection is reset.

2.19.3 Emergency Brake (See Nonmandatory Appendix F)

2.19.3.1 Where Required

2.19.3.1.1 When required by 2.19.1 for protection against ascending car overspeed, an emergency brake (see 1.3) conforming to 2.19.3.2 shall be provided.

2.19.3.1.2 When required by 2.19.2 for protection against unintended car movement, an emergency brake (see 1.3) conforming to 2.19.3.2 shall be provided.

2.19.3.1.3 A single device shall be permitted to meet the requirements of both 2.19.3.1.1 and 2.19.3.1.2, or separate devices shall be provided.

2.19.3.2 Requirements. The emergency brake is permitted to consist of one or more devices and shall

(a) function to decelerate the car by acting on one or more of the following (see also 2.19.4):

(1) counterweight [e.g., counterweight safety (see 2.17.4 and 2.17.7)].

(2) car.

(3) suspension or compensation rope system.

(4) drive sheave of a traction machine.

(5) brake drum or braking surface of the driving machine brake, provided that the driving-machine brake surface is integral (cast or welded) with or directly attached to the driving-machine sheave. Attachments, where used, shall conform to 2.24.3 and 2.24.4.1. Welding, where used, shall conform to 8.8.

(b) be independent of the driving-machine brake.

(c) not be used to provide, or assist in providing, the normal stopping of the car. When the emergency brake is activated during normal elevator stops, it shall only be applied to and released from a stationary braking surface.

(d) not require the application of electrical power for its activation, nor be rendered inoperative by the failure of any power supply.

(e) not on its own cause the car average retardation to exceed 9.8 m/s2 (32.2 ft/s2) during the stopping or slowdown phase during ascending car overspeed.

(f) be designed so that the factors of safety based on the maximum stresses developed in the parts subject to load during the operation of the emergency brake shall comply with the following:

(1) Where an emergency brake is activated only when protecting against either an ascending car overspeed condition or unintended car movement with the car and hoistway doors open, the minimum factors of safety, when applied during the retardation phase of emergency braking, shall be not less than those specified in 2.17.12.1.

(2) Where an emergency brake is activated during normal stops of the elevator, the minimum factors of safety, when applied during the retardation phase of emergency braking, shall be not less than those specified in 2.24.3.1 and 2.24.3.2.

(3) Where an emergency brake acts on the suspension or compensation rope system

(a) the factor of safety with respect to the breaking strength of the ropes shall be not less than 5 at any time during the retardation phase

(b) it shall be designed to prevent appreciable damage or deformation to the ropes resulting from its activation

(g) be arranged to be tested in accordance with the requirements specified in 8.10.2.

(h) if the design of the emergency brake is such that field adjustment or servicing is required and the emergency brake acts on the brake drum or braking surface of the driving-machine brake, it shall be provided with a sign stating "EMERGENCY BRAKE." The sign shall be located on the emergency brake at a location visible from the area likely to require service. The sign shall be of such material and construction that the letters shall remain permanently and readily legible. The height of the letters shall be not less than 6 mm (0.25 in.).

2.19.3.3 Marking Plate Requirements. The emergency brake shall be provided with a marking plate indicating the range of total masses (car with attachments and its load) for which it is permitted to be used, the range of speeds at which it is set to operate, and the criteria such as rail lubrication requirements that are critical to the performance.

2.19.4 Emergency Brake Supports

All components and structural members, including their fastenings, subjected to forces due to the application of the emergency brake shall be designed to withstand the maximum forces developed during the retardation phase of the emergency braking so that the resulting stresses shall not exceed those permitted for the applicable type of equipment as follows:

(a) machinery and sheave beams (see 2.9.6)

(b) guide rails and their supports (see 2.23.5.3)

(c) counterweight frames (see 2.21.2.3.3)

(d) car frames (see 2.15.10.2)

(e) machines, sheaves, and bedplates (see 2.24.3.2)

SECTION 2.20
SUSPENSION ROPES AND THEIR CONNECTIONS

2.20.1 Suspension Means

Elevator cars shall be suspended by steel wire ropes attached to the car frame or passing around sheaves attached to the car frame specified in 2.15.1. Ropes that have previously been installed and used on another installation shall not be reused.

Only iron (low-carbon steel) or steel wire ropes, having the commercial classification "Elevator Wire Rope," or wire rope specifically constructed for elevator use, shall be used for the suspension of elevator cars and for the suspension of counterweights. The wire material for ropes shall be manufactured by the open-hearth or electric furnace process or their equivalent.

2.20.2 Wire Rope Data

2.20.2.1 On Crosshead Data Plate. The crosshead data plate required by 2.16.3 shall bear the following wire-rope data:

(a) the number of ropes

(b) the diameter in millimeters (mm) or inches (in.)

(c) the manufacturer's rated breaking strength per rope in kilo Newton (kN) or pounds (lb)

2.20.2.2 On Rope Data Tag. A metal data tag shall be securely attached to one of the wire-rope fastenings. This data tag shall bear the following wire-rope data:

(a) the diameter in millimeters (mm) or inches (in.)

(b) the manufacturer's rated breaking strength

(c) the grade of material used

(d) the month and year the ropes were installed

(e) the month and year the ropes were first shortened

(f) whether the ropes were nonpreformed or preformed

(g) construction classification

(h) name of the person or organization who installed the ropes

(i) name or trademark of the manufacturer of the ropes

(j) lubrication information

A new tag shall be installed at each rope renewal. The material and marking of the rope data tag shall conform to 2.16.3.3, except that the height of the letters and figures shall be not less than 1.5 mm (0.06 in.).

2.20.3 Factor of Safety

Suspension ropes must be stranded carbon steel wire ropes (minimum 8 mm (.3 in)) or noncircular elastomeric coated steel suspension members. They must comply with ASME A17.6-2010, Part 1 and Part 3 and ASME A17.1-2010 as referred to in A17.6-2010. Aramid fiber ropes are not permitted.

2.20.4 Minimum Number and Diameter of Suspension Ropes

Suspension ropes must be stranded carbon steel wire ropes (minimum 8 mm (.3 in)) or noncircular elastomeric coated steel suspension members. They must comply with ASME A17.6-2010, Part 1 and Part 3 and ASME A17.1-2010 as referred to in A17.6-2010. Aramid fiber ropes are not permitted.

2.20.5 Suspension-Rope Equalizers

2.20.5.1 Suspension-rope equalizers, where provided, shall be of the individual compression spring type or shall meet the requirements of 2.20.5.3. Springs in tension shall not be used to attach suspension ropes.

2.20.5.2 Single-bar-type equalizers shall be permitted only for winding drum machines with two ropes, to attach the ropes to the dead-end hitch plate, provided it meets the requirements of 2.20.5.3.

2.20.5.3 Equalizers other than the individual compression spring type shall be permitted, provided that their strength is established through tensile engineering tests. Such tests shall show the ultimate strength of the equalizers and its fastenings in its several parts and assembly to be not less than 10% in excess of the strength of the suspension ropes as required by 2.20.3.

2.20.6 Securing of Suspension Wire Ropes to Winding Drums

Suspension wire ropes of winding-drum machines shall have the drum ends of the ropes secured on the inside of the drum by clamps.

Where the ropes extend beyond their clamps or sockets, means shall be provided to prevent the rope ends from coming out of the inside of the drum and to prevent interference with other parts of the machine.

2.20.7 Spare Rope Turns on Winding Drums

Suspension wire ropes of winding drum machines shall have not less than one turn of the rope on the drum when the car is resting on the fully compressed buffers.

2.20.8 Reserved

2.20.9 Suspension-Rope Fastening

2.20.9.1 Type of Rope Fastenings. The car and counterweight ends of suspension wire ropes, or the stationary hitch-ends where multiple roping is used,

shall be fastened in such a manner that all portions of the rope, except the portion inside the rope sockets, shall be readily visible.

Fastening shall be

(a) by individual tapered rope sockets (see 2.20.9.4) or other types of rope fastenings that have undergone adequate tensile engineering tests, provided that

(1) such fastenings conform to 2.20.9.2 and 2.20.9.3;

(2) the rope socketing is such as to develop at least 80% of the ultimate breaking strength of the strongest rope to be used in such fastenings; or

(b) by individual wedge rope sockets (see 2.20.9.5); and

(c) U-bolt-type rope clamps or similar devices shall not be used for suspension rope fastenings.

2.20.9.2 Adjustable Shackle Rods. The car ends, or the car or counterweight dead ends where multiple roping is used, of all suspension wire ropes of traction-type elevators shall be provided with shackle rods of a design that will permit individual adjustment of the rope lengths. Similar shackle rods shall be provided on the car or counterweight ends of compensating ropes.

2.20.9.3 General Design Requirements. Wire-rope fastenings shall conform to 2.20.9.3.1 through 2.20.9.3.8.

2.20.9.3.1 The portion of the rope fastening that holds the wire rope (rope socket) and the shackle rod shall be in one piece (unit construction), or separate.

2.20.9.3.2 The rope socket shall be either cast or forged steel, provided that where the rope socket and the shackle rod are in one piece (unit construction), the entire fastening shall be of forged steel. not in one piece, the shackle rod shall be of forged or rolled steel.

2.20.9.3.4 Cast or forged steel rope sockets, shackle rods, and their connections shall be made of unwelded steel, having an elongation of not less than 20% in a gauge length of 50 mm (2 in.), when measured in accordance with ASTM E 8, and conforming to ASTM A 668, Class B for forged steel, and ASTM A 27, Grade 60/30 for cast steel, and shall be stress relieved. Steels of greater strength shall be permitted, provided they have an elongation of not less than 20% in a length of 50 mm (2 in.).

2.20.9.3.5 Where the shackle rod is separate from the rope socket, the fastening between the two parts shall be positive, and such as to prevent their separation under all conditions of operation of the elevator.

Where the connection of the two parts is threaded, the thread design, tolerance, and manufacture shall conform to the requirements of ASME B1.13M, M-6H/6g, coarse or fine threads (ASME B1.1, UNC or UNF Class 2A and Class 2B threads). The length of the thread engagement of the rod in the socket shall be not less than 1.5 times the root diameter of the thread on the rod, and a cotter pin or equivalent means shall in addition be provided to restrict the turning to the rod in the socket and prevent unscrewing of the connection in normal operation.

Eye bolts used as connections with clevis-type sockets shall be of forged steel conforming to ASTM A 668, Class B (heat treated), without welds.

2.20.9.3.6 Rope sockets shall be of such strength that the rope will break before the socket is materially deformed.

2.20.9.3.7 The shackle rod, eye bolt, or other means used to connect the rope socket to the car or counter weight shall have a strength at least equal to the manufacturer's rated breaking strength of the rope.

2.20.9.3.8 Rope fastenings incorporating antifriction devices that will permit free spinning of the rope shall not be used.

2.20.9.4 Tapered Rope Sockets. Tapered rope sockets shall be of a design as shown in Fig. 2.20.9.4, and shall conform to 2.20.9.2 and 2.20.9.3, and 2.20.9.4.1 through 2.20.9.4.5.

2.20.9.4.1 The axial length L of the tapered portion of the socket shall be not less than 4.75 times the diameter of the wire rope used.

2.20.9.4.2 The axial length, L', of the open portion of the rope socket shall be not less than 4 times the diameter of the wire rope used.

2.20.9.4.3 The length of the straight bore, L'', at the small end of the socket shall be not more than 13mm (0.5 in.) nor less than 3 mm (0.125 in.), and its outer edge shall be rounded and free from cutting edges.

2.20.9.4.4 The diameter, d, of the hole at the large end of the tapered portion of the socket shall be not less than 2.25 times nor more than 3 times the diameter of the wire rope used.

2.20.9.4.5 The diameter, d', of the hole at the end of the tapered portion of the socket shall be not more than shown in Table 2.20.9.4.5.

2.20.9.5 Wedge Rope Sockets. Wedge socket assemblies shall be of a design as shown in Fig. 2.20.9.5, and shall conform to 2.20.9.2 and 2.20.9.3, and 2.20.9.5.1 through 2.20.9.5.6.

2.20.9.5.1 A test specimen consisting of the strongest elevator wire rope for a given diameter and wedge socket assembly shall be subjected to a destructive tensile engineering test. The rope socketing shall develop at least 80% of the ultimate breaking strength of the strongest rope to be used in

such a fastening without the rope slipping through the assembly.

2.20.9.5.2 Wedge socket assemblies shall be of such a strength that when tested as in 2.20.9.5.1, the rope shall break before the socket or wedge is materially deformed.

2.20.9.5.3 Suppliers of wedge sockets shall submit certification showing that the sockets, with visible permanent manufacturer's identification, have successfully passed the tests described in 2.20.9.5.1 and 2.20.9.5.2 at a testing laboratory.

2.20.9.5.4 When the rope has been seated in the wedge socket by the load on the rope, the wedge shall be visible, and at least two wire-rope retaining clips shall be provided to attach the termination side to the load-carrying side of the rope (see Fig. 2.20.9.5). The first clip shall be placed a maximum of 4 times the rope diameter above the socket, and the second clip shall be located within 8 times the rope diameter above the first clip. The purpose of the two clips is to retain the wedge and prevent the rope from slipping in the socket should the load on the rope be removed for any reason. The clips shall be designed and installed so that they do not distort or damage the rope in any manner.

2.20.9.5.5 Markings on the wedge socket assembly components shall be as follows:

(a) Each socket shall be permanently and legibly marked or color-coded to identify the corresponding wedge, or wedges, and rope size to be used in the assembly. The markings shall be visible after installation.

(b) Each wedge shall be permanently and legibly marked or color coded to identify the corresponding socket, or sockets, and rope size, within which it is to be inserted to form an assembly. The markings shall be visible after installation.

2.20.9.5.6 Load-carrying rope shall be in line with shackle rod, and the sockets shall be permitted to be staggered in the direction of travel of the elevator and counterweight, where used.

2.20.9.6 Rope Socket Embedment Medium. Only babbitt metal or thermosetting resin compositions intended for elevator wire rope socketing shall be used to secure ropes in tapered sockets. The embedment material shall conform to 2.20.9.6.1 through 2.20.9.6.3.

2.20.9.6.1 Babbitt Metal. Babbitt metal shall contain at least 9% of antimony and shall be clean and free from dross.

2.20.9.6.2 Thermosetting Resin Composition

(a) Physical Properties. The thermoset resin composition shall have the following properties:

(1) Uncured (Liquid) Material

(a) Viscosity of Resin-Catalyst Mixture. The viscosity of the resin-catalyst mixture shall be sufficiently low to permit rapid, complete saturation of the rope rosette in order to prevent entrapment of air.

(b) Flash Point. All components shall have a minimum flash point of 27°C (80°F).

(c) Shelf Life. All components shall have a minimum of 1 year shelf life at 21°C (70°F).

(d) Pot Life and Cure Time. After mixing, the resin catalyst mixture shall be pourable for a minimum of 8 min at 21°C (70°F) and shall cure within 1 h after hardening. Heating of the resin mixture in the socket to accelerate curing shall follow the resin manufacturer's instructions.

(2) Cured Resin

(a) Socket Performance. Resin, when cured, shall develop sufficient holding strength to solvent-washed wire in wire-rope sockets to develop 80% of the ultimate strength of all types of elevator wire rope. No slippage of wire is permissible when testing resin-filled rope socket assemblies in tension; however, after testing, some seating of the resin cone shall be permitted to be apparent and is acceptable. Resin terminations shall also be capable of withstanding tensile shock loading.

(b) Shrinkage. The volumetric shrinkage of fully cured resin shall not exceed 2%. The use of an inert filler in the resin is permissible.

(c) Curing. The resin-catalyst mixture shall be capable of curing either at ambient [16°C to 38°C (60°F to 100°F)] or elevated temperatures. At temperatures below 16°C (60°F), an elevated temperature cure shall be used.

(b) Materials Required. The thermoset resin composition intended for elevator wire rope socketing shall be supplied in two parts consisting of preweighed resin and preweighed catalyst, each packaged separately within a kit. Each kit containing the thermoset resin composition shall consist of the following:

(1) preweighed thermoset resin

(2) preweighed catalyst

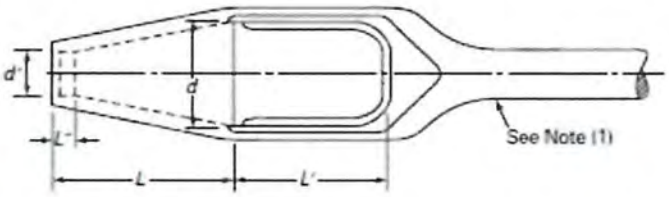
(3) necessary materials for mixing and pouring *(4)* detachable label on resin container

(c) Marking

(1) Resin Container. The label on the resin container shall show the following information:

(a) product name

(b) part designation (e.g., "Part A" or "Resin")

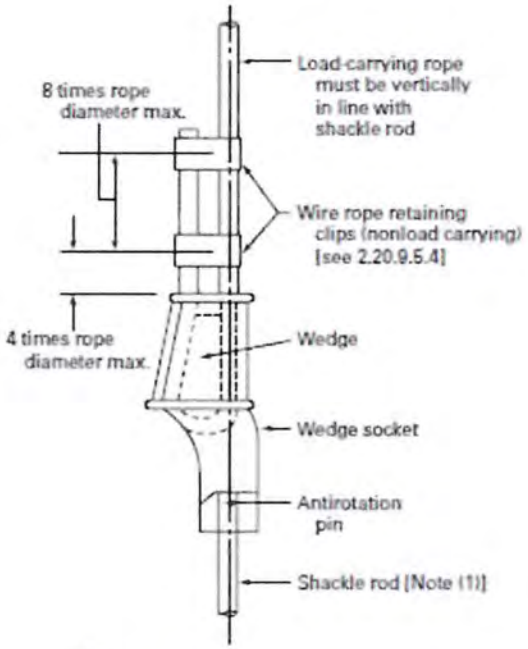


NOTE:
(1) Rope socket and shackle rod may be in one piece, as shown (unit construction) or the socket and rod may be separate (see 2.20.9.3).

Fig. 2.20.9.4 Tapered Rope Sockets

Table 2.20.9.4.5 Relation of Rope Diameter to Diameter of the Small Socket Hole

Nominal Rope Diameter, mm	Maximum Diameter of Hole, d', mm	Nominal Rope Diameter, in.	Maximum Diameter of Hole, d', in.
10 to 12 inclusive	2.5 larger than nominal rope diameter	3/8 to 7/16 inclusive	3/32 larger than nominal rope diameter
13 to 19 inclusive	3 larger than nominal rope diameter	1/2 to 3/4 inclusive	1/8 larger than nominal rope diameter
22 to 29 inclusive	4 larger than nominal rope diameter	7/8 to 1 1/8 inclusive	5/32 larger than nominal rope diameter
32 to 40 inclusive	5 larger than nominal rope diameter	1 1/4 to 1 1/2 inclusive	3/16 larger than nominal rope diameter



NOTE:
(1) Rope socket and shackle rod may be in one piece, as shown (unit construction) or the socket and rod may be separate (see 2.20.9.3).

Fig. 2.20.9.5 Wedge Rope Sockets

(c) manufacturer 's name or trademark and address

(d) mixing instructions

(e) ICC information

(f) safety warnings and cautions

(g) packaging date

(h) flash point

(i) shelf life

(j) storage instructions

(k) curing instructions

(l) net weight

(m) a statement certifying that the product conforms to 2.20.9.6.2 of ASME A17.1 or CSA B44

2.20.9.6.3 Catalyst Container. The label on the catalyst container shall show the following information:

(a) product name

(b) part designation (e.g., "Part B," "Catalyst," or "Hardener")

(c) manufacturer's name or trademark and address;

(d) safety warnings and cautions

(e) flash point

(f) storage instructions

(g) net weight

2.20.9.7 Method of Securing Wire Ropes in Tapered Sockets. Where the tapered type of socket is used, the method and procedure to be followed in making up the fastening shall conform to the following as applicable.

2.20.9.7.1 Handling. The rope to be socketed shall be carefully handled to prevent twisting, untwisting, or kinking.

2.20.9.7.2 Seizing of Rope Ends. The rope ends to be socketed shall be seized before cutting with seizing in accordance with the following:

(a) The seizing shall be done with annealed iron wire, provided that other methods of seizing be permitted, which give the same protection from loss of rope lay. Where iron wire is used for seizing, the length of each seizing shall be not less than the diameter of the rope.

(b) For nonpreformed rope, three seizings shall be made at each side of the cut in the rope. The first seizing shall be close to the cut end of the rope, and the second seizing shall be spaced back from the first the length of the end of the rope to be turned in. The third seizing shall be at a distance from the second equal to the length of the tapered portion of the socket.

(c) For preformed rope, one seizing shall be made at each side of the cut in the rope. The seizing shall be at a distance from the end of the rope equal to the length of the tapered portion of the socket plus the length of the portion of the rope to be turned in.

2.20.9.7.3 Spreading of Rope Strands. After the rope has been seized, it shall be inserted into the socket through the hole in the small end, a sufficient distance for manipulation, and where nonpreformed rope is used, the first two seizings shall be removed. The rope strands shall then be spread apart, and where rope with fibre core is used, the fibre core shall be cut away as close as possible to the remaining seizing.

2.20.9.7.4 Removal of Grease or Oil. Thorough cleaning of the outer wires of the strand surface and the inside of the rope socket is required for good adhesion. Brush or dip in clean solvents is recommended.

2.20.9.7.5 Turning in of Rope Strands. The exposed rope strands shall then be bent, turned in, and bunched closely together, each strand being turned back the same distance. The portion turned in (rope rosette) shall have a length of not less than 2.5 times the diameter of the rope, and such that, when the rope is pulled as far as possible into the socket, the bend of the turned-in strands shall be slightly overflush with the mouth of the tapered socket (large end) and will be visible when the socket has been completed (see 2.20.9.7.9). Where rope with steel core is used, the steel core shall be cut off even with tops of the looped strands.

2.20.9.7.6 Insertion of Bent-In Rope Strands in Socket. The rope end shall be pulled as far as possible into the socket, so that the remaining seizing projects outside the hole at the small end of the socket.

2.20.9.7.7 Position of Socket Preparatory to Pouring Embedment Medium. The socket shall be held in a vertical position with the large end up, and the rope held in a position truly axial with the socket. Tape or waste shall be permitted to be wound around the rope at the small end of the socket to prevent the embedment medium from seeping through, but shall be removed after completion of the socket.

2.20.9.7.8 Preparation of Embedment Medium

(a) Babbitt Metal

(1) Heating of Babbitt. The babbitt shall be heated to a fluidity just sufficient to char a piece of soft wood such as white pine without igniting it. Care shall be taken not to overheat the babbitt sufficiently to damage the rope.

(2) Heating of Socket Basket and Pouring of Babbitt. The rope socket basket shall be heated by a blowtorch flame sufficiently to prevent chilling of the

babbitt and to ensure that the babbitt, when poured, will completely fill the basket, including all the spaces between the rope strands. Following this the molten babbitt shall be poured slowly and evenly into the basket until it is filled to a point level with the top of the opening in the large end.

(b) Thermosetting Resin Composition

(1) The manufacturer's directions shall be strictly followed in handling, mixing, pouring, and curing the resin material.

(2) New containers of resin and catalyst shall be utilized for each set of rope sockets. The entire quantity of resin and catalyst shall be mixed when the containers are opened.

(3) Resin sockets shall not be poured at a temperature below 16°C (60°F) without first warming the socket and the resin composition to 21°C to 32°C (70°F to 90°F). The socket shall be permitted to be warmed using the electrical resistance heating devices intended for curing resin sockets.

(4) Curing of resin sockets shall be accomplished by heating at elevated temperature following the manufacturer's suggested schedule and directions. Cure time shall not exceed 30 min. Electrical resistance heating devices designed to fit around the sockets, or other means of providing controlled, evenly distributed heat, shall be used to provide the elevated temperature for curing. Open flames or exposed electrical resistance heating elements shall not be used.

(5) Upon completion of the socketing, the label from the container of resin shall be attached to one of the rope sockets for inspection purposes and shall be suitably protected.

2.20.9.7.9 Inspection of Sockets After Completion. A visual inspection of the completed sockets shall be made after they have cooled and the tape or waste has been removed from the small end of the sockets. The visual inspection shall verify that

(a) the embedment medium is visible at the small end of the socket

(b) the bends of all of the individual rope strands (see 2.20.9.7.5) are approximately the same height above the embedment medium and visible within the range of not less than one-half the diameter of the rope strand above the embedment medium and that there is not more than 1.5 mm (0.06 in.) clearance between the embedment medium and the underside of the bend in the rope strand

(*c)* no loss of rope lay has occurred where the wire rope enters the socket

2.20.9.7.10 Lubrication of Wire Rope After Socket Attachment. After the resin has cured, the wire ropes shall be lubricated at the base of the socket (small end) to replace the lubricant that was removed during the cleaning operation required under 2.20.9.7.4.

2.20.9.8 Antirotation Devices. Following the completion of the rope socketing and any adjustments shall be provided to prevent the rotation of the suspension ropes without restricting their movement horizontally or vertically of individual shackle rods as provided for in 2.20.9.2, means

2.20.10 Auxiliary Rope Fastening Devices

Auxiliary rope fastening devices, designed to support elevator cars or counterweights if any regular rope fastening fails, shall be permitted to be provided, subject to the requirements of 2.20.10.1 through 2.20.10.9.

2.20.10.1 They shall be approved on the basis of adequate tensile and fatigue engineering tests.

2.20.10.2 The device and its fastenings, in its several parts and assembly, shall have a strength at least equal to that of the manufacturer's breaking strength of the rope to which it is to be attached.

2.20.10.3 Steel parts used in the device shall be cast or forged with an elongation of not less than 20%, conforming to ASTM A 668, Class B, for forgings and ASTM A 27, Grade 60/30 for cast steel, and shall be stress relieved.

2.20.10.4 The device shall be so designed and installed that

(a) it will not become operative unless there is a failure of the normal rope fastening

(b) it will function in a rope movement of not over 38 mm (1.5 in.)

(c) it will not interfere with the vertical or rotational movements of the rope during normal service

2.20.10.5 Means shall be provided to cause the electric power to be removed from the driving-machine motor and brake when any auxiliary fastening device operates. Such means shall

(a) have all electrical parts enclosed

(b) be of the manually reset type that can be reset only when the wire rope or ropes have been resocketed and the auxiliary rope fastening device has been restored to its normal running position

2.20.10.6 The method used to attach the device to the rope shall be such as to prevent injury to, or appreciable deformation of, the rope.

2.20.10.7 The installation of the device shall not reduce the required overhead clearances.

2.20.10.8 The car-frame supports for the fastening members of the device shall conform to 2.15.13, or

where existing conditions will not permit compliance with this requirement, other means of fastening shall be permitted to be used subject to the approval of the enforcing authority.

2.20.10.9 Each device shall be permanently marked with the name or trademark of the manufacturer by means of metal tags or plates with the following data of the wire rope for which they are designated to be used:

(a) diameter of the rope in millimeters (mm) or inches (in.)

(b) manufacturer's rated breaking strength of the rope

(c) construction classification of the wire rope The material and marking of the tags or plates shall conform to 2.16.3.3, except that the height of the letters and figures shall be not less than 1.5 mm (0.06 in.).

SECTION 2.21
COUNTERWEIGHTS

2.21.1 General Requirements

2.21.1.1 Frames. Weight sections of a counterweight shall be mounted in structural or formed metal frames so designed as to retain them securely in place (see 2.21.2.6).

2.21.1.2 Retention of Weight Sections. Means shall be provided to retain weight sections in place in the event of buffer engagement or safety application or if they become broken.

Where tie rods are used, a minimum of two shall be provided, which shall pass through all weight sections.

Tie-rods shall be provided with a lock nut and cotter pin at each end.

2.21.1.3 Guiding Members. Counterweight frames shall be guided on each guide rail by upper and lower guiding members attached to the frame.

Retention means shall be provided to prevent the counterweight from being displaced by more than 13 mm (0.5 in.) from its normal running position should any part of the guiding means fail, excluding the guiding member base and its attachment to the frame. The retention means shall be permitted to be integral with the base.

2.21.1.4 Independent Car Counterweights. Where an independent car counterweight is provided, it shall run in separate guide rails and shall not be of sufficient weight to cause undue slackening of the hoisting ropes during acceleration or retardation of the elevator car.

2.21.2 Design Requirements for Frames and Rods

2.21.2.1 Material. Frames and rods shall be made of steel or other metals conforming to 2.15.6.2 and 2.15.6.3, provided that where steels of greater strength than those specified, or where metals other than steel are used, the factor of safety used in the design shall conform to 2.21.2.3.

2.21.2.2 Frame Connections. Connections between frame members shall conform to 2.15.7.

2.21.2.3 Factor of Safety

2.21.2.3.1 The frame members and their connections shall be designed with a factor of safety of not less than 5 with the elevator at rest and the counterweight at the top of its travel.

2.21.2.3.2 The counterweight frame shall be designed with a factor of safety of not less than 2.5 at buffer engagement or safety application.

2.21.2.3.3 The frame members, brackets, and their connections subject to forces due to the application of the emergency brake (see 2.19.4) shall be designed to withstand the maximum forces developed during the retardation phase of the emergency braking so that the resulting stresses due to the emergency braking and all other loading acting simultaneously, if applicable, shall not exceed 190 MPa (27,500 psi).

2.21.2.4 Sheaves. Where a hoisting sheave or sheaves are mounted in the frame, the requirements of 2.15.12 shall apply (see also 2.24.2 and 2.24.3 for requirements for sheaves).

2.21.2.5 Suspension Rope Hitch or Shapes. Where counterweights are suspended by ropes attached directly to the frames by means of rope fastenings, the rope attachments shall conform to 2.15.13.

2.21.2.6 Securing of Weights in Frames. The weights shall be so mounted and secured in the frames as to prevent shifting of the weights by an amount that will reduce the running clearances to less than those specified in 2.5.1.2.

2.21.3 Cars Counterbalancing One Another

An elevator car shall not be used to counterbalance another elevator car.

2.21.4 Compensation Means

Compensation means, such as compensating ropes or chains or other mechanical means and their attachments (except for safety hooks, where used) to tie the counterweight and car together, shall be capable of withstanding, with a factor of safety of 5, any forces to which the means is subjected with the elevator at rest.

The maximum suspended weight of compensation means with car or counterweight at the top of its travel

and one-half total weight of tension sheave assembly, where used, shall be included.

The factor of safety for compensation means shall be based on the proof load, breaking strength, or test reports.

2.21.4.1 Connections. The connections between the car or counterweight and the compensation means, shall be bolted or welded and shall conform to 2.15.7.3.

2.21.4.1.1 Cast iron, where used, shall have a factor of safety of not less than 10, based on maximum stress developed.

2.21.4.1.2 When compensation ropes are used with a tension sheave, one end of each rope shall be provided with a means to individually adjust rope length.

2.21.4.2 Tie-Down Compensation Means. For rated speeds greater than 3.5 m/s (700 ft/min), a tie-down compensation means device shall be provided and fastened to the building structure to limit the jump of the car or counterweight as a result of car or counterweight buffer engagement or safety application.

The device components, compensation means, connection, building structural members, and fastenings, shall be capable of withstanding with a factor of safety of not less than 2.5 the maximum forces to which they are subjected due to car or counterweight buffer engagement or safety application.

SECTION 2.22
BUFFERS AND BUMPERS

2.22.1 Type and Location

2.22.1.1 Type of Buffers. Buffers of the spring, oil, or equivalent type shall be installed under the cars and counterweights of passenger and freight elevators subject to the requirements of 2.22.1.1.1 through 2.22.1.1.3.

2.22.1.1.1 Spring buffers or their equivalent shall be permitted to be used where the rated speed is not in excess of 1 m/s (200 ft/min).

2.22.1.1.2 Oil buffers or their equivalent shall be used where the rated speed is in excess of 1 m/s (200 ft/min).

2.22.1.1.3 Where Type C safeties are used (see 2.17.8.2), car buffers are not required if solid bumpers are installed.

2.22.1.2 Location. Buffers or bumpers shall be located so as to retard the car and counterweight without exceeding allowable design stresses in the car frame and counterweight frame.

2.22.2 Solid Bumpers

Solid bumpers, where permitted, shall be made of wood or other suitably resilient material of sufficient strength to withstand without failure the impact of the car with rated load, or the counterweight, descending at governor tripping speed.

The material used shall be of a type that will resist deterioration or be so treated as to resist deterioration.

2.22.3 Spring Buffers

2.22.3.1 Stroke. The stroke of the buffer spring, as marked on its marking plate, shall be equal to

Table 2.22.3.1 Minimum Spring Buffer Stroke

Rated Car Speed, m/s (ft/min)	Minimum Stroke, mm (in.)
0.5 or less (100 or less)	38 (1.5)
0.51 to 0.75 (101 to 150)	63 (2.5)
0.76 to 1.00 (151 to 200)	100 (4.0)

2.22.3.2 Load Rating

2.22.3.2.1 Buffers for cars and counterweights shall be capable of supporting, without being compressed solid or to a fixed stop, a static load having a minimum of 2 times the total weight of

(a) the car and its rated load for car buffers

(b) the counterweight for counterweight buffers

2.22.3.2.2 Buffers for cars and counterweights shall be compressed solid or to a fixed stop with a static load of three times the weight of

(a) the car and its rated load for car buffers

(b) the counterweight for counterweight buffers

2.22.3.2.3 Where the space below the hoistway is not permanently secured against access, the load rating specified in 2.22.3.2.1 shall be increased to meet the requirements of 2.6.1(b) and 2.6.2.

2.22.3.3 Marking Plates. Each spring buffer shall be provided with a marking plate showing its load rating and stroke and the number of springs. Where the springs are removable, each spring shall be identified, and the assembly marking plate shall indicate this identification. Markings shall be made in a permanent and legible manner.

2.22.4 Oil Buffers

2.22.4.1 Stroke. The minimum stroke of oil buffers shall be based on the requirements of 2.22.4.1.1 or 2.22.4.1.2.

2.22.4.1.1 The stroke shall be such that the car or the counterweight, on striking the buffer at 115% of the rated speed, shall be brought to rest with an

average retardation of not more than 9.81 m/s2 (32.2 ft/s2).

2.22.4.1.2 Where terminal speed reducing device is installed that conforms to 2.25.4.1, and that will limit the speed at which the car or counterweight can strike its buffer, the buffer stroke shall be based on at least 115% of such reduced striking speed and on an average retardation not exceeding 9.81 m/s2 (32.2 ft/s2). In no case shall the stroke used be less than 50% of the stroke required by 2.22.4.1.1 for rated speeds under 4 m/s (800 ft/min), nor less than 331/3%, or 450 mm (18 in.), whichever is greater, for rated speeds of 4 m/s (800 ft/min) or more.

NOTE (2.22.4.1): Figure 8.2.4 indicates the minimum buffer strokes for various initial velocities. Table 2.22.4.1 indicates the minimum buffer strokes for the most usual rated speeds. See formula in 8.2.4 for calculation of buffer strokes differing from or exceeding those listed in Table 2.22.4.1.

2.22.4.2 Retardation. Oil buffers shall develop an average retardation not in excess of 9.81 m/s2 (32.2 ft/s2), and shall develop no peak retardation greater than 24.5 m/s2 (80.5 ft/s2), having a duration exceeding 0.04 s with any load in the car, from rated load to a minimum load of 70 kg (154 lb), when the buffers are struck with an initial speed of not more than

(a) 115% of the rated speed for buffers conforming to 2.22.4.1.1

(b) 115% of the predetermined reduced speed for buffers conforming to 2.22.4.1.2

2.22.4.3 Factor of Safety for Oil-Buffer Parts. The factor of safety of parts of oil buffers, based on the yield point for compression members and on the ultimate strength and elongation for other parts, at gravity retardation with the maximum load for which the buffer is designed, when tested in accordance with ASTM E8 using a 50 mm (2 in.) gauge length, shall be not less than

(a) 3 for materials having an elongation 20% or more

(b) 3.5 for materials having an elongation from 15% to 20%

(c) 4 for materials having an elongation from 10% to 15%

(d) 5 for materials having an elongation less than 10%

(e) 10 for cast iron parts

2.22.4.4 Slenderness Ratio for Members Under Compression as Columns. The slenderness ratio (*L/R*) for members of oil buffers under compression as columns shall be not more than 80.

The slenderness ratio (*L/R*) specified applies only to those main buffer members that are subject to the impact of the fully loaded car when striking the buffer.

2.22.4.5 Plunger Return Requirements. Oil buffers shall be so designed that

(a) the buffer plunger of gravity-return and spring return- type oil buffers, when the buffer is filled with oil shall, when released after full compression, return to its fully extended position within 90 s

(b) the plunger of a spring-return-type oil buffer with a 20 kg (44 lb) weight resting on it shall, when released after being depressed 50 mm (2 in.), return to the fully extended position within 30 s

(c) gas spring-return oil buffers shall be provided with a switch conforming to 2.26.2.22 which shall be actuated if the plunger is not within 13 mm (0.5 in.) of the fully extended position

2.22.4.6 Means for Determining Oil Level. Oil buffers shall be provided with means for determining that the oil level is within the maximum and minimum allowable limits. Glass sight gauges shall not be used.

2.22.4.7 Type Tests and Certification for Oil Buffers

2.22.4.7.1 Each type of oil buffer shall be subjected to the type tests as specified in 8.3.2 and to the certification process as specified in 8.3.1.

2.22.4.7.2 A type test on an oil buffer shall be permitted to be acceptable for similarly designed buffers, provided that the longest stroke of the type is subjected to the type test; and the load range of the buffer is within the maximum and minimum range for the oil portings of the given buffer.

2.22.4.7.3 Oil buffers tested in accordance with the test requirements of prior editions of ASME A17.1 or CSA B44 shall be acceptable without being retested, provided the buffer has been listed/certified to a previous edition of the Code or on submittal by the person or organization installing the buffers of the test certificate stating that the buffer, when tested, met the specified test requirements of that edition of the Code.

2.22.4.8 Compression of Buffers When Car Is Level With Terminal Landings. Car and counterweight oil buffers of the mechanical spring-return type shall be permitted to be compressed not to exceed 25% of their stroke when the car is level with the terminal landings (see 2.4.2.1)

Table 2.22.4.1 Minimum Oil Buffer Strokes

SI Units			Imperial Units		
Rated Speed, m/s	115% of Rated Speed, m/s	Minimum Stroke, mm	Rated Speed, ft/min	115% of Rated Speed, ft/min	Minimum Stroke, in.
1.00	1.15	65	200	230	2.75
1.12	1.29	85	225	369	3.50
1.25	1.44	105	250	288	4.25
1.50	1.73	155	300	345	6.25
1.75	2.01	205	350	402	8.25
2.00	2.30	270	400	460	11.00
2.25	2.59	340	450	517	13.75
2.50	2.88	425	500	575	17.00
3.00	3.45	605	600	690	24.75
3.50	4.03	825	700	805	33.25
4.00	4.60	1 080	800	920	43.75
4.50	5.18	1 365	900	1,035	55.50
5.00	5.75	1 685	1,000	1,150	68.50
5.50	6.32	2 040	1,100	1,265	83.00
6.00	6.90	2 425	1,200	1,380	98.50
6.50	7.48	2 845	1,300	1,495	115.50
7.00	8.05	3 300	1,400	1,610	134.50
7.50	8.63	3 790	1,500	1,725	154.00
8.00	9.20	4 310	1,600	1,840	175.25
8.50	9.78	4 870	1,700	1,955	197.75
9.00	10.35	5 460	1,800	2,070	221.75
9.50	10.93	6 080	1,900	2,185	247.00
10.00	11.50	6 740	2,000	2,300	273.75

2.22.4.9 Buffer Oil Requirements. Oils used in oil buffers shall have a pour point of −18°C (0°F), or lower, as defined in ASTM D 97, and a viscosity index of 75, or higher, as defined in ASTM D 2270.

2.22.4.10 Load Ratings of Oil Buffers. The minimum and maximum load ratings of car and counterweight oil buffers, as indicated on the buffer marking plate, shall conform to 2.22.4.10.1 through 2.22.4.10.3.

2.22.4.10.1 The minimum load rating shall be not greater than

(a) for car oil buffers, the total weight of the car as marked on the car crosshead data plate plus 70 kg (150 lb)

(b) for counterweight oil buffers, the weight of the counterweight used

2.22.4.10.2 The maximum load rating shall be not less than

(a) for car oil buffers, the total weight of the car as marked on the crosshead data plate plus the rated load

(b) for counterweight oil buffers, the weight of the counterweight used

2.22.4.10.3 When compensating rope tie-down is present, the increase in load shall be taken into account (see 2.17.17).

2.22.4.11 Buffer Marking Plate. Every installed oil buffer shall have permanently attached thereto a metal plate, marked by the manufacturer in a legible and permanent manner, indicating

(a) the maximum and minimum loads and the maximum striking speeds for which the buffer has been rated for use in conformance with the requirements in 2.22

(b) the permissible range in viscosity of the buffer oil to be used, stated in Saybolt Seconds Universal at 38°C (100°F)

(c) the viscosity index number of the oil to be used

(d) the pour point in degrees Celsius (Fahrenheit) of the oil to be used

(e) the stroke of the buffer in mm (in.)

(f) the composition of the gas, if used

(g) the name, trademark, or file number by which the organization that manufactured the product can be identified

(h) the certification marking in accordance with 8.3.1.3

SECTION 2.23
CAR AND COUNTERWEIGHT GUIDE RAILS, GUIDERAIL SUPPORTS, AND FASTENINGS

2.23.1 Guide Rails Required

Elevator cars and counterweights shall be provided with guide rails.

2.23.2 Material

Guide rails, guide-rail brackets, rail clips, fishplates, and their fastenings shall be either

(a) of steel or other metals conforming to 2.23; or

(b) where steel presents an accident hazard, as in chemical or explosive plants, guide rails shall be permitted to be of selected wood or other suitable nonmetallic materials, provided the rated speed of the car does not exceed 0.75 m/s (150 ft/min).

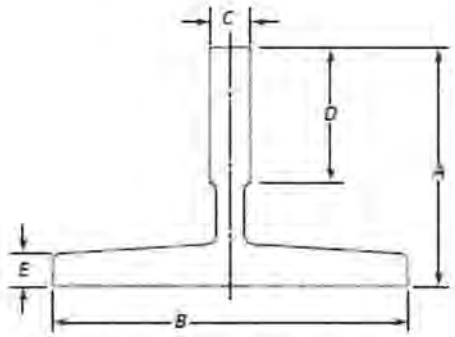
2.23.2.1 Requirements for Steel, Where Used

(a) Rails, brackets, fishplates, and rail clips shall be made of open-hearth steel, or its equivalent, having a tensile strength of not less than 380 MPa (55,000 psi) and having an elongation of not less than 22% in a length of 50 mm (2 in.) when measured in accordance with ASTM E 8.

(b) Bolts shall conform to ASTM A 307.

(c) Rivets shall conform to ASTM A 502.

(d) Maximum permissible stresses and deflections shall conform to 2.23.5.



T Section Rail

Fig. 2.23.3 Elevator Guide Rails

2.23.2.2 Requirements for Metals Other Than Steel.

Metals other than steel shall be permitted to be used, provided the factor of safety is not less than, and the deflections are not more than, the values specified in this section, and provided that cast iron is not used.

2.23.3 Rail Section

Guide rails shall be either

(a) T-section, conforming to the nominal weights and dimensions shown in Fig. 2.23.3 and Table 2.23.3; or

(b) other shapes, subject to the following requirements:

(1) They shall have a section modulus and moment of inertia equal to or greater than that of the section shown in Fig. 2.23.3 for a given loading condition.

(2) They shall have a sectional area sufficient to withstand the compressive forces resulting from the application of the car or counterweight safety device, if used.

2.23.4 Maximum Load on Rails in Relation to the Bracket Spacing

The maximum load on guide rails in relation to the bracket spacing shall conform to 2.23.4.1 through 2.23.4.3. In addition to the loads specified therein any static and dynamic loads imposed by the support of machines, sheaves, and hitches, if any, on one or more guide rails shall be taken into account in determining rail size and bracket spacing.

The combination of all vertical loads on any single guide rail shall not exceed one-half of the values specified in Fig. 2.23.4.1-1 in relation to the bracket spacing. This load requirement is not intended to limit design, and more detailed design and calculation methods shall be permitted to be used, provided that the moments and vertical loads induced into the rail system are taken into account in the calculations.

EXAMPLES (2.23.4):

(1) *SI Units.* For 2 750 kg total weight of car plus load and a 2 150 kg counterweight, both roped 2:1; 90 kg suspension weight, 70 kg compensation weight, 20 kg traveling cable weight, and a machine weight of 360 kg; and with the machine supported in the overhead by one guide rail; the impacted reaction on that guide rail due to the machine loading is 2 750 kg + 2 150 kg + 90 kg + 70 kg + 20 kg + 360 kg p 5 440 kg. The equivalent static loading per pair of guide rails is 5 440 kg and given a 22.5 kg/m rail, there is a maximum bracket spacing of 4 050 mm.

Table 2.23.3 T-Section Guide-Rail Dimensions

SI Units						Imperial Units					
Nominal Mass, kg/m	Nominal Dimensions, mm					Nominal Weight, lb/ft	Nominal Dimensions, in.				
	A	B	C	D	E		A	B	C	D	E
8.5	68.3	82.6	9.1	25.4	6.0	5¾	2 11/16	3¼	11/32	1	15/64
9.5	49.2	69.9	15.9	25.4	7.9	6¾	1 15/16	2¾	⅝	1	5/16
12.0	61.9	88.9	15.9	31.8	7.9	8	2 7/16	3½	⅝	1¼	5/16
16.5	88.9	114.3	15.9	38.1	7.9	11	3½	4½	⅝	1½	5/16
18.0	88.9	127.0	15.9	44.5	7.9	12	3½	5	⅝	1¾	5/16
22.5	88.9	127.0	15.9	50.0	12.7	15	3½	5	⅝	1 31/32	½
27.5	106.0	139.7	19.1	50.0	12.7	18½	4¼	5½	¾	1 31/32	½
33.5	101.6	139.7	28.6	50.8	14.3	22½	4	5½	1⅛	2	9/16
44.5	127.0	139.7	31.8	57.2	17.5	30	5	5½	1¼	2¼	11/16

(2) *Imperial Units.* For 6,000 lb total weight of car plus load and a 4,700 lb counterweight, both roped 2:1; 200 lb suspension weight; 150 lb compensation weight; 45 lb traveling cable weight, and a machine weight of 800 lb; and with the machine supported in the overhead by one guide rail; the impacted reaction on that guide rail due to the machine loading is 6,000 lb + 4,700 lb + 200 lb + 150 lb +45 lb + 800 lb p 11,895 lb. The equivalent static loading per pair of guide rails is 11,895 lb and given a 15 lb rail, there is a maximum bracket spacing of 13 ft 3 in.

2.23.4.1 With Single Car or Counterweight Safety. Where a single car or counterweight safety is used, the maximum suspended weight of the car and its rated load, or the maximum suspended weight of the counterweight, including the weight of any compensation means and of any traveling cables suspended therefrom per pair of guide rails, shall not exceed the maximum specified in Fig. 2.23.4.1-1 for the size of the rail and the bracket spacing used, except that the bracket spacing shall be permitted to exceed the values specified in Fig. 2.23.4.1-1, provided that

(a) the guide rail is reinforced or a rail of larger size is used

(b) the moment of inertia of a single reinforced rail or of a single larger size T-section about the *x-x* axis parallel to the base of the rail is not less than that required by Fig. 2.23.4.1-1 for the given weight of car plus load, or the counterweight with safety device, at the bracket spacing used

(c) where the bracket spacings exceed those shown on Figs. 2.23.4.1-1 and 2.23.4.1-2, the rail system

(1) conforms to 2.23.5

(2) is designed to limit the deflection during the application of the safety with a fully loaded car to not more than 6 mm (0.25 in.) per rail

EXAMPLES [2.23.4.1(c)]:

(1) *SI Units.* For 5 500 kg total weight of car plus load and a bracket spacing of 4 875 mm, there is required

(a) 27.5 kg/m rail without reinforcement; or

(b) 22.5 kg/m rail with reinforcement having a combined moment of inertia of 3.3 mm X 106 mm4.

(2) *Imperial Units.* For 12,000 lb total weight of car plus load and a bracket spacing of 16 ft 0 in., there is a required

(a) 18.5 lb rail without reinforcement; or

(b) 15 lb rail with reinforcement having a combined moment of inertia of 8 in.4

2.23.4.2 With Two (Duplex) Car or Counterweight Safeties. Where the car or counterweight is provided with two safety devices, the loads specified in Fig. 2.23.4.1-1 shall be permitted to be increased by the factors specified in Table 2.23.4.2.

2.23.4.3 Counterweight With No Safety

2.23.4.3.1 Guide rails for counterweights not provided with a safety device shall be fastened to the building structure at intervals specified in Table 2.23.4.3.1, except as specified in 2.23.4.3.2, and the weight of the counterweight for each size of guide rail shall not exceed that specified in Table 2.23.4.3.1.

2.23.4.3.2 The bracket spacing specified shall be permitted to be increased by an amount determined by Figs. 2.23.4.1-1 and 2.23.4.1-2, subject to the following requirements:

(a) where guide rails are reinforced or a larger rail section is used having a moment of inertia, about an axis parallel to the base [*x-x* axis in Fig. 2.23.4.1-2], at least equal to that of the rail sections shown in Table 2.23.3, based on the weight of the counterweight.

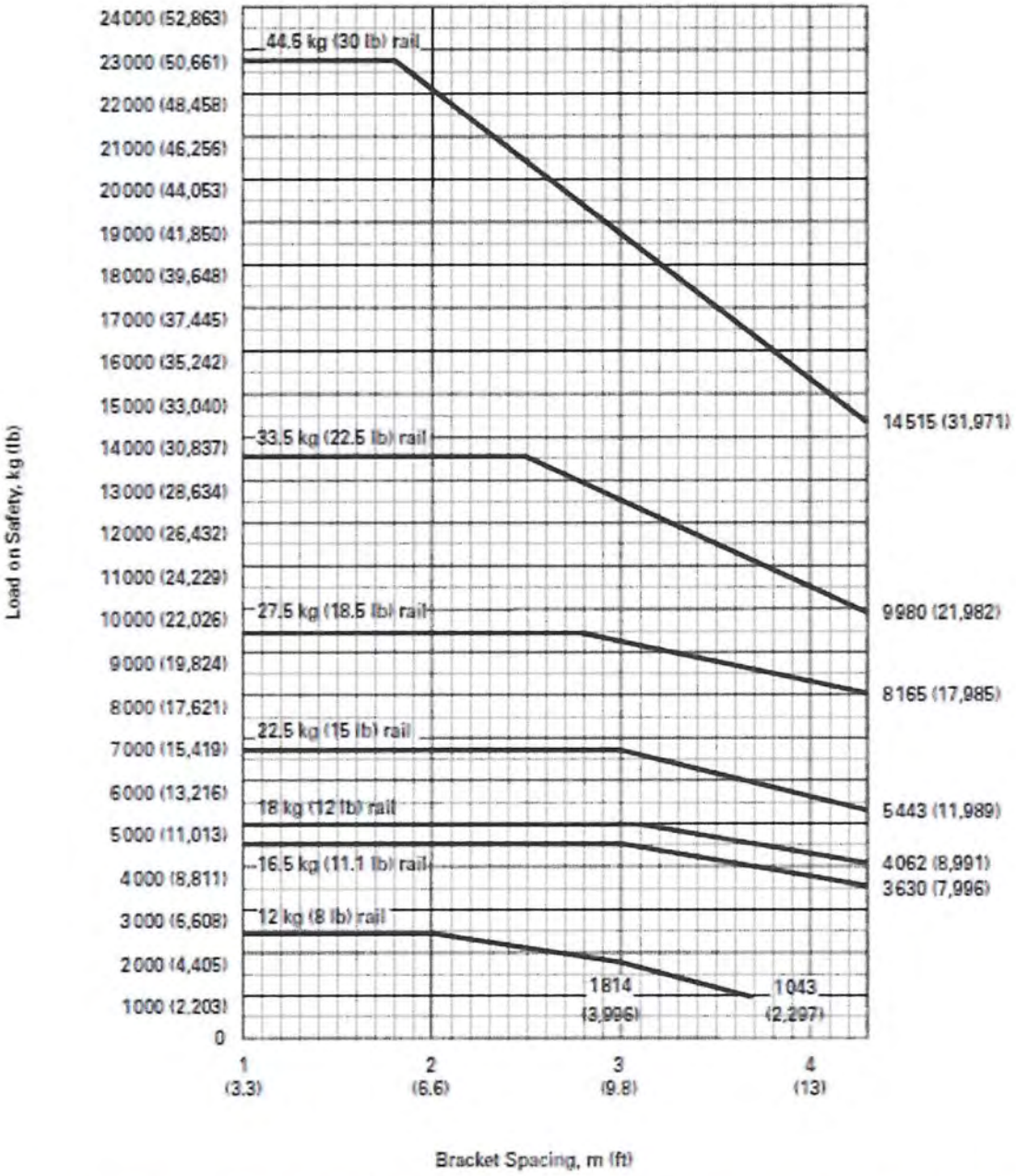


Fig. 2.23.4.1-1 Maximum Weight of a Car With Rated Load or of Counterweight With Safety Device for a Pair of Guide Rails as Specified in 2.23.4.1

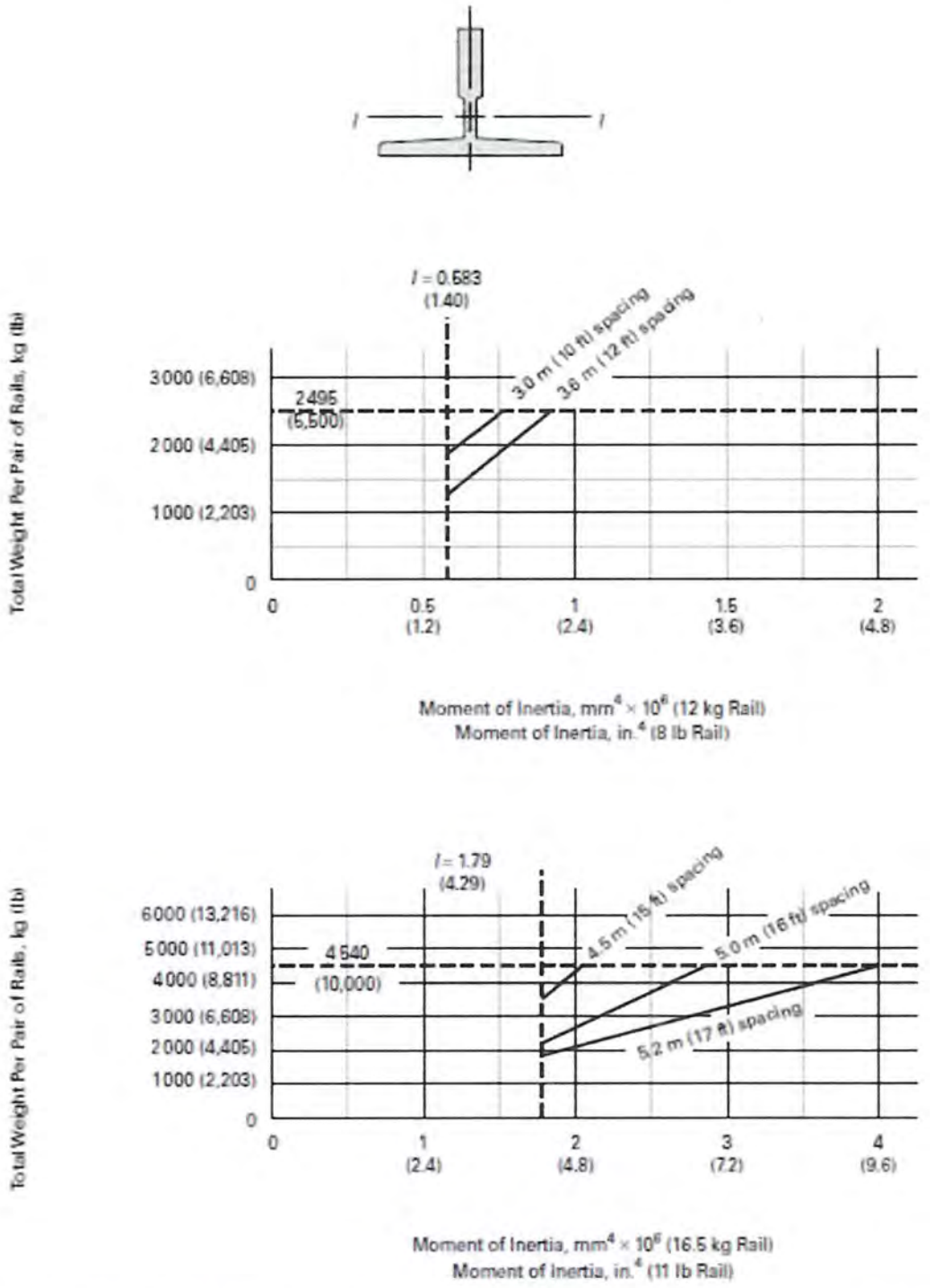
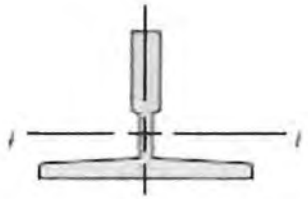
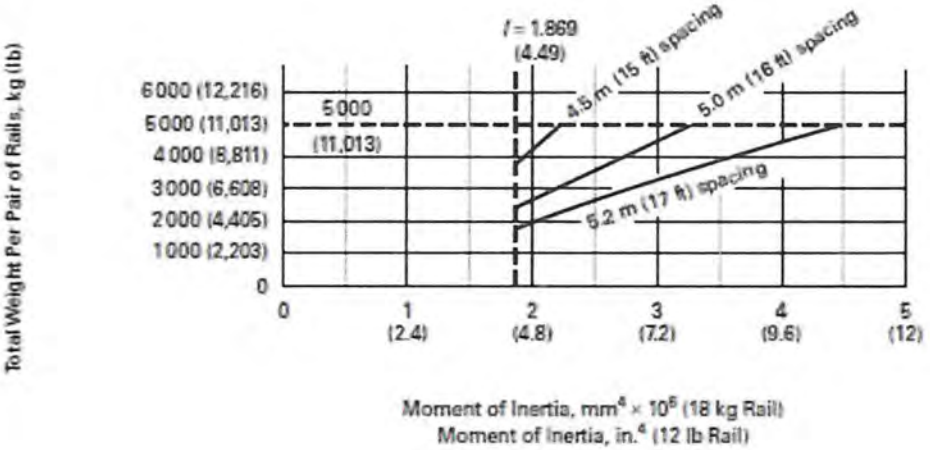


Fig. 2.23.4.1-2 Minimum Moment of Inertia About *x-x* Axis for a Single Guide Rail With Its Reinforcement





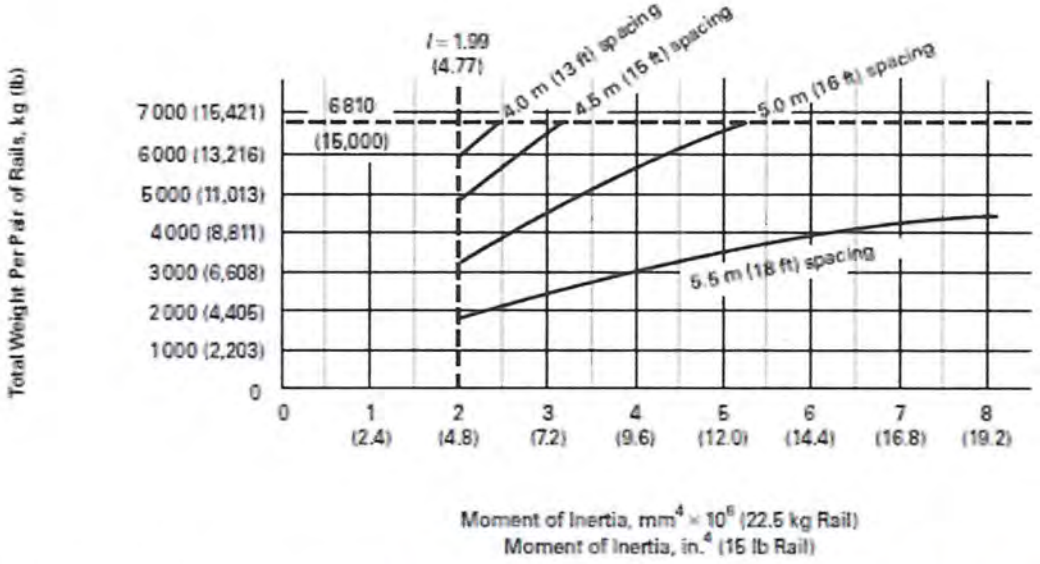
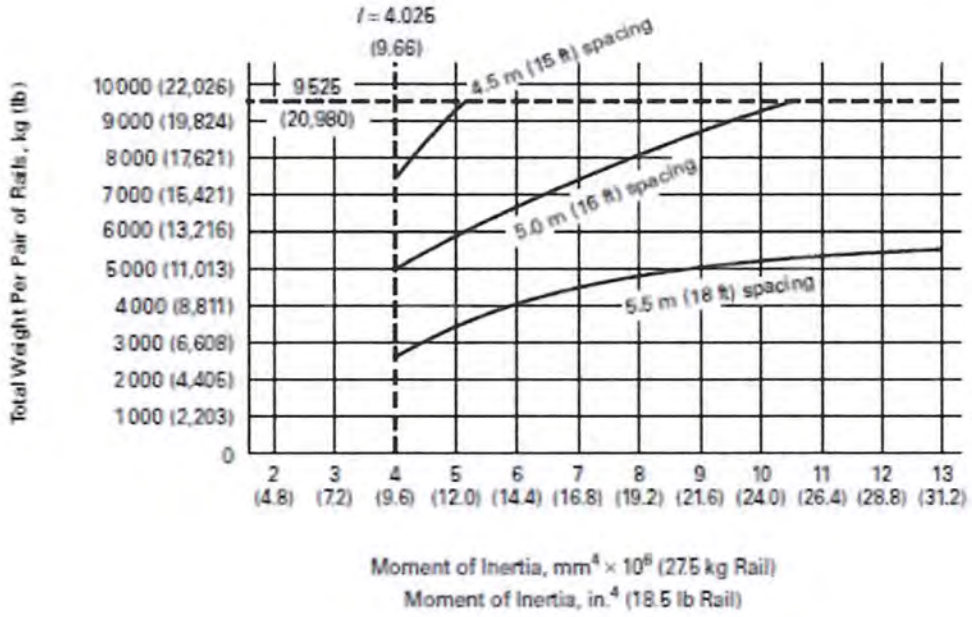


Fig. 2.23.4.1-2 Minimum Moment of Inertia About *x-x* Axis for a Single Guide Rail With Its Reinforcement (Cont'd)



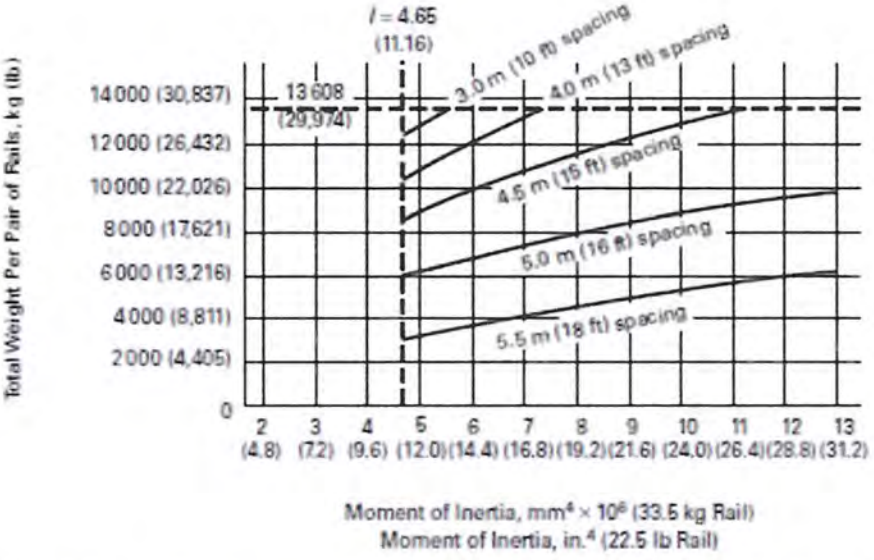


Fig. 2.23.4.1-2 Minimum Moment of Inertia About *x-x* Axis for a Single Guide Rail With Its Reinforcement (Cont'd)

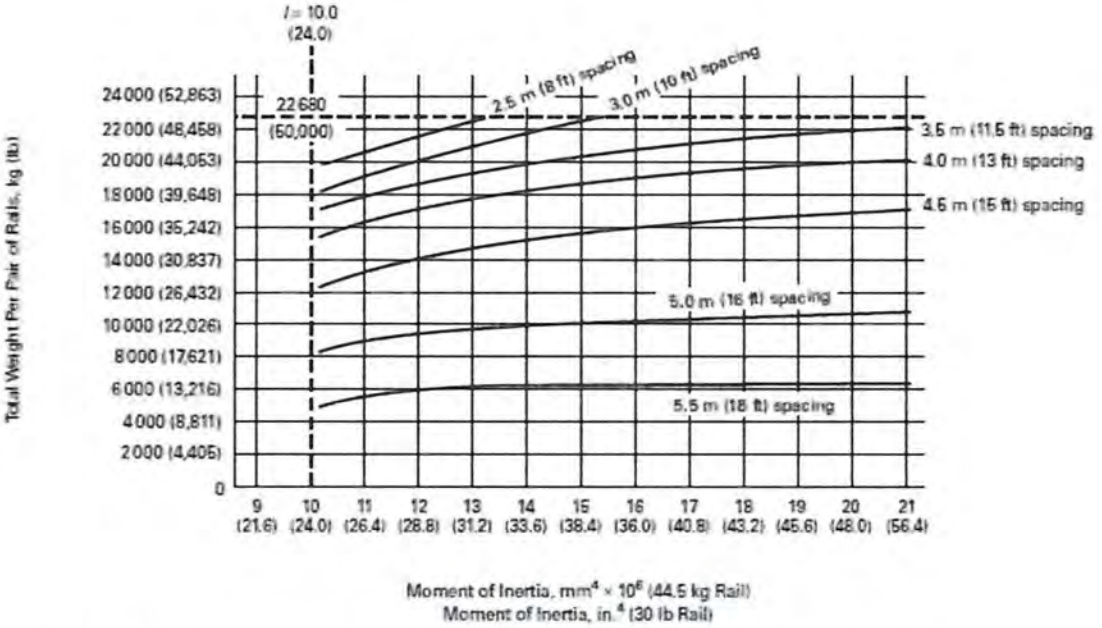


Fig. 2.23.4.1-2 Minimum Moment of Inertia About *x-x* Axis for a Single Guide Rail With Its Reinforcement (Cont'd)

Table 2.23.4.2 Load Multiplying Factor for Duplex Safeties

Vertical Distance Between Safeties, mm (in.)	Multiply Load in Fig. 2.23.4.1-1 by
5 400 (212 or more)	2.00
4 600 (182)	1.83
3 700 (146)	1.67
2 700 (106)	1.50

Table 2.23.4.3.1 Guide Rails for Counterweight Without Safeties

SI Units			Imperial Units		
Mass of Counterweight, kg	Nominal Mass of Guide Rail, kg/m	Maximum Bracket Spacing Without Reinforcement, mm	Weight of Counterweight, lb	Nominal Weight of Guide Rail, lb/ft	Maximum Bracket Spacing Without Reinforcement, ft
3 000	9.5	3 000	6,600	6 3/4	10
4 000	8.5	4 400	8,800	5 3/4	14.5
7 000	12.0	4 900	15,000	8	16
12 000	16.5	4 900	27,000	11	16
13 000	18.0	4 900	29,000	12	16
18 000	22.5	4 900	40,000	15	16
25 000	27.5	4 900	56,000	18 1/2	16
36 000	33.5	4 900	80,000	22 1/2	16
60 000	44.5	4 900	133,000	30	16

Table 2.23.4.3.3 Intermediate Tie Brackets

Nominal Distance Between Fastenings to Building Structure, mm (in.)		Number of Intermediate Tie Brackets
For 8.5 kg (6 1/4 lb) Rail	for All Other Rails	
0–3 300 (0–130)	0–3 700 (0–146)	0
3 301–3 800 (130–150)	3 701–4 300 (147–169)	1
3 801–4 400 (150–173)	4 301–4 900 (170–193)	2

(b) where intermediate tie brackets, approximately equally spaced, are provided between the guide rails at intervals of not over 2 130 mm (84 in.)

2.23.4.3.3 Intermediate tie brackets, approximately equally spaced, shall be provided between the guide rails at intervals as specified in Table 2.23.4.3.3. Intermediate tie brackets are not required to be fastened to the building structure.

2.23.5 Stresses and Deflections

2.23.5.1 Guide Rails

2.23.5.1.1 For steels conforming to 2.23.2.1, the stresses in a guide rail, or in the rail and its reinforcement shall not exceed 105 MPa (15,000 psi), based upon the class of loading, and the deflection shall not exceed 6mm (0.25 in.). The loads used to determine the guide rail stress and deflection shall include vertical and moment loads transferred into the rail, which are imposed by equipment supported by the guide rail, combined with the horizontal forces imposed on the rail during loading, unloading, or running, calculated without impact (see 2.16.2.2 and 8.2.2.6).

2.23.5.1.2 Where steels of greater strength than those specified in 2.23.2.1 are used, the stresses specified may be increased proportionately, based on the ratio of the ultimate strengths.

2.23.5.2 Brackets, Fastenings, and Supports. The guide-rail brackets, their fastenings, and supports, such as building beams and walls, shall be capable of resisting the horizontal forces imposed by the class of loading (see 2.16.2.2 and 8.2.2.6) with a total deflection at the point of support not in excess of 3 mm (0.125 in.).

2.23.5.3 Allowable Stresses Due to Emergency Braking. Guide rails, brackets, supports, and their fastenings subject to forces due to the application of the emergency brake (see 2.19.4) shall be designed to withstand the maximum forces developed during the retardation phase of the emergency braking so that the resulting stresses due to the emergency braking and all other loading acting simultaneously, if applicable, shall not exceed 190 MPa (27,500 psi).

2.23.6 Guide-Rail Surfaces

Guide-rail surfaces used for guiding a car or counterweight shall be sufficiently smooth and true to operate properly with the guiding members. Those surfaces that the car or counterweight safeties engage shall be smooth and true within the tolerances required to ensure proper safety application without excessive retardation or excessive out-of-level platform conditions resulting (see 2.17.3, 2.17.9.2, and 2.17.16).

2.23.7 Rail Joints and Fishplates

2.23.7.1 Type and Strength of Rail Joints. Metal guide-rail sections shall be joined together as specified in 2.23.7.2. The jointed rail sections shall withstand the forces specified in 2.23.5.1 without exceeding the stress and deflection limitations.

Table 2.23.7.2.1 Minimum Thickness of Fishplates and Minimum Diameter of Fastening Bolts

SI Units			Imperial Units		
Nominal Mass of Guide Rail, kg/m	Minimum Thickness of Fish Plates, mm	Minimum Diameter of Bolts, mm	Nominal Weight of Guide Rail, lb/ft	Minimum Thickness of Fish Plates, in.	Minimum Diameter of Bolts, in.
8.5	9.5	M12	5¾	⅜	½
9.5	9.5	M12	6¼	⅜	½
12.0	14.0	M12	8	9/16	½
16.5	17.0	M16	11	11/16	⅝
18.0	17.0	M16	12	11/16	⅝
22.5	17.0	M16	15	11/16	⅝
27.5	20.0	M20	18½	13/16	¾
33.5	20.0	M20	22½	13/16	¾
44.5	23.0	M20	30	15/16	¾

2.23.7.2 Design and Construction of Rail Joints

2.23.7.2.1 The joints of metal guide rails with T section profiles as specified in 2.23.3(a) shall conform to the following requirements:

(a) The ends of the rails shall be accurately machined with a tongue and matching groove centrally located in the web.

(b) The backs of the rail flanges shall be accurately machined, in relation to the rail guiding surfaces, to a uniform distance front to back of the rails to form a flat surface for the fishplates.

(c) The ends of each rail shall be bolted to the fishplates with not fewer than four bolts that conform to Table 2.23.7.2.1.

(d) The width of the fishplate shall be not less than the width of the back of the rail.

(e) The thickness of the fishplates and the diameter of the bolts for each size of guide rail shall be not less than specified in Table 2.23.7.2.1.

(f) The diameter of bolt holes shall not exceed the diameter of the bolts by more than 2 mm (0.08 in.) for guide rails nor 3 mm (0.125 in.) for fishplates.

2.23.7.2.2 Joints of different design and construction shall be permitted to be used, provided they are equivalent in strength and will adequately maintain the accuracy of the rail alignment.

2.23.8 Overall Length of Guide Rails

The car and counterweight guide rails shall extend at the top and bottom to prevent the guiding members (see 2.15.2 and 2.21.1.3) from disengaging from the guide rails in the event that either the car or counterweight reaches its extreme limit of travel.

2.23.9 Guide-Rail Brackets and Building Supports

2.23.9.1 Design and Strength of Brackets and Supports

2.23.9.1.1 The building construction forming the supports for the guide rails and the guide-rail brackets shall be designed to

(a) safely withstand the application of the car or counterweight safety when stopping the car and its rated load or the counterweight

(b) withstand the forces specified in 2.23.5.2 within the deflection limits specified

2.23.9.1.2 Walls of bricks, terra-cotta, hollow blocks, and similar materials shall not be used for attachment of guide-rail brackets unless adequately reinforced.

2.23.9.1.3 Where necessary, the building construction shall be reinforced to provide adequate support for the guide rails.

2.23.9.2 Bracket Fastenings

2.23.9.2.1 Guide-rail brackets shall be secured to their supporting structure by one of the following means:

(a) by bolts or rivets

(b) by using clip fastenings to mount brackets to the building structure, provided that

(1) the friction force of such clips has a minimum factor of safety of 10

(2) an additional means, having a safety factor of not less than 5, of resisting horizontal shear is incorporated

(c) by welding conforming to 8.8

2.23.9.2.2 Fastening bolts and bolt holes in brackets and their supporting beams shall conform to 2.23.10.

2.23.9.3 Slotted guide-rail brackets having single bolt fastenings shall be provided with an additional means to prevent lateral movement of the rail bracket. Such means shall have a factor of safety of not less than 5.

Table 2.23.10.2 Minimum Size of Rail-Fastening Bolts

SI Units		Imperial Units	
Nominal Mass of Guide Rail, kg/m	Minimum Diameter of Rail Bolts, mm	Nominal Weight of Guide Rail, lb/ft	Minimum Diameter of Rail Bolts, in.
8.5	M12	5¾	½
9.5	M12	6⅜	½
13.0	M12	8	½
16.5	M16	11	⅝
18.0	M16	12	⅝
22.5	M16	15	⅝
27.5	M16	18½	⅝
33.5	M20	22½	¾
44.5	M20	30	¾

2.23.10 Fastening of Guide Rails to Rail Brackets

2.23.10.1 Type of Fastenings. Guide rails shall be secured to their brackets by clips, welds, or bolts.

Bolts used for fastening shall be of such strength as to withstand the forces specified in 2.23.5.2 and 2.23.9.1.

Welding, where used, shall conform to 8.8.

2.23.10.2 Size of Bolts for Fastening. The size of bolts used for fastening the guide rails or rail clips to the brackets shall be not less than specified in Table 2.23.10.2.

2.23.10.3 Bolt Holes for Fastenings. The diameter of holes or the width of slots for fastening bolts shall not exceed the diameter of the bolt by more than 2 mm (0.08 in.).

SECTION 2.24
DRIVING MACHINES AND SHEAVES

2.24.1 Type of Driving Machines

All driving machines shall be of the traction type, except that winding-drum machines shall be permitted for freight elevators, subject to the following:

(a) They shall not be provided with counterweights.

(b) The rated speed of the elevator shall not exceed 0.25 m/s (50 ft/min).

(c) The travel of the elevator car shall not exceed 12.5 m (40 ft).

NOTE (2.24.1): See 4.1 for rack-and-pinion machines and 4.2 for screw machines.

2.24.2 Sheaves and Drums

2.24.2.1 Material and Grooving. Sheaves and drums used with suspension and compensating ropes shall be of metal and provided with finished grooves for ropes or shall be permitted to be lined with nonmetallic groove material.

2.24.2.2 Minimum Pitch Diameter. Sheaves and drums used with suspension and compensating ropes shall have a pitch diameter of not less than

(a) 40 times the diameter of the rope where used with suspension ropes

(b) 32 times the diameter of the ropes where used with compensating ropes

2.24.2.3 Traction

2.24.2.3.1 Where the grooves are used to transmit power, sufficient traction shall be provided between the rope and groove, and in the event of nonmetallic lining failure, between the rope and the remaining sheave groove, to safely stop and hold the car with rated load [see 2.16.8(c)] from rated speed in the down direction.

2.24.2.3.2 If either the car or the counterweight bottoms on its buffers or becomes otherwise immovable

(a) the ropes shall slip in the drive sheave grooves and not allow the car or counterweight to be raised; or

(b) the driving system shall stall and not allow the car or counterweight to be raised.

2.24.2.4 Minimum Sheave and Drum Diameter. Drive sheaves and drums shall be permanently and legibly marked to state the minimum sheave or drum diameter, measured at the bottom of the groove, that is required to maintain structural integrity (see 2.24.3).

2.24.3 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 suspension and compensating ropes, shall be not less than

(a) 8 for metals having an elongation of at least 14% in a gauge length of 50 mm (2 in.) when tested in accordance with ASTM E 8

(b) 10 for cast iron, or for metals having an elongation of less than 14% in a gauge length of 50 mm (2 in.) when tested in accordance with ASTM E 8

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

2.24.3.1 Factors of Safety Based on Alternating / Reversing Stresses

2.24.3.1.1 Driving-machine components subjected to alternating or reversing stresses shall have a factor of safety of not less than 1.5.

2.24.3.1.2 This factor of safety shall be the ratio of the endurance limit of the components (see 1.3) to the actual alternating or reversing stress to which the components can be subjected under any normal operating condition. The endurance limit shall be based on 107 cycles of stress reversals. The actual stress shall include all designed or anticipated load conditions and stress risers, such as sharp corners, shock loading, surface finish, key ways, material variations, alignment tolerances, etc.

2.24.3.2 Factors of Safety at Emergency Braking. Driving-machine components including bedplate, where used, subject to forces due to the application of the emergency brake (see 2.19.4) shall be designed to withstand the maximum forces developed during the retardation phase of the emergency braking so that the factor of safety resulting from the emergency braking and all other loading acting simultaneously, if applicable, shall be not less than those specified in 2.24.3(a) and 2.24.3(b).

2.24.4 Fasteners Transmitting Load

2.24.4.1 Fasteners and Rigid Connections. Set screws or threaded portions located in the shear plane of bolts and screws shall not be used to transmit load.

Means shall be provided to ensure that there is no relative motion between rigidly joined components transmitting load.

The factors of safety to be used in the design of fasteners transmitting load in driving machines and sheaves shall be not less than those specified in 2.24.3.

2.24.4.2 Flexible Connections. Where flexible couplings are used to transmit load, means shall be provided to prevent disengagement of the coupling components in the event of the failure of or excessive motion in the flexible connection.

2.24.5 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 prevent excessive stress concentrations in the shafts (see 2.24.3.1).

Shafts that support drums, sheaves, gears, couplings, and other members, and that transmit torque, shall be provided with tight-fitting keys.

2.24.6 Cast-Iron Worms and Worm Gears

Worms and worm gears made of cast iron shall not be used in elevator driving machines.

2.24.7 Friction Gearing and Clutches

Friction gearing or a clutch mechanism shall not be used to connect a driving-machine drum or sheave to the main driving mechanism.

2.24.8 Braking System and Driving-Machine Brakes (See Nonmandatory Appendix F, Table F1)

2.24.8.1 General Requirements. The elevator shall be provided with a braking system conforming to 2.24.8.2.

2.24.8.2 Braking System

2.24.8.2.1 The braking system shall consist of a driving machine brake and in addition shall be permitted to include other braking means, such as electrically assisted braking.

2.24.8.2.2 The braking system shall be capable of decelerating the car from its rated speed when it is carrying its rated load (see 2.16.8) in the down direction, or empty car in the up direction from the speed at which the governor overspeed switch is set. Any deceleration not exceeding 9.8 m/s2 (32.2 ft/s2) is acceptable, provided that all factors such as, but not limited to, system heat dissipation and allowable buffer striking speeds are considered. The loss of main line power shall not reduce the braking system capacity below the requirements stated here.

2.24.8.3 Driving-Machine Brake. The driving machine shall be equipped with a friction brake applied by a spring or springs, or by gravity, and released electromechanically or electro hydraulically (see 1.3) in conformance with 2.26.8. The driving-machine brake, on its own, shall be capable of

(a) holding the car at rest with its rated load (see 2.16.8 and 2.26.8).

(b) holding the empty car at rest.

(c) decelerating the empty car traveling in the up direction from the speed at which the governor overspeed switch is set. Any deceleration not exceeding 9.8 m/s2 (32.2 ft/s2) is acceptable provided that all factors such as, but not limited to, system heat dissipation and allowable buffer striking speeds are considered.

2.24.8.4 Means for Manual Release. Means shall be permitted for manual release of the driving-machine brake. The means shall permit car movement in a gradual, controllable manner. Provision shall be made to prevent unintended actuation of the device. The manual release device shall be designed to be hand applied only with continuous effort. The brake shall reapply at its fully adjusted capacity in the absence of the hand applied effort. Devices required in accordance with 2.19 are permitted to be temporarily disabled when the manual release device is in use.

2.24.8.5 Marking Plates for Brakes. The brake setting and method of measurement shall be

permanently and legibly marked on the driving machine.

2.24.8.6 Driving-Machine Brake Design. The driving machine brake design shall ensure contact of the friction material on the braking surface consistent with good engineering practice. Means shall be provided to protect the braking surfaces from contamination caused by any driving-machine fluid leak.

2.24.9 Indirect Driving Machines

2.24.9.1 Belt and Chain Drives. Indirect driving machines, utilizing V-belt drives, tooth drive belts, or drive chains, shall include not less than three belts or chains operating together in parallel as a set. Belt and chain drive sets shall be preloaded and matched for length in sets.

2.24.9.2 General Requirements

2.24.9.2.1 Belt sets shall be selected on the basis of the manufacturer's rated breaking strength and a factor of safety of 10. Chain and sprocket sets shall be selected on the basis of recommendations set forth in the Supplementary Information section of ASME B29.1M, using a service factor of 2. Offset links in chain are not permitted.

2.24.9.2.2 Sprockets in a chain drive set and also a driven set shall be assembled onto a common hub, with teeth cut in-line after assembly to assure equal load distribution on all chains. Tooth sheaves for a belt drive shall be constructed in a manner to assure equal load distribution on each belt in the set.

2.24.9.2.3 Load determination for both the belt and chain sets shall be based on the maximum static loading on the elevator car, which is the full load in the car at rest and at a position in the hoistway that creates the greatest load, including either the car or counterweight resting on its buffer.

2.24.9.2.4 Chain drives and belt drives shall be guarded to protect against accidental contact and to prevent foreign objects from interfering with the drives.

2.24.9.3 Monitoring and Brake Location. Each belt or chain shall be continuously monitored by a broken belt or chain device, which shall function to stop the car at the next available landing and prevent it from running, in the event that any belt or chain in the set breaks or becomes excessively slack. The driving-machine brake shall be located on the traction sheave or drum assembly side of the driving machine so as to be fully effective in the event that the entire belt set or chain set should break.

2.24.10 Means for Inspection of Gears

Each gear case of geared machines must have access to permit inspection of the contact surfaces of the gears.

SECTION 2.25
TERMINAL STOPPING DEVICES

2.25.1 General Requirements

2.25.1.1 Normal terminal stopping devices required by 2.25.2, emergency terminal stopping devices required by 2.25.4.2, and emergency terminal speed-limiting devices required by 2.25.4.1 shall be permitted to use mechanically operated, magnetically operated, optical, or solid-state devices for determining car position and speed.

2.25.1.2 Final terminal stopping devices required by 2.25.3 shall use only mechanically operated switches for determining car position.

2.25.1.3 Terminal stopping devices that are located on the car or in the hoistway shall be of the enclosed type and securely mounted in such a manner that horizontal movement of the car shall not affect the operation of the device.

2.25.2 Normal Terminal Stopping Devices

2.25.2.1 Where Required and Function. Normal terminal stopping devices shall conform to 2.25.2.1.1 through 2.25.2.1.3.

2.25.2.1.1 Normal terminal stopping devices shall be provided and arranged to slow down and 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 (see 2.16.8).

2.25.2.1.2 Such devices shall function independently of the operation of the normal stopping means and of the final terminal stopping device, except that on elevators with a rated speed of 0.75 m/s (150 ft/min) or less, the normal terminal stopping device shall be permitted to be used as the normal stopping means.

2.25.2.1.3 The device shall be so designed and installed that it will continue to function until the final terminal stopping device operates.

2.25.2.2 Location of Stopping Devices. Normal terminal stopping devices shall be located as specified in 2.25.2.2.1 and 2.25.2.2.2.

2.25.2.2.1 Stopping devices for traction machines shall be located on the car, in the hoistway, a machinery space, machine room, control space, or control room, and shall be operated by the movement of the car.

2.25.2.2.2 Stopping devices for winding drum machines shall be located on the car or in the hoistway, and shall be operated by the movement of the car.

2.25.2.3 Indirectly Operated Normal Terminal Stopping Devices. Stopping devices that are not located on the car or in the hoistway shall conform to 2.25.2.3.1 through 2.25.2.3.3.

2.25.2.3.1 The stopping device shall be mounted on and operated by a stopping means mechanically connected to and driven by the car.

Stopping means depending on friction or traction shall not be used.

2.25.2.3.2 Tapes, chains, ropes, or 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 (see 2.26.2.6).

2.25.2.3.3 If mechanically operated switches are used, only one set of floor-stopping contacts is necessary for each terminal landing on floor controllers or other similar devices used to stop the car automatically at the landings (such as automatic operation, signal operation, etc.), provided these contacts and the means for operating them conform to 2.25.2.3.1 and 2.25.2.3.2. These contacts shall be permitted to serve also as the normal terminal stopping devices.

2.25.3 Final Terminal Stopping Devices

2.25.3.1 General Requirements. Final terminal stopping devices shall conform to 2.25.1 and the following:

(a) They shall be mechanically operated.

(b) Operating cams shall be of metal.

(c) The switch contacts shall be directly opened mechanically.

(d) Final limit switches and bracket must be permanently secured and pinned.

2.25.3.2 Where Required and Function. Final terminal stopping devices shall be provided and arranged to cause the electric power to be removed automatically from the elevator driving-machine motor and brake after the car has passed a terminal landing.

The device shall be set to function as close to the terminal landing as practicable, but so that under normal operating conditions it 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

(a) at the top terminal landing, until the car has traveled above this landing a distance equal to the counterweight runby plus 1.5 times the buffer stroke, but in no case less than 0.6 m (2 ft)

(b) 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.

2.25.3.3 Location. Final terminal stopping devices shall be located as specified in 2.25.3.3.1 and 2.25.3.3.2.

2.25.3.3.1 Traction machine elevators shall have final terminal stopping switches located in the hoistway and operated by cams attached to the car.

2.25.3.3.2 Winding drum machine elevators shall have two sets of final terminal stopping switches, one located on and operated by the driving machine, and the other located in the hoistway and operated by cams attached to the car (see 2.25.3.5).

2.25.3.4 Controller Switches Controlled by 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 AC driving-machine motor is used, these switches shall be of the multipole type.

The control shall be so designed and installed that a single ground or short circuit may permit either, but not prevent both, the normal or final stopping device circuits from stopping the car.

2.25.3.5 Additional Requirements for Winding Drum Machines. Final terminal stopping devices for winding drum machines shall conform to 2.25.3.5.1 through 2.25.3.5.3.

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

2.25.3.5.2 Where a two- or three-phase AC driving-machine motor is used, the mainline circuit to the driving-machine motor and the circuit of the driving machine brake coil shall be directly 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 required by 2.25.3.2.

2.25.3.5.3 Driving machines equipped with a direct-current brake and having a DC mainline 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 need not conform to 2.25.3.5.2. This does not eliminate the need for a machine-operated switch.

2.25.4 Emergency Terminal Stopping Means

2.25.4.1 Emergency Terminal Speed Limiting Device. Emergency terminal speed-limiting devices shall be installed on all elevators where reduced stroke buffers are used (see 2.22.4.1.2 and 2.26.2.12), and shall conform to 2.25.4.1.1 through 2.25.4.1.9.

2.25.4.1.1 The operation of the emergency terminal speed-limiting devices shall be entirely independent of the operation of the normal terminal stopping device.

The emergency terminal speed-limiting device shall automatically reduce the car and counterweight speed by removing power from the driving-machine motor and brake, such that the rated buffer striking speed is not exceeded if the normal terminal stopping device fails to slow down the car at the terminal as intended.

2.25.4.1.2 The car speed sensing device shall be independent of the normal speed control system.

2.25.4.1.3 The emergency terminal speed-limiting device shall provide a retardation not in excess of 9.81 m/s2 (32.2 ft/s2).

2.25.4.1.4 The emergency terminal speed-limiting devices shall not apply the car safety.

2.25.4.1.5 The emergency terminal speed-limiting devices shall be so designed and installed that a single short circuit caused by a combination of grounds, or by other conditions, shall not render the device ineffective.

2.25.4.1.6 The emergency terminal speed-limiting devices shall be located on the car, in the hoistway, or a machinery space, machine room, control space, or control room, and shall be operated by the movement of the car.

2.25.4.1.7 Mechanically operated switches, where located on the car or in the hoistway, shall conform to 2.25.3.1.

2.25.4.1.8 Where the operation of emergency terminal-speed-limiting devices is dependent on car position relative to the terminal landings

(a) friction or traction drives shall not be used

(b) if tape, chain, or rope is used for connection to the car, a switch shall be provided to remove electrical power from the driving-machine motor and brake should this connection fail (see 2.26.2.6)

2.25.4.1.9 Where magnetically operated, optical, or solid-state devices are used for position sensing, a single short circuit caused by a combination of grounds or by other conditions, or the failure of any single magnetically operated, optical, or solid-state device shall not

(a) render the emergency terminal speed-limiting device inoperative

(b) permit the car to restart after a normal stop

2.25.4.2 Emergency Terminal Stopping Device. Elevators with static control and rated speeds over 1 m/s (200 ft/min) shall be provided with an emergency terminal stopping device that will cause power to be removed from the driving-machine motor and brake should the normal stopping means and the normal terminal stopping device fail to cause the car to slow down at the terminal as intended.

The emergency terminal stopping device shall function independently of the normal terminal stopping device and the normal speed control system.

Elevators with static generator-field control that use the normal terminal stopping device to limit the generator-field current directly, or elevators that have an emergency terminal speed-limiting device that complies with 2.25.4.1, are not required to have an emergency terminal stopping device.

SECTION 2.26
OPERATING DEVICES AND CONTROL EQUIPMENT

2.26.1 Operation and Operating Devices

2.26.1.1 Types of Operating Devices. All operating devices shall be of the enclosed electric type.

Rope or rod operating devices actuated directly by hand, or rope operating devices actuated by wheels, levers, or cranks, shall not be used.

2.26.1.2 For Car-Switch Operation Elevators. Handles of lever-type operating devices of car-switch operation elevators shall be so arranged that they will return to the stop position and latch there automatically when the hand of the operator is removed.

2.26.1.3 Additional Operating Devices for Elevators Equipped to Carry One-Piece Loads Greater Than the Rated Load. Elevators equipped to carry one-piece loads greater than their rated load shall be provided with an additional operating device of the continuous-pressure type to operate the elevator at a speed not exceeding 0.75 m/s (150 ft/min) under such conditions. The normal operating devices shall be inoperative during such operation (see 2.16.7.10).

2.26.1.4 Inspection Operation. See Appendix R, Table R-1.

2.26.1.4.1 General Requirements

(a) Operating Devices

(1) Operating devices for inspection operation shall be provided

(a) on the top of the car

(b) at the inspection and test panel when required by 2.7.6.5.2(h)

(2) Operating devices for inspection operation shall also be permitted

(a) in the car

(b) in a machinery space outside the hoistway

(c) in a machine room

(d) in a control space outside the hoistway

(e) in a control room

(f) in the pit in accordance with 2.7.5.2.2

(g) at a working platform in accordance with 2.7.5.3.6

(b) A switch for transferring control of the elevator to the operating devices for inspection operation shall be provided, which shall

(1) be manually operated

(2) be labeled "INSPECTION"

(3) have two positions, labeled "INSPECTION" or "INSP" and "NORMAL" or "NORM"

(4) when in the "INSPECTION" position

(a) enable inspection operation by means of the inspection operating devices

(b) except as provided, in 2.26.1.4.2(f), cause the movement of the car to be solely under the control of the inspection operating devices through a contact that shall be positively opened mechanically and whose opening shall not depend solely on springs

(c) disable automatic power door opening and closing and car leveling, except as provided in 2.26.1.4.2(f)

(5) when in the "NORMAL" position, disable inspection operation by means of the inspection operating devices

(c) Inspection operating devices shall

(1) be of the continuous-pressure type

(2) be labeled "UP" and "DOWN," respectively

(d) Inspection operation shall conform to the following:

(1) the speed of the car shall not exceed 0.75 m/s (150 ft/min)

(2) be subject to the electrical protective devices required by 2.26.2, except as permitted by 2.26.1.5

(3) fully closed doors shall be permitted to be held in the closed position with power applied

(e) Inspection operation shall be used only by elevator personnel.

2.26.1.4.2 Top-of-Car Inspection Operation. Top-of car inspection operation shall conform to 2.26.1.4.1 and the following:

(a) A stop switch (see 2.26.2.8) shall be permanently located on the car top and readily accessible to a person, while standing at the hoistway entrance normally used for access to the car top.

(b) The transfer switch [see 2.26.1.4.1(b)] shall be located on the car top and shall be so designed as to prevent accidental transfer from the "INSPECTION" to "NORMAL" position.

(c) A separate device of the continuous-pressure type labeled "ENABLE" shall be provided adjacent to the inspection operating devices.

(d) The inspection operating devices shall become effective only when the "ENABLE" device is activated.

(e) The inspection operating devices (see 2.26.1.4.1(c)) must be portable, with a cord length of the distance from the connection point to the farthest corner of the top of car, provided that

(1) The "ENABLE" device (see 2.26.1.4.2(c)), and a stop switch, in addition to the stop switch required in 2.26.1.4.2(a) are included in the portable unit; and

(2) The flexible cord is permanently attached so that the portable unit cannot be detached from the car top.

(f) Separate additional devices of the continuous pressure type shall be permitted to be provided on the car top to make power door opening and closing and automatic car leveling operative from the top of the car for testing purposes.

(g) When on top-of-car inspection operation, a separate additional device shall be permitted to render ineffective the top final terminal-stopping device, and the buffer switch for gas spring return counterweight oil buffers, in conformance with the requirements of 2.26.4.3, 2.26.9.3(a), and 2.26.9.4, and it shall allow the car to be moved to a position in conformance with the requirements of 2.7.4.5 and 2.7.5.1.3(c).

2.26.1.4.3 In-Car Inspection Operation. When in car inspection operation is provided, it shall conform to 2.26.1.4.1, and the transfer switch [see 2.26.1.4.1(b)]

(a) shall be located in the car.

(b) shall be key-operated or placed behind a locked cover. Keys to operate or access the switch shall be Group 1 Security (see 8.1).

(c) shall be rendered ineffective if top-of-car inspection operation is activated.

(d) when in the "INSPECTION" position, shall not enable hoistway access switch(es). A third switch position shall be permitted to enable the hoistway access switches [see 2.12.7.3.3(a)].

2.26.1.4.4 Machinery Space Outside the Hoistway, Machine Room, Control Space Outside the Hoistway, Control Room, Pit, Landing, and Working Platform Inspection Operations. Where inspection operation in a machinery space outside the hoistway, machine room, control space outside the hoistway, control room, pit, or at an inspection and test panel, or a working platform is provided, it shall conform to 2.26.1.4.1 and the following:

(a) The transfer switch [see 2.26.1.4.1(b)] shall be

(1) located in the pit, where provided in accordance with 2.7.5.2.2 (Pit Inspection Operation)

(2) located in the inspection and test panel as required by 2.7.6.5.2(h) (Landing Inspection Operation)

(3) located in the machinery space outside the hoistway, machine room, control space outside the hoistway, or control room, as applicable

(4) located at a working platform where required by 2.7.5.3.6 (Working Platform Inspection Operation)

(5) rendered ineffective if top-of-car inspection operation, in-car inspection operation, or hoistway access operation is activated, or when a car door or hoistway door bypass switch is in the "BYPASS" position

(b) Only one mode of the inspection operation as described in 2.26.1.4.4(a)(1) through (4) shall be permitted to be operative at any time. If more than one inspection operation transfer switch, as permitted in 2.26.1.4.4(a)(1) through (4), is in the "INSPECTION" position, the controls shall prevent operation of the car from any location as described in 2.26.1.4.4(a)(1) through (4).

(c) Pit inspection operation where provided shall also conform to 2.26.1.4.2(c) and (d). When the pit transfer switch is in the "INSPECTION" position, the controls shall prevent operation of the car when any inspection transfer switch, other than that in the pit, is in the "INSPECTION" position, or when hoistway access operation is enabled.

(d) Where inspection operation from a working platform is provided and the working platform transfer switch is in the "INSPECTION" position, the controls shall prevent operation of the car when any other inspection transfer switch, other than that at the working platform, is in the "INSPECTION" position, or when hoistway access operation is enabled.

2.26.1.5 Inspection Operation With Open Door Circuits. A single set of switches marked "CAR DOOR BYPASS" and "HOISTWAY DOOR BYPASS" shall be provided in the elevator controller enclosure containing the car door and gate electric contact circuits and hoistway door interlock and hoistway door electric contact circuits (see 2.26.2.14 and 2.26.2.15); except where the switches are not accessible from outside the hoistway, they shall be located in the inspection and test panel (see 2.7.6.5). The switches shall prepare the control system so that, only when top-of-car or in-car inspection operation is activated, the car shall be permitted to be moved with open door contacts. The switches shall conform to 2.26.1.5.1 through 2.26.1.5.8.

2.26.1.5.1 They shall have contacts that are positively opened mechanically, when switching to either "BYPASS" or "OFF" positions, and their opening shall not be solely dependent on springs.

2.26.1.5.2 The positions of the "BYPASS" switches shall be clearly marked "BYPASS" and "OFF."

2.26.1.5.3 The related circuits shall comply with 2.26.9.3 and 2.26.9.4.

2.26.1.5.4 When either or both of the switches are in the "BYPASS" position, all means of operation shall be made inoperative except top-of-car and in-car inspection operation [see also 2.26.1.4.4(c) and (d)].

2.26.1.5.5 When the "CAR-DOOR BYPASS" switch is in the "BYPASS" position, it shall permit top of-car and in-car inspection operation with open car door (or gate) contacts.

2.26.1.5.6 When the "HOISTWAY DOOR BYPASS" switch is in the "BYPASS" position, it shall permit top-of-car and in-car inspection operation with open hoistway door interlocks or contacts.

2.26.1.5.7 Each of the "BYPASS" switches shall be permitted to be replaced by a set of switches used to bypass individual groups of door contacts. Each switch in this set shall be marked to identify the specific door contacts bypassed.

2.26.1.5.8 A warning sign shall be mounted adjacent to the "BYPASS" switches stating, "Jumpers shall not be used to bypass hoistway door or car door electric contacts."

2.26.1.6 Operation in Leveling or Truck Zone. Operation of an elevator in a leveling or truck zone at any landing by a car leveling or truck zoning device, when the hoistway doors, or the car doors or gates, or any combination thereof, are not in the closed position,

is permissible, subject to the requirements of 2.26.1.6.1 through 2.26.1.6.7.

2.26.1.6.1 Operating devices of manually operated car leveling devices or truck zoning devices shall be of the continuous-pressure type and located in the car.

2.26.1.6.2 Car platform guards, conforming to 2.15.9, shall be provided. Where a car leveling device is used, landing sill guards, conforming to 2.11.12.7, shall also be provided.

2.26.1.6.3 The leveling zone at any landing shall not extend more than 450 mm (18 in.) above and below any landing where an automatic leveling device is used, and not more than 250 mm (10 in.) above and below any landing where a manually operated leveling device is used.

2.26.1.6.4 The truck zone at any landing shall not extend more than 1 700 mm (67 in.) above the landing.

2.26.1.6.5 Where a truck or leveling zone for one hoistway entrance extends into the door interlocking zone for a second entrance, the truck zoning or leveling operation shall be inoperative unless the hoistway door at the second entrance is in the closed position.

Where a truck or leveling zone for one hoistway entrance extends into the leveling zone for a second entrance, the leveling operation for the second entrance shall be inoperative while the hoistway door at the first entrance is open.

2.26.1.6.6 A leveling or truck-zoning device shall not move the car at a speed exceeding 0.75 m/s (150 ft/min).

For elevators with static control, an independent means shall be provided to limit the leveling speed to a maximum of 0.75 m/s (150 ft/min) with the doors open, should the normal means to control this speed (mechanical, electrical, or solid state devices) fail to do so.

2.26.1.6.7 For elevators with static control, an inner landing zone extending not more than 75 mm (3 in.) above and 75 mm (3 in.) below the landing shall be provided. A car shall not move if it stops outside of the inner landing zone unless the doors are fully closed.

2.26.2 Electrical Protective Devices

When an electrical protective device is activated (operated, opened), it shall cause the electric power to be removed from the elevator driving machine motor and brake. [See also 2.26.3, 2.26.4.3, 2.26.4.4, 2.26.7, 2.26.8.3(c), 2.26.9.3, and 2.26.9.4]. Electrical protective devices shall be provided as specified in 2.26.2.1 through 2.26.2.37.

2.26.2.1 Slack-Rope Switch. Winding drum machines shall be provided with a slack-rope device equipped with a slack-rope switch of the enclosed manually reset type. This switch shall operate whenever the ropes are slack.

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

2.26.2.3 Compensating-Rope Sheave Switch. Compensating-rope sheaves shall be provided with a compensating-rope sheave switch or switches mechanically opened by the compensating-rope sheave before the sheave reaches its upper or lower limit of travel.

2.26.2.4 Motor Field Sensing Means. Where direct current is supplied to an armature and shunt field of an elevator driving-machine motor, a motor field current sensing means shall be provided, which shall cause the electric power to be removed from the driving-machine motor armature, and brake unless current is flowing in the shunt field of the motor, except for static control elevators provided with a device to detect an overspeed condition prior to, and independent of, the operation of the governor overspeed switch. This device shall cause power to be removed from the elevator driving-machine motor armature and machine brake.

2.26.2.5 Emergency stop switch. On all elevators, an emergency stop switch must be provided in the car, and located in or adjacent to each car operating panel. When open ("STOP" position), this switch must cause the electric power to be removed from the elevator driving-machine motor and brake. Emergency stop switches must:

(a) Be of the manually opened and closed type;

(b) Have red operating handles or buttons;

(c) Be conspicuously and permanently marked "STOP" and must indicate the "STOP" and "RUN" positions; and

(d) While opened, cause the audible device to sound (see 2.27.1.2).

2.26.2.6 Broken Rope, Tape, or Chain Switches. The switch or switches that shall be opened by a failure of a rope, tape, or chain, shall be provided when required by 2.25.2.3.2 or 2.25.4.1.8(b).

2.26.2.7 Stop Switch in Pit. A stop switch conforming to 2.26.2.5(a), (b), (c) shall be provided in the pit of every elevator (see 2.2.6).

2.26.2.8 Stop Switch on Top of Car. A stop switch conforming to 2.26.2.5(a), (b), and (c) shall be provided on the top of every elevator car.

2.26.2.9 Car Safety Mechanism Switch. A switch, conforming to 2.17.7 shall be required where a car safety is provided.

2.26.2.10 Speed-Governor Overspeed Switch. A speed-governor overspeed switch shall be provided when required by 2.18.4.1 and shall conform to 2.18.4.1.2, 2.18.4.2, and 2.18.4.3.

2.26.2.11 Final Terminal Stopping Devices. Final terminal stopping devices, conforming to 2.25.3, shall be provided for every electric elevator.

2.26.2.12 Emergency Terminal Speed Limiting Devices. Where reduced-stroke oil buffers are provided, as permitted by 2.22.4.1.2, emergency terminal speed limiting devices conforming to 2.25.4.1 shall be provided.

2.26.2.13 Buffer Switches for Oil Buffers Used With Type C Car Safeties. Oil level and compression switches conforming to 2.17.8.2.7 and 2.17.8.2.8 shall be provided for all oil buffers used with Type C safeties (see 2.17.5.3).

2.26.2.14 Hoistway Door Interlocks and Hoistway Door Electric Contacts. Hoistway door interlocks or hoistway door electric contacts conforming to 2.12 shall be provided for all elevators.

2.26.2.15 Car Door and Gate Electric Contacts. Car door or gate electric contacts, conforming to 2.14.4.2, shall be provided for all elevators; except when car door interlock, conforming to 2.26.2.28 is provided.

2.26.2.16 Emergency Terminal Stopping Devices. Emergency terminal stopping devices conforming to 2.25.4.2 shall be provided for all elevators where static control is used, unless exempted by 2.25.4.2.

2.26.2.17 - MISSING FROM DOCUMENT

2.26.2.18 Car Top Emergency Exit Electrical Device. An electrical device conforming to 2.14.1.5.1(f) shall be provided on the car top emergency exit cover.

2.26.2.19 Motor-Generator Overspeed Protection. Means shall be provided to cause the electric power to be removed automatically from the elevator driving machine motor and brake should a motor-generator set, driven by a DC motor, overspeed excessively.

2.26.2.20 Electric Contacts for Hinged Car Platform Sills. Hinged car platform sills, where provided, shall be equipped with electric contacts conforming to 2.15.16.

2.26.2.21 RESERVED

2.26.2.22 Buffer Switches for Gas Spring-Return Oil Buffers. Buffer switches conforming to 2.22.4.5(c) shall be provided.

2.26.2.23 Stop Switch in Remote Machine and Control Rooms. A stop switch conforming to 2.26.2.5(a), (b), and (c) shall be provided in remote machine and control rooms where required by 2.7.8.

2.26.2.24 Stop Switch for Machinery Spaces and Control Spaces. A stop switch conforming to 2.26.2.5(a), (b), and (c) shall be provided where required by 2.7.3.5.

2.26.2.25 Blind Hoistway Emergency Door Locking Device. A locking device conforming to 2.11.1.2(e) shall be provided on every emergency door in a blind hoistway.

2.26.2.26 Pit Access Door Electric Contact. An electric contact shall be provided on each pit access door where required by 2.2.4.4.

2.26.2.27 Stop Switch in Remote Counterweight Hoistways. A stop switch conforming to 2.26.2.5(a), (b), and (c) shall be provided in the remote counterweight hoistway where required by 2.3.3.3.

2.26.2.28 Car Door Interlock. An interlock conforming to 2.14.4.2 shall be provided where required by 2.14.4.2.1.

2.26.2.29 Ascending Car Overspeed Protection Device. An overspeed device shall be provided when required by 2.19.1 and shall meet the requirements of 2.19.1.2(a).

2.26.2.30 Unintended Car Movement Device. An unintended car movement device shall be provided when required by 2.19.2 and shall meet the requirements of 2.19.2.2(a). Where generator-field control is used, this electrical protective device shall also cause the power to be removed from the drive motor of the motor-generator set.

2.26.2.31 Car Access Panel Locking Device. A locking device conforming to 2.14.2.6 shall be provided where required by 2.14.2.6(e).

2.26.2.32 Hoistway Access Opening Locking Device. Access openings in the hoistway shall be provided with a locking device where required by 2.11.1.4.

2.26.2.33 RESERVED

2.26.2.34 Unexpected Car Movement Device. An unexpected car movement device shall be provided where required by 2.7.5.1.2(c). This requirement shall be permitted to be satisfied by another device specified

in 2.26.2, provided that the means required by 2.7.5.1.1 actuates the electrical device.

2.26.2.35 Equipment Access Panel Electrical Device. An electric contact on equipment access panels in the car shall be provided where required by 2.7.5.1.4 or 2.14.2.2(g).

2.26.2.36 Working Platform Electrical Device. An electric contact conforming to 2.14.4.2.3(b), (c), and (e) shall be provided where required by 2.7.5.3.1.

2.26.2.37 Retractable Stop Electrical Device. An electric contact conforming to 2.14.4.2.3(b), (c), and (e) shall be provided where required by 2.7.5.5(a).

2.26.3 Contactors and Relays for Use in Critical Operating Circuits

Where electromechanical contactors or relays are provided to fulfill the requirements of 2.26.8.2, and 2.26.9.3 through 2.26.9.7, they shall be considered to be used in critical operating circuits. If contact(s) on these electromechanical contactors or relays are used for monitoring purposes, they shall be prevented from changing state if the contact(s) utilized in a critical operating circuit fail to open in the intended manner. The ability of the monitoring contact(s) to perform this function shall not be solely dependent upon springs.

2.26.4 Electrical Equipment and Wiring

2.26.4.1 All electrical equipment and wiring shall conform to NFPA70 or CSA C22.1, whichever is applicable (see Part 9).

2.26.4.2 Drive-machine controllers, logic controllers, and operating devices accessory thereto for starting, stopping, regulating, controlling, or protecting electric motors, generators, or other equipment shall be listed/certified and labeled/marked to the requirements of CAN/CSA-B44.1/ASME A17.5.

2.26.4.3 The devices covered by 2.26.2 shall have contacts that are positively opened mechanically; their opening shall not be solely dependent on springs. Exceptions are devices described by 2.26.2.4, 2.26.2.19, 2.26.2.29, and 2.26.2.30; and 2.26.2.12 and 2.26.2.16 where magnetically operated, optical, or static-type switches are used.

2.26.4.4 Control equipment shall be tested in accordance with the testing requirements of EN 12016 by exposing it to interference levels at the test values specified for "safety circuits." The interference shall not cause any of the conditions described in 2.26.9.3(a) through (e) and shall not cause the car to move while on inspection operation.

If enclosure doors or suppression equipment must remain installed to meet the above requirements, warning signs to that effect shall be posted on the control equipment.

2.26.4.5 In jurisdictions enforcing CSA C22.1, power supply line disconnecting means, shall not be opened automatically by a fire alarm system.

2.26.5 System to Monitor and Prevent Automatic Operation of the Elevator With Faulty Door Contact Circuits

Means shall be provided to monitor the position of power-operated car doors that are mechanically coupled with the landing doors while the car is in the landing zone, in order

(a) to prevent the operation of the car if the car door is not closed (see 2.14.4.11), regardless whether the portion of the circuits incorporating the car door contact or the interlock contact of the landing door coupled with car door, or both, are closed or open, except as permitted in 2.12.7, 2.26.1.5, and 2.26.1.6

(b) to prevent, except as permitted in 2.26.1.5, the power closing of the doors if the car door is fully open and any of the following conditions exist:

(1) the car door contact is closed or the portion of the circuit, incorporating this contact is bypassed

(2) the interlock contact of the landing door that is coupled to the opened car door is closed or the portion of the circuit, incorporating this contact is bypassed

(3) the car door contact and the interlock contact of the door that is coupled to the opened car door are closed, or the portions of the circuits incorporating these contacts are bypassed

2.26.6 Phase Protection of Motors

Elevators having a polyphase AC power supply shall be provided with means to prevent the starting of the elevator drive motor or door motor if a reversal of phase rotation, or phase failure of the incoming polyphase AC power, will cause the elevator car or elevator door(s) to operate in the wrong direction.

2.26.7 Installation of Capacitors or Other Devices to Make Electrical Protective Devices Ineffective

The installation of capacitors or other devices, the operation or failure of which will cause an unsafe operation of the elevator, is prohibited.

No permanent device that will make any required electrical protective device ineffective shall be installed except as provided in 2.7.6.5.2(h), 2.12.7.1, 2.26.1.4.2(g), 2.26.1.5, 2.26.1.6, and 2.27.3.1.6(c) (see 8.6.1.6.1).

2.26.8 Release and Application of Driving-Machine Brakes

2.26.8.1 Driving-machine brakes shall not be electrically released until power has been applied to the driving machine motor except as permitted by 2.7.6.4.3.

2.26.8.2 Two devices shall be provided to independently remove power from the brake. If the brake circuit is ungrounded, all power feed lines to the brake shall be opened.

2.26.8.3 The brake shall apply automatically when

(a) the operating device of a car switch or continuous pressure operation elevator is in the stop position;

(b) a normal stopping means functions

(c) any electrical protective device is activated

(d) there is a loss of power to the driving machine brake

2.26.8.4 The application of the brake shall be permitted to occur on or before the completion of the slowdown and leveling operations, under conditions described in 2.26.8.3(a) and (b).

2.26.8.5 The brake shall not be permanently connected across the armature or field of a direct-current elevator driving-machine motor.

2.26.9 Control and Operating Circuits

The design and installation of the control and operating circuits shall conform to 2.26.9.1 through 2.26.9.8.

2.26.9.1 If springs are used to actuate switches, contactors, or relays to break the circuit to stop an elevator at the terminal landings, they shall be of the compression type.

2.26.9.2 The completion or maintenance of an electric circuit shall not be used to interrupt the power to the elevator driving-machine motor or brake at the terminal landings, nor to stop the car when any of the electrical protective devices (see 2.26.2) operate. Requirement 2.26.9.2 does not apply to dynamic braking, nor to speed control switches.

2.26.9.3 The occurrence of a single ground or the failure of any single magnetically operated switch, contactor, or relay, or any single device that limits the leveling or truck zone, or any single solid state device; or a software system failure, shall not

(a) render any electrical protective device ineffective (see 2.26.2)

(b) permit the car to move beyond the leveling or truck zone if any hoistway door interlock is unlocked or if any hoistway door or car door or gate electric contact is not in the closed position (see 2.26.1.6)

(c) permit speeds in excess of those specified in 2.12.7.3.2, 2.26.1.4.1(d)(1), 2.26.1.5.10(b), and 2.26.1.6.6

(d) permit the car to revert to normal operation when the electrical contact required by 2.7.5.2.1(b)(3) is in the open position, or the electrical device as permitted in 2.7.5.5(b) is activated, or on hoistway access switch operation (see 2.12.7.3), or on inspection operation (see 2.26.1.4), or on bypass operation (see 2.26.1.5)

(e) continue to make ineffective any hoistway-door interlock or car door or gate electric contact when either a hoistway access switch (see 2.12.7.3) or a "BYPASS" switch (see 2.26.1.5) is turned to the "OFF" position.

2.26.9.4 Redundant devices used to satisfy 2.26.9.3 in the determination of the occurrence of a single ground, or the failure of any single magnetically operated switch, contactor or relay, or of any single solid state device, or any single device that limits the leveling or truck zone, or a software system failure, shall be checked prior to each start of the elevator from a landing, when on automatic operation. When a single ground or failure, as specified in 2.26.9.3, occurs, the car shall not be permitted to restart. Implementation of redundancy by a software system is permitted, provided that the removal of power from the driving-machine motor and brake shall not be solely dependent on software-controlled means.

2.26.9.5 Except for elevators employing alternating current hoist motors driven from a direct-current source through a static inverter (see 2.26.9.6), elevators with driving motors employing static control without motor generator sets shall conform to 2.26.9.5.1 through 2.26.9.5.6.

2.26.9.5.1 Two devices shall be provided to remove power independently from the driving-machine motor. At least one device shall be an electromechanical contactor.

2.26.9.5.2 The contactor shall be arranged to open each time the car stops.

2.26.9.5.3 The contactor shall cause the driving machine brake circuit to open.

2.26.9.5.4 An additional contactor shall be provided to also open the driving-machine brake circuit. This contactor is not required to have contacts in the driving-machine motor circuit.

2.26.9.5.5 The electrical protective devices required by 2.26.2 shall control the solid state device and both contactors, except that leveling shall be permitted to take place with power opening of doors and gates in conformance with 2.13.2.1.1 and 2.13.2.2.1.

2.26.9.5.6 After each elevator stop, the car shall not respond to a signal to start unless both contactors are in the de-energized position.

2.26.9.6 Elevators employing alternating-current driving motors driven from a direct-current power source through a static inverter shall conform to 2.26.9.6.1 through 2.26.9.6.6.

2.26.9.6.1 Two separate means shall be provided to independently inhibit the flow of alternating-current through the solid state devices that connect the direct current power source to the alternating-current driving motor. At least one of the means shall be an electromechanical relay.

2.26.9.6.2 The relay shall be arranged to open each time the car stops.

2.26.9.6.3 The relay shall cause the driving machine brake circuit to open.

2.26.9.6.4 An additional contactor shall be provided to also open the driving-machine brake circuit. This contactor is not required to have contacts in the driving machine motor circuit.

2.26.9.6.5 The electrical protective devices required by 2.26.2 shall control both the means that inhibit the flow of alternating current through the solid state devices and the contactors in the brake circuit, except that leveling shall be permitted to take place with power opening of the doors and gates as restricted by 2.13.2.1.1 and 2.13.2.2.1.

2.26.9.6.6 After each elevator stop, the car shall not respond to a signal to start unless the relay that inhibits the flow of alternating current through the solid state devices, as well as the contactors in the brake circuit, are in the de-energized position.

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

2.26.9.8 The control circuits shall be so designed and installed that the car speed in the down direction with rated load in the car, under normal operating conditions with the power supply on or off, shall not exceed governor tripping speed, or 125% of rated speed, whichever is the lesser (see also 2.16.8).

2.26.10 Absorption of Regenerated Power

When a power source is used that, in itself, is incapable of absorbing the energy generated by an overhauling load, means for absorbing sufficient energy to prevent the elevator from attaining governor tripping speed or a speed in excess of 125% of rated speed, whichever is less, shall be provided on the load side of each elevator power supply line disconnecting means (see 2.16.8).

2.26.11 Car Platform to Hoistway Door Sills Vertical Distance

Where ANSI/ICC A117.1 or ADAAG is not applicable, the vertical distance between the car platform sill and the hoistway door sill on passenger elevators shall be in accordance with the following:

(a) it shall not exceed 13 mm (0.5 in.) on initial stop at a landing

(b) the car shall relevel if the vertical distance exceeds 25 mm (1 in.) while loading or unloading

2.26.12 Symbols

2.26.12.1 Where reference is made requiring wording to designate a specific function, the symbols as shown in Table 2.26.12.1 shall be substituted for, or used in conjunction with, the required wording.

2.26.12.2 The emergency stop switch shall have the "STOP" and "RUN" positions conspicuously and permanently marked as required by 2.26.2.5(c).

2.26.12.3 Where Braille is provided it shall conform to the requirements in Table 2.26.12.1.

NOTE (2.26.12): See also ANSI/ICC A117.1, ADAAG, and B44 Appendix E.

2.26.12.4 Identify "HELP" button [see 2.27.1.1.3(b)] and visual indication [see 2.27.1.1.3(c)] with the phone symbol.

SECTION 2.27
EMERGENCY OPERATION AND SIGNALING DEVICES

NOTE (2.27): Additional requirements may be found in the building code.

2.27.1 Car Emergency Signaling Devices

2.27.1.1 Emergency Communications

2.27.1.1.1 A two-way communications means between the car and a location in the building that is readily accessible to authorized and emergency personnel must be provided. Means must be provided to enable two-way voice communication between the machine, the control room, the control space and the interior of the car.

2.27.1.1.2 When the two-way communications location in the building is not staffed 24 h a day, by authorized personnel who can take appropriate action, the means of two-way communications shall automatically be directed within 30 s to an additional on- or offsite location, staffed by authorized personnel, where an appropriate response can be taken.

2.27.1.1.3 The two-way communication means within the car shall comply with the following requirements:

(a) In jurisdictions enforcing NBCC, Appendix E of CAN/CSA B44, or in jurisdictions not enforcing NBCC, ICC/ANSI A117.1.

(b) A push button to actuate the two-way communication means shall be provided in or adjacent

to a car operating panel. The push button shall be visible and permanently identified as "HELP." The identification shall be on or adjacent to the "HELP" button. When the push button is actuated, the emergency two-way communication means shall initiate a call for help and establish two-way communications.

(c) A visual indication on the same panel as the "HELP" push button shall be provided, which is activated by authorized personnel, to acknowledge that two-way communications link has been established. The visual indication shall be extinguished when the two way communication link is terminated.

(d) The two-way communication means shall provide on demand to authorized personnel, information that identifies the building location and elevator number and that assistance is required.

(e) After the call acknowledgement signals are sent [2.27.1.1.3(c)], the two-way voice communications shall be available between the car and authorized personnel.

(f) The two-way communications, once established, shall be disconnected only when authorized personnel outside the car terminate the call.

(g) The two-way communication means shall not use a handset in the car.

(h) The two-way communications shall not be transmitted to an automated answering system. The call for help shall be answered by authorized personnel.

(i) Operating instructions shall be incorporated with or adjacent to the "HELP" button.

2.27.1.1.4 Where the elevator travel is 18 m (60 ft) or more, a two-way voice communication means within the building shall be provided and comply with the following requirements:

(a) The means shall enable emergency personnel within the building to establish two-way voice communications to each car individually. Two-way voice communication shall be established without any intentional delay and shall not require intervention by a person within the car. The means shall override communications to outside of the building.

(b) Two-way voice communications, once established, shall be disconnected only when emergency personnel outside the car terminates the call.

(c) Once the two-way voice communication has been established, the visual indication [see 2.27.1.1.3(c)] within the car shall illuminate. The visual indication shall be extinguished when the two-way communication is terminated.

(d) Operating instructions shall be incorporated with or adjacent to the two-way voice communication outside the car. Instructions shall conform to 2.27.7.3.

2.27.1.1.5 If the emergency communication means is normally connected to the building's main power supply, it shall automatically transfer to an alternate source(s) of power when the normal power supply fails. The alternate source(s) of power (standby, emergency, etc.) shall be capable of providing power for illumination of the visual indication [see 2.27.1.1.3(c)] within the car, and the means of emergency communications for at least 4 h; and the audible signaling device (see 2.27.1.2) for at least 1h.

2.27.1.2 Emergency Stop Switch Audible Signal. When an emergency stop switch (2.26.2.5) is provided, an audible signaling device shall be provided. The audible signaling device shall

(a) have a rated sound pressure rating of not less than 80 dBA nor greater than 90 dBA at 3 m (10 ft)

(b) respond without delay after the switch has been activated

(c) be located inside the building and audible inside the car and outside the hoistway

(d) for elevators with a travel greater than 30 m (100 ft), be duplicated as follows:

(1) one device shall be mounted on the car

(2) a second device shall be placed at the designated level

2.27.2 Emergency or Standby Power System

Where an emergency or standby power system is provided to operate an elevator in the event of normal power supply failure, the requirements of 2.27.2.1 through 2.27.2.5 shall be complied with.

2.27.2.1 The emergency or standby power system shall be capable of operating the elevator(s) with rated load (see 2.16.8), at least one at a time, unless otherwise required by the building code.

2.27.2.2 The transfer between the normal and the emergency or standby power system shall be automatic.

2.27.2.3 An illuminated signal marked "ELEVATOR EMERGENCY POWER" shall be provided in the elevator lobby at the designated level to indicate that the normal power supply has failed and the emergency or standby power is in effect.

2.27.2.4 Where the emergency or standby power system is not capable of operating all elevators simultaneously, requirements of 2.27.2.4.1 through 2.27.2.4.5 shall be conformed to.

2.27.2.4.1 A selector switch(es) marked "ELEVATOR EMERGENCY POWER" in red

lettering a minimum of 5 mm (0.25 in.) in height, which is key-operated or under a locked cover (see 2.27.8), shall be provided to permit the selection of the elevator(s) to operate on the emergency or standby power system. The key shall be Group 3 Security (see 8.1).

2.27.2.4.2 The selector switch(es) positions shall be marked to correspond with the elevator identification number (see 2.29) and a position marked "AUTO."

2.27.2.4.3 Means must be provided adjacent to the selector switch(es) to indicate that the elevator is at the designated level with the doors in the normally open position.

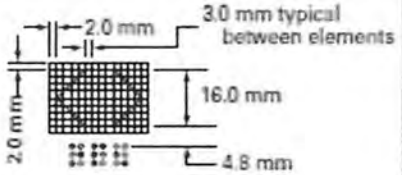
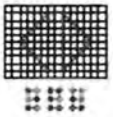
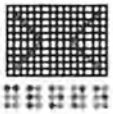
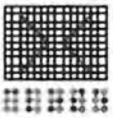
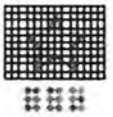
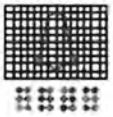
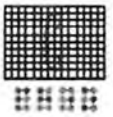
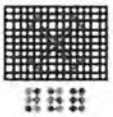
2.27.2.4.4 When the selector switch is in the "AUTO" position, automatic power selection shall be provided, which will return each elevator that is not on designated attendant operation, inspection operation or Phase II In-Car Emergency Operation, one or more at a time, to the recall level. Failure of the selected car to move shall cause power to be transferred to another car.

2.27.2.4.5 The selector switch(es) positions corresponding to the elevator identification numbers (see 2.29.1) shall override the automatic power selection. Operation of the selector switch(es) shall not cause power to be removed from any elevator until the elevator is stopped.

NOTE(2.27.2.4): The selector switch(es) should normally be placed in the "AUTO" position.

2.27.2.5 When the emergency or standby power system is designed to operate only one elevator at a time, the energy absorption means (if required) shall be permitted to be located on the supply side of the elevator power disconnecting means, provided all other requirements of 2.26.10 are conformed to when operating any of the elevators the power might serve. Other building loads, such as power and lights that can be supplied by the emergency or standby power system, shall not be considered as a means of absorbing the regenerated energy for the purposes of conforming to 2.26.10, unless such loads are normally powered by the emergency or standby power system.

Table 2.26.12.1 Symbol Identification

Function	Tactile Symbol	Braille Message Where Provided	Proportions (Open Circles Indicate Unused Dots Within Each Braille Cell)
Door Open		 OP"EN"	
Rear/Side Door Open		 REAR/SIDE OP"EN"	
Door Close		 CLOSE	
Rear/Side Door Close		 REAR/SIDE CLOSE	
Main		 MA"IN"	
Alarm		 AL"AR"M	
Phone		 PH"ONE"	
Emergency Stop		 "ST"OP	

2.27.3 Firefighters' Emergency Operation: Automatic Elevators. See Chapter K1 of Appendix K of the *New York City Building Code*, and replace the words "machine room" with "control room and control space".

2.27.4 Firefighter's Emergency Operation: Nonautomatic Elevators. See Chapter K1 of Appendix K of the *New York City Building Code.*

2.27.5 Firefighter's Emergency Operation: Automatic Elevators with Designated Attendant Operation. See Chapter K1 of Appendix K of the *New York City Building Code.*

2.27.6 Firefighters' Emergency Operation: Inspection Operation

When an elevator that is provided with firefighters' service is on inspection operation (see 2.26.1.4 and 2.26.1.5) or when the hoistway access switch(es) has been enabled [see 2.12.7.3.3(a)], a continuous audible signal, audible at the location where the operation is activated shall sound when the "FIRE RECALL" switch(es) (see 2.27.3.1) is in the "ON" position or when the fire alarm initiating device (see 2.27.3.2) is activated to alert the operator of an emergency. The car shall remain under the control of the operator until removed from inspection operation or hoistway access operation. Inspection operation or hoistway access operation shall take precedence over Phase I Emergency Recall Operation and Phase II Emergency In-Car Operation.

2.27.7 Firefighters' Emergency Operation: Operating Procedures

2.27.7.1 Instructions for operation of elevators under Phase I Emergency Recall Operation shall be incorporated with or adjacent to the "FIRE RECALL" switch at the designated level. The instructions shall include only the wording shown in Fig. 2.27.7.1.

2.27.7.2 A sign containing instructions for operation of elevators under Phase II Emergency In-Car Operation shall be incorporated with or adjacent to the switch in each car and shall be visible only when the cover (2.27.3.3.7) is open. The sign shall include only the wording and graphics shown in Fig. 2.27.7.2, except

(a) for elevators with manually operated doors, the instructions for opening and closing the doors shall be permitted to be replaced with short phrases such as "PUSH DOOR" or "PULL DOOR UP" instructions for returning the car to the recall floor shall be permitted to be expanded to include instructions for closing the door

2.27.7.3 Instructions shall be in letters not less than 3 mm (0.125 in.) in height and shall be permanently installed and protected against removal or defacement.

2.27.7.4 In jurisdictions that enforce the NBCC, a symbol showing a red firefighters' hat on a contrasting background, as shown in Fig. 2.27.3.1.6(h) (figure not to scale), shall be used exclusively to identify elevators that comply with 2.27.3 and additional NBCC requirements. This identification shall be located on the elevator entrance frame or adjacent to it at each emergency recall level. The identification on the entrance frame, or adjacent to it, shall be a minimum of 50 mm (2 in.) in height.

2.27.8 Switch Keys.

See Chapter K1 of Appendix K of the New York City Building Code.

2.27.9 RESERVED

SECTION 2.28
LAYOUT DRAWINGS

2.28.1 Information Required on Layout Drawings

Elevator layout drawings shall, in addition to other data, indicate the following:

(a) the maximum bracket spacing (see 2.23)

(b) the estimated maximum vertical forces on the guide rails on application of the safety or other retarding device (see 2.23 and 2.19.3)

(c) in the case of freight elevators for Class B or C loading (see 2.16.2.2), the horizontal forces on the guiderail faces during loading and unloading, and the estimated maximum horizontal forces in a post-wise direction on the guide-rail faces on the application of the safety device (see 2.23)

(d) the size and linear weight kg/m (lb/ft) of any rail reinforcement, where provided (see 2.23)

(e) the total static and impact loads imposed on machinery and sheave beams, supports, and floors or foundations (see 2.9)

(f) the impact load on buffer supports due to buffer engagement at the maximum permissible speed and load (see 8.2.3)

(g) where compensation tie-down is applied (see 2.21.4.2), the load on the compensation tie-down supports

(h) the total static and dynamic loads from the governor, ropes, and tension system

(i) the horizontal forces on the building structure stipulated by 2.11.11.8 and 2.11.11.9

SECTION 2.29
IDENTIFICATION

2.29.1 Identification of Equipment.

In buildings with more than one elevator, each elevator must be assigned a unique [alphabetical] or numerical identification, a minimum of 50 mm (2 in) in height. The identification number must be applied to the following locations:

(a) Driving machine;

(b) MG and / or transformers;

(c) Controller;

(d) Selector;

(e) Governor;

(f) Main line disconnect switch;

(g) The crosshead or, where there is no crosshead, the car frame, such that it is visible from the top of the car;

(h) The car operating panel, minimum of 13 mm (0.5 in) in height;

(i) Adjacent to or on every elevator entrance at the designated level, minimum of 75 mm (3 in) height; and

(j) Each bank of elevators must be identified by a letter.

2.29.1.1 New York City Identification Number. Each elevator must be assigned a unique numerical identification a minimum of 6 mm (.25 in) in height. The city identification number must be applied to the following locations:

(a) The driving machine;

(b) MG and / or transformers;

(c) Controller;

(d) Main line disconnect switch;

(e) The crosshead or, where there is no crosshead, the car frame, such that it is visible from the top of the car;

(f) The car operating panel (main panel only).

2.29.2 Identification of Floors

Hoistways shall have floor numbers, not less than 100 mm (4 in.) in height, on the hoistway side of the enclosure or hoistway doors.

2.29.3 Main Line Location Signage.

A permanent sign must be located on or adjacent to the Phase I key switch. The sign must indicate the location of the mainline disconnect switches for that bank of elevators. Lettering must be a minimum of 6 mm (0.25 in) high in red or a color contrasting with a red background.

Part 3
Hydraulic Elevators

SCOPE

Part 3 applies to direct-acting hydraulic elevators and the roped-hydraulic types.

NOTE: See also Part 8 for additional requirements that apply to *hydraulic elevators*.

SECTION 3.1
CONSTRUCTION OF HOISTWAYS AND HOISTWAY ENCLOSURES

Hoistways, hoistway enclosures, and related construction shall conform to 2.1.1 through 2.1.6 and 2.29.2, except 2.1.2.3 and 2.1.3.1.2.

3.1.1 Strength of Pit Floor

The pit equipment, beams, floor, and their supports shall be designed and constructed to meet the applicable building code requirements and to withstand the following loads in the manner in which they occur:

(a) the impact load due to car buffer engagement (see 8.2.3 and 3.22.2)

(b) where a plunger gripper, or car, or counterweight safety is furnished, the part of the load transmitted by the application of such gripper(s) or safety(s)

(c) loads imposed by the hydraulic jack

(1) to the cylinder during normal operation

(2) to the buffer when resting on the buffer or during conditions described in 3.1.1(a)

(d) hoist rope up-pull, where applicable, for indirect roped-hydraulic elevators

3.1.2 Floors Over Hoistways

The floor shall be located entirely above the horizontal plane required for hydraulic elevator top car clearance.

When a hydraulic pump unit and/or control equipment is located on a floor over the hoistway, access shall comply with 2.7.3.

SECTION 3.2
PITS

Pits shall conform to 2.2, except 2.2.7.

3.2.1 Minimum Pit Depths Required

The pit depth shall not be less than is required for the installation of the buffers, hydraulic jack, platform guard (apron), and all other elevator equipment located therein, and to provide the minimum bottom clearance and runby required by 3.4.1 and 3.4.2, respectively.

SECTION 3.3
LOCATION AND GUARDING OF COUNTERWEIGHTS

The location and guarding of counterweights, where provided, shall conform to 2.3.

SECTION 3.4
BOTTOM AND TOP CLEARANCES AND RUNBYS FOR CARS AND COUNTERWEIGHTS

Requirement 2.4 does not apply to hydraulic elevators.

3.4.1 Bottom Car Clearance

3.4.1.1 When the car rests on its fully compressed buffers or bumpers, there shall be a vertical clearance of not less than 600 mm (24 in.) between the pit floor and the lowest structural or mechanical part, equipment, or device installed beneath the car platform, including a plunger-follower guide, if provided, except as specified in 3.4.1.2.

3.4.1.2 The 600 mm (24 in.) clearance does not apply to the following:

(a) any equipment on the car within 300 mm (12 in.) horizontally from any side of the car platform

(b) any equipment located on or traveling with the car located within 300 mm (12 in.) horizontally from either side of the car frame centerline parallel to the guide rails

(c) any equipment mounted in or on the pit floor located within 300 mm (12 in.) horizontally from either side of the car frame centerline parallel to the guide rails

3.4.1.3 In no case shall the available refuge space be less than either of the following:

(a) a horizontal area 600 mm X 1 200 mm (24 in. X 47 in.), with a height of 600 mm (24 in.)

(b) a horizontal area 450 mm X 900 mm (18 in. X 35 in.), with a height of 1 070 mm (42 in.)

3.4.1.4 Trenches and depressions or foundation encroachments permitted by 2.2.2 shall not be considered in determining these clearances.

3.4.1.5 When the car is resting on its fully compressed buffers or bumpers, no equipment traveling with the car, including a plunger-follower guide, if provided, shall strike any part of the pit or any equipment mounted therein.

3.4.1.6 Where the vertical clearance outside the refuge space is less than 600 mm (24 in.), that area shall be clearly marked on the pit floor. Markings shall not be required in the area under the apron and guiding means. The marking shall consist of alternating 100 mm (4 in.) diagonal red and white stripes. In addition, a sign with the words "DANGER LOW CLEARANCE" shall be prominently posted on the hoistway enclosure and shall be visible from within the pit and at the entrance to the pit. The sign shall conform to ANSI Z535.2 or CAN/CSA-Z321, whichever is applicable (see Part 9). The sign shall be of such material and construction that the letters and figures stamped, etched, cast, or otherwise applied to the face remain permanently and readily legible.

3.4.2 Minimum Bottom and Top Car Runby

3.4.2.1 Bottom Car Runby. The bottom car runby shall be

(a) not less than 75 mm (3 in.) for operating speed(s) in the down direction up to 0.50 m/s (100 ft/min)

(b) increased from 75 mm (3 in.) to 150 mm (6 in.) in proportion to the increase in operating speed(s) in the down direction from 0.50 m/s (100 ft/min) to 1 m/s (200 ft/min)

(c) a minimum of 150 mm (6 in.) for operating speed(s) in the down direction exceeding 1 m/s (200 ft/min)

3.4.2.2 Car Top Minimum Runby. The top runby of the car shall be

(a) not less than 75 mm (3 in.) for rated speeds up to 0.50 m/s (100 ft/min)

(b) increased from 75 mm (3 in.) to 150 mm (6 in.) in proportion to the increase in rated speed from 0.50 m/s (100 ft/min) to 1 m/s (200 ft/min)

(c) a minimum of 150 mm (6 in.) for rated speeds exceeding 1 m/s (200 ft/min)

3.4.3 Car Top and Bottom Maximum Runby

Neither the top nor the bottom runby of the car shall be more than 600 mm (24 in.).

3.4.4 Top Car Clearance

The top car clearance shall be not less than the sum of the following two items (see Nonmandatory Appendix G):

(a) the top car runby

(b) the height of the refuge space on top of the car (see 3.4.7) or the clearance required for equipment projecting above the car top or crosshead (see 3.4.5), whichever is greater

3.4.5 Equipment Projecting Above the Car Top

When the car reaches its maximum upward movement

(a) all equipment attached to and projecting above the car top, other than equipment mentioned in 3.4.5(b) shall be at least 150 mm (6 in.) from striking any part of the overhead structure or any equipment located in the hoistway

(b) guide-shoe assemblies or gate posts for vertically sliding gates shall not strike any part of the overhead structure

(c) the car crosshead shall have a minimum of 300mm (12 in.) vertical clearance to the horizontal plane described by the lowest point of the overhead structure (see 1.3)

3.4.6 Top Clearance and Bottom Runby of Counterweight

Where a counterweight is provided, the top clearance and the bottom runby of the counterweight shall conform to 3.4.6.1 and 3.4.6.2.

3.4.6.1 Top Clearance. The top clearance shall be not less than the sum of the following:

(a) the bottom car runby

(b) the stroke of the car buffers used

(c) 150 mm (6 in.)

3.4.6.2 Bottom Runby. The bottom runby shall be not less than the sum of the following:

(a) the distance the car can travel above its top terminal landing until the plunger strikes its mechanical stop

(b) 150 mm (6 in.)

The minimum runby specified shall not be reduced by rope stretch (see 3.22.2 prohibiting counterweight buffers).

3.4.7 Refuge Space on Top of Car Enclosure

An unobstructed horizontal area of not less than 0.51 m2 (5.49 ft2) shall be provided on top of the car enclosure for refuge space. It shall measure not less than 600 mm (24 in.) on any side. The area shall be permitted to include the space utilized for top emergency exit [see 2.14.1.5.1(f)]. The minimum vertical distance in the refuge area between the top of the car enclosure and the horizontal plane described by the lowest point of the overhead structure or other obstruction shall be not less than 1 100 mm (43 in.) when the car has reached its maximum upward movement.

3.4.8 Vertical Clearances With Underslung Car Frames

Where an underslung car frame is used, the clearances between the overhead car rope dead-end

hitch, or overhead car sheave, and the portions of the car structure vertically below them, when the car floor is level with the top terminal landing, shall be not less than the following:

(a) where no counterweight is used, the sum of the following items:

(1) the car top runby

(2) 200 mm (8 in.)

(b) where a counterweight is used, the sum of the following items:

(1) the bottom counterweight runby (see 3.4.6.2)

(2) 150 mm (6 in.)

SECTION 3.5
HORIZONTAL CAR AND COUNTERWEIGHT CLEARANCES

The horizontal car and counterweight clearances shall conform to 2.5.

SECTION 3.6
PROTECTION OF SPACES BELOW HOISTWAY

Requirement 2.6 does not apply to hydraulic elevators. Where there is space below the hoistway that is accessible to persons, requirements of 3.6.1 through 3.6.4 shall be conformed to.

3.6.1 Jack-Supporting Structure

The hydraulic jack shall be supported by a structure of sufficient strength to support the entire static load at rated capacity that is capable of being imposed upon it.

The design factor of safety shall be not less than 5, based on ultimate strength for static loads transmitted.

3.6.2 Car and Counterweight Safety Actuation.

Where the space referred to in 3.6 falls underneath the car or counterweight and/or its guides, the car and counterweight must be provided with a safety device.

3.6.3 Buffer Types

The car shall be provided with buffers of either of the following types:

(a) oil buffers conforming to 3.22.1

(b) spring buffers of a design that will not be fully compressed when struck by a car with rated load at the operating speed in the down direction (see 3.22.1)

3.6.4 Buffer Supports

Car buffer supports shall be provided that will withstand, without permanent deformation, the impact resulting from buffer engagement by a car with rated load at the operating speed in the down direction. The design factor of safety shall conform to 2.22.4.3.

SECTION 3.7
MACHINERY SPACES, MACHINE ROOMS, CONTROL SPACES, AND CONTROL ROOMS

A machinery space outside the hoistway containing a hydraulic machine and a motor controller shall be a machine room.

3.7.1 Machinery spaces, machine rooms, control spaces, and control rooms must conform to the requirements of Sections 2.7.1 through 2.7.7 and 2.7.9. Hydraulic machines and controllers are not permitted in the hoistway or pit.

3.7.1.1 This paragraph shall conform to the requirements of 2.7.5.1.1, 2.7.5.2, and 2.7.5.2.4, except the words "elevator driving machine brake or an emergency brake" shall be replaced with the words "hydraulic machine."

3.7.1.2 This paragraph shall conform to the requirements of 2.7.5.1.1 and 2.7.5.1.2(a), except the words "elevator driving machine brake, emergency brake" shall be replaced with the words "hydraulic machine."

3.7.1.3 This paragraph shall conform to the requirements of 2.7.5.1.2(b), except 3.7.1.3 shall be worded as follows: "for a roped-hydraulic elevator support not less than twice the unbalanced weight of the system with no load and up to rated load in the car and all suspension ropes in place; and for a direct-acting hydraulic elevator support not less than twice the weight of the car with rated load."

3.7.1.4 This paragraph shall conform to the requirements of 2.7.5.1.2(c), 2.7.5.3.1, and 2.7.5.5(a), except the words "elevator driving machine motor and brake" shall be replaced with the words "hydraulic machine."

3.7.1.5 This paragraph shall conform to the requirements of 2.7.5.1.2(e) and 2.7.5.2.1(b)(4), except the words "before maintaining or inspecting brake, emergency brake" shall be replaced with the words "before maintaining or inspecting the hydraulic machine."

3.7.1.6 This paragraph shall conform to the requirements of 2.7.5.2.1(b)(1) and 2.7.5.5(d), except the words "115% of rated speed" shall be replaced with the words "operating speed in the down direction."

3.7.1.7 This paragraph shall conform to the requirements of 2.7.6.3.1, except the words "electric driving machine" shall be replaced with the words "hydraulic machine."

3.7.1.8 This paragraph shall conform to the requirements of 2.7.6.4, except it shall be worded as follows: "Where hydraulic machine, or an elevator motion controller or motor controller is located in the hoistway or pit, means necessary for tests that require movement of the car, shall be provided and arranged so that they can be operated from outside the hoistway and shall conform to 2.7.6.4.1 through 2.7.6.4.2. These means are also permitted to be used by elevator personnel for passenger rescue."

3.7.1.9 This paragraph shall conform to the requirements of 2.7.6.4.1, except the first paragraph shall be worded as follows: "Where direct observation of the elevator or ropes in the case of a roped-hydraulic elevator is not possible from the location of the means necessary for tests that require movement of the car, display devices or the equivalent shall be provided. They shall be visible from the location of the means and shall convey the following information about the elevator simultaneously."

3.7.1.10 Requirement 2.7.6.4.3 does not apply to hydraulic elevators.

SECTION 3.8

ELECTRICAL EQUIPMENT, WIRING, PIPES, AND DUCTS IN HOISTWAY, MACHINERY SPACES, MACHINE ROOMS, CONTROL SPACES, AND CONTROL ROOMS

Electrical equipment, wiring, pipes, and ducts shall conform to 2.8.

SECTION 3.9

MACHINERY AND SHEAVE BEAMS, SUPPORTS, AND FOUNDATIONS

Machinery and sheave beams, supports, and foundations shall conform to 2.9.

SECTION 3.10

GUARDING OF EXPOSED AUXILIARY EQUIPMENT

Guarding of exposed auxiliary equipment shall conform to 2.10.

SECTION 3.11

PROTECTION OF HOISTWAY LANDING OPENINGS

Protection of hoistway landing openings shall conform to 2.11, except as excluded by 3.11.1.

3.11.1 Emergency Doors

Emergency doors, where required by 2.11.1, are required only when car safeties are provided.

SECTION 3.12

HOISTWAY DOOR LOCKING DEVICES, CAR DOOR OR GATE ELECTRIC CONTACTS, AND HOISTWAY ACCESS SWITCHES

3.12.1 Hoistway Door Locking Devices and Electric Contacts, and Hoistway Access Switches

Hoistway door locking devices and electric contacts, and hoistway access switches shall conform to 2.12.

3.12.2 Car Door or Gate Electric Contacts and Car Door Interlocks

Car door or gate electric contacts and car door interlocks shall conform to 2.14.4.2.

SECTION 3.13

POWER OPERATION, POWER OPENING, AND POWER CLOSING OF HOISTWAY DOORS AND CAR DOORS OR GATES

Power operation, power opening, and power closing of hoistway doors and car doors or gates shall conform to 2.13.

SECTION 3.14

CAR ENCLOSURES, CAR DOORS AND GATES, AND CAR ILLUMINATION

Car enclosures, car doors and gates, and car illumination shall conform to 2.14.

SECTION 3.15 CAR FRAMES AND PLATFORMS

3.15.1 Requirements

3.15.1.1 Direct-acting hydraulic elevators shall be provided with car frames and platforms conforming to 2.15, subject to the modification hereinafter specified. (See 3.18.2.3 for connection between plunger and platform or car frame.)

A car frame shall not be required, provided 3.15.1.1.1 through 3.15.1.1.6 are conformed to.

3.15.1.1.1 The platform frame shall be of such design and construction that all eccentric loads are carried through the structure and plunger attachment into the hydraulic jack (see 3.18.2.3).

3.15.1.1.2 The platform frame shall be guided on each guide rail by single-guiding members attached to the frame.

3.15.1.1.3 The platform frame shall be designed to withstand the forces resulting from the class of loading for which the elevator is designed without exceeding the stresses and deflections in 2.15.10 and 2.15.11 (see 8.2.2.6).

3.15.1.1.4 The hydraulic jack connection to the car shall be designed to transmit the full eccentric moment into the plunger with a factor of safety of not less than 4 (see 3.18.2.3).

3.15.1.1.5 The hydraulic jack shall be designed to withstand the stresses due to bending during the loading and unloading of the platform based on the type of loading for which the elevator is designed (see 8.2.8.1.2).

3.15.1.1.6 Car safeties shall not be provided.

3.15.1.2 Roped-hydraulic elevators shall be provided with car frames and platforms conforming to 2.15.

3.15.2 Maximum Allowable Stresses and Deflections in Car Frame and Platform Members

3.15.2.1 Direct-Acting Hydraulic Elevators. The stresses and deflections in car frame and platform members and their connections, based on the static load imposed upon them, shall be not more than those permitted by 2.15, provided that the maximum stresses in the car frame uprights that are normally subject to compression shall conform to 8.2.9.1.1.

3.15.2.2 Roped-Hydraulic Elevators. The stresses and deflection in car frame and platform members and their connections, based on the static load imposed upon them, shall be not more than those permitted by 2.15, and shall conform to 8.2.2.

3.15.3 Calculations of Stresses and Deflections in Car Frame and Platform Members

3.15.3.1 Direct-Acting Hydraulic Elevators. The calculations of the stresses and deflections in side-post car frame and platform members shall be based on the formulas and data in 8.2.9.

For cars with corner-post or sub-post car frames, the formulas and specified methods of calculations do not generally apply and shall be modified to suit the specific conditions and requirements in each case.

3.15.3.2 Roped-Hydraulic Elevators. The calculations of the stresses and deflections in side-post car frame and platform members shall be based on the formulas and data in 8.2.2.

For cars with corner-post or sub-post car frames, or where the rope hitches are not on the crosshead, the formulas and specified methods of calculations do not generally apply and shall be modified to suit the specific conditions and requirements in each case.

SECTION 3.16
CAPACITY AND LOADING

3.16.1 Minimum Rated Load for Passenger Elevators

The requirements of 2.16.1 shall apply.

3.16.2 Minimum Rated Load for Freight Elevators

The requirements of 2.16.2 shall apply, except, in 2.16.2.2.4(c) the wording "hydraulic jack, hydraulic machine, pressure piping and fittings" shall be substituted for the wording "driving-machine motor, brake and traction relation."

3.16.3 Capacity and Data Plates

The requirements of 2.16.3 shall apply, except:

(a) requirement 2.16.3.2.1(a) shall not apply to hydraulic elevators.

(b) on data plates (see 2.16.3.2.2), the weight of the plunger is not to be included in the weight of the complete car, even though it is attached. The plunger weight is to be indicated independently. The operating speed in the down direction shall also be indicated.

3.16.4 Carrying of Passengers on Freight Elevators

The requirements of 2.16.4 shall apply, except 2.16.4.3 shall not apply to hydraulic elevators.

3.16.5 Signs Required in Freight Elevators

The requirements of 2.16.5 shall apply.

3.16.6 Overloading of Freight Elevators

The requirements of 2.16.6 shall apply, except 2.16.6(b) shall not apply to hydraulic elevators.

3.16.7 One-Piece Loads Exceeding the Rated Load

Requirement 2.16.7 shall not apply. One-piece loads exceeding rated load shall not be carried on hydraulic elevators.

3.16.8 Additional Requirements for Passenger Overload

Requirement 2.16.8 shall not apply. Hydraulic passenger elevators shall be designed based on 100% of rated load.

3.16.9 Special Loading Means

The requirements of 2.16.9 shall apply.

SECTION 3.17
CAR AND COUNTERWEIGHT SAFETIES AND PLUNGER GRIPPER

3.17.1 Car Safeties

Car safeties shall be provided for roped-hydraulic elevators and shall be permitted to be provided for direct acting hydraulic elevators. When provided, car safeties shall conform to 2.17, and to 3.17.1.1 through 3.17.1.3.

3.17.1.1 The slack-rope device required by 3.18.1.2 shall be permitted to be an additional means of activating the car safety on roped-hydraulic elevators using hydraulic jacks equipped with plungers. The slack-rope device required by 3.18.1.2.7 shall be an additional means of activating the car safety on roped-hydraulic elevators using hydraulic jacks equipped with pistons.

3.17.1.2 The safety shall be of a type that can be released only by moving the car in the up direction. To return a car to normal operation after a safety set, the car shall be moved hydraulically in the up direction. For repairs of obvious or suspected malfunction, the car shall be permitted to be raised by other means capable of holding the entire car weight. Prior to releasing the other means, the car shall be run hydraulically in the up direction.

If an auxiliary pump is used to move the car in the up direction to release the safeties, it shall

(a) have a relief valve that limits the pressure to not more than 2.3 times the working pressure

(b) be connected between the check valve or control valve and the shutoff valve

3.17.1.3 The switches required by 2.18.4.1 shall, when operated, remove power from the hydraulic machine motor and control valves before or at the time of application of the safety.

3.17.2 Counterweight Safeties

Counterweight safeties, where provided in accordance with 3.6.2, shall conform to 2.17, provided that safeties shall be operated as a result of the breaking or slackening of the counterweight suspension ropes, irrespective of the rated speed of the elevator.

3.17.3 Plunger Gripper

A plunger gripper shall be permitted to be provided for direct-acting hydraulic elevators using hydraulic jacks equipped with plungers. A plunger gripper shall be capable of stopping and holding the car with its rated load from the actual measured tripping speed per Table 2.18.2.1 and shall conform to 3.17.3.1 through 3.17.3.9. In Table 2.18.2.1 the words "rated speed" shall be replaced by "operating speed in the down direction."

3.17.3.1 Limits of Application. A plunger gripper shall be permitted, provided that

(a) the external pressure applied to the plunger by the device is symmetrically distributed at locations around the circumference of the plunger. The resulting stress in the plunger shall not exceed 67% of the yield strength at any point of the plunger.

(b) the external pressure applied to the plunger by the device does not exceed 67% of the value that will cause local buckling. Where the external pressure is applied over substantially the full circumference of the plunger, the maximum value shall be permitted to be determined by 8.2.8.6.

(c) during the application, the plunger and the plunger gripper are capable of withstanding any vertical forces imposed upon them, and transfer such forces to the supporting structure. During the application of the device, any loading on the plunger shall not damage the cylinder.

(d) power is removed from the hydraulic machine before or at the time of application.

3.17.3.2 Means of Application. A plunger gripper shall mechanically grip the plunger.

3.17.3.2.1 Hydraulic means are permitted to be used to hold the gripper in the retracted position. A loss of hydraulic pressure or fluid causing uncontrolled downward motion is permitted to be used to apply the plunger gripper.

3.17.3.2.2 When electrical means are used to actuate the gripper, the following shall apply:

(a) The plunger gripper shall be fully operational during a primary electrical system power failure.

(b) In the event of the failure of any single mechanically operated switch, contactor, relay, solenoid, or any single solid-state device, or a software system failure, or the occurrence of a single ground, the elevator shall not be permitted to restart after a normal stop.

3.17.3.3 Release

3.17.3.3.1 The plunger gripper shall be released by establishing at least no-load static pressure on the hydraulic system, or by other means capable of holding the entire car weight.

3.17.3.3.2 The elevator shall not be permitted to be restarted without establishing at least no-load static pressure on the hydraulic system.

3.17.3.4 Clearance. In the normally retracted position of the plunger gripper, any contact between the gripping surface and the plunger shall not cause degradation of the plunger or premature degradation of the gripping surface.

3.17.3.5 Deceleration. The deceleration of the elevator upon actuation of the plunger gripper shall comply with the following criteria:

(a) The average deceleration rate at rated load shall be not less than 0.1 gravity nor more than 1.0 gravity. (See Nonmandatory Appendix P for minimum and maximum stopping distances.)

(b) Any peak deceleration rate in excess of 2.0 gravity shall have a duration of not greater than 0.04s.

3.17.3.6 Minimum Factors of Safety and Stresses of Safety Parts and Rope Connections

3.17.3.6.1 Compliance with 2.17.12.1 and 2.17.12.6 is required. Springs shall be permitted in the operation of the plunger gripper. The maximum fiber stress in the spring shall not exceed 85% of the elastic limit in the material at any time. The factor of safety of wire ropes, if provided in the construction of the plunger gripper, shall not be less than 5. Tiller-rope construction shall not be used.

3.17.3.6.2 Leaf and roller chains, if provided in the construction of the plunger gripper, shall conform to ASME B29.

3.17.3.6.3 The factors of safety shall be based upon the maximum stresses developed in the parts during operation of the gripper when stopping rated load from the tripping speed (see 3.17.3) of the speed-measuring device.

3.17.3.6.4 Rope or tape used to drive an electrical encoder is not required to comply with the requirements for governor rope.

3.17.3.6.5 If a governor is used, it must comply with 2.18.5.1, except lang-lay construction is permitted and the diameter is permitted to be less than 9.5 mm (0.375 in.).

3.17.3.7 Corrosion-Resistant Bearings in Plunger Gripper and Gripper Operating Mechanisms. Compliance with 2.17.13 is required.

3.17.3.8 Marking Plates for a Plunger Gripper. A permanent marking plate shall be securely attached to each plunger gripper so as to be readily visible, and shall be marked in a legible and permanent manner with letters and symbols not less than 6 mm (0.25 in.) in height, indicating

(a) that it is a plunger gripper.

(b) the maximum operating speed in the down direction in m/s (ft/min) for which the plunger gripper shall be permitted to be used.

(c) the maximum load in Newtons (pounds) for which the gripper is designed and installed to stop and sustain.

(d) the manufacturer's name or trademark and identification number of the device.

(e) space for date of acceptance test. Date to be permanently marked following test.

(f) the diameter and minimum wall thickness of the plunger for which the device is applicable.

3.17.3.9 Flexible Hoses. Flexible hoses used for the operation of a plunger gripper shall be permitted, provided that their failure does not cause an uncontrolled descent. These flexible hoses are not required to meet the requirements of 3.19.3.3.

SECTION 3.18
HYDRAULIC JACKS

3.18.1 Hydraulic Jack and Connections

Where multiple hydraulic jacks are used, they shall be hydraulically connected to form a single hydraulic system.

3.18.1.1 Direct-Acting Hydraulic Elevators. The driving member of the hydraulic jack shall be attached to the car frame or car platform with fastenings of sufficient strength to support that member with a factor of safety of not less than 4 and shall be capable of withstanding, without damage, any forces resulting from a plunger stop as described in 3.18.4.2.

Any plunger or cylinder head mechanical connector or connection shall conform to 3.18.2.1, 3.18.2.4, 3.18.4, and 3.18.5.

3.18.1.2 Roped-Hydraulic Elevator

3.18.1.2.1 The driving member of the hydraulic jack shall be vertical. Cars shall be suspended with not less than two wire ropes per hydraulic jack in conformance with 2.15.13 and 2.20.

3.18.1.2.2 Where three or more hydraulic jacks are utilized, one rope per hydraulic jack shall be permitted to be used. Should one hydraulic jack become disconnected, the remaining hydraulic jacks shall be capable of supporting the load without exceeding allowable car frame stresses or hydraulic jack stress. The ropes shall conform to 2.15.13 and 2.20.

3.18.1.2.3 Ropes passing through seals fixed in cylinder heads shall be permitted to have a clear plastic coating applied in order to seal properly and facilitate rope inspection.

3.18.1.2.4 The roping ratio that relates the driving member of the hydraulic jack speed to the car speed shall not exceed 1:2.

3.18.1.2.5 Sheaves used to transfer load from the hydraulic jack to the car frame through wire ropes shall conform to 2.24.2, 2.24.3, and 2.24.5.

3.18.1.2.6 Means shall be provided to prevent the ropes, if slack, from leaving the sheave grooves.

3.18.1.2.7 A slack-rope device with an enclosed manually reset switch shall be provided that shall cause the electric power to be removed from the hydraulic machine pump motor and the control valves should any rope become slack.

3.18.1.2.8 The traveling sheave shall be attached with fastenings having a minimum factor of safety of 4, based upon the ultimate strength of the material used. The load to be used in determining the factor of safety shall be the resultant of the maximum tensions

in the ropes leading from the sheave with the elevator at rest and with rated load in the car.

3.18.2 Plungers

3.18.2.1 Material. The plunger and connecting couplings for the plunger shall be of materials in accordance with 3.18.2.1.1 and 3.18.2.1.2.

3.18.2.1.1 Tensile, compressive, bending, and torsional loading shall have a factor of safety of not less than 5, based on ultimate strength.

3.18.2.1.2 Pressure loadings shall have a factor of safety not less than that calculated per 8.2.8.5.

3.18.2.2 Plunger Design. Plungers made of steel shall be designed and constructed in compliance with the applicable formula in 8.2.8.1 for calculation of elastic stability, bending, and external pressure. For other materials, the appropriate modulus of elasticity must be utilized Plungers subject to internal pressure shall also be designed and constructed in accordance with cylinder design formula in 8.2.8.2.

3.18.2.3 Plunger Connection

3.18.2.3.1 When the hydraulic jack is not subjected to eccentric loading, it shall

(a) carry in tension the weight of the plunger with a factor of safety not less than 4

(b) restrict total vertical movement to less than 20% of the buffer stroke, where vibration damping means are provided

3.18.2.3.2 In addition, when the hydraulic jack is subjected to eccentric loading, the following shall also apply:

(a) The plunger connection to the car shall also be so designed and constructed as to transmit the full eccentric moment into the plunger with a factor of safety not less than 4.

(b) The plunger and the plunger connection to the car shall also be so designed and constructed that the total vertical deflection of the loading edge of the car platform due to eccentric loading of the car shall not exceed 19 mm (0.75 in.).

3.18.2.4 Plunger Joints. Plungers composed of more than one section shall have joints designed and constructed to

(a) carry in tension the weight of all plunger sections below the joint with a factor of safety of not less than 4

(b) transmit in compression the gross load on the plunger with a factor of safety of not less than 5, based on ultimate strength

(c) withstand without damage any forces resulting from a plunger stop as described in 3.18.4.2

(d) for eccentric loading, the joints shall conform to 3.18.2.2 and 3.18.2.3

3.18.2.5 Plungers Subject to External Pressure. For plungers subjected to external pressure, the working pressure shall be not greater than indicated by the formula in 8.2.8.1.3.

3.18.2.6 Plunger Heads Subject to Fluid Pressure. Heads of plungers subject to fluid pressure shall conform to 3.18.3.6.

3.18.2.7 Plunger-Follower Guide

3.18.2.7.1 A plunger-follower guide shall be permitted to be used, provided it is arranged so that the elevator is always in a position where the unsupported length of the plunger conforms to the "maximum free length" as defined in 8.2.8.1. If this length is exceeded, upward movement of the car shall immediately stop, and it shall be permitted to allow the car to return nonstop to the lowest landing; power-operated doors shall open, and electric power shall be removed from the motor and the control valve. After not less than 15 s nor more than 60 s, the doors shall close in compliance with 2.11.3. A manual reset of the means shall be required before the elevator is returned to service. The in-car door open button shall remain operative.

Plunger-follower guides shall be designed and constructed to comply with all applicable requirements of 2.15.

3.18.2.7.2 Telescopic plungers shall have each plunger section internally guided. If more than two movable sections are used, external guides shall be provided for each plunger section. External guides shall be designed and constructed to comply with all applicable requirements of 2.15.

3.18.3 Cylinders

3.18.3.1 Material. The cylinder and connecting couplings for the cylinder shall be made of materials in compliance with 3.18.3.1.1 and 3.18.3.1.2.

3.18.3.1.1 For tensile, compressive, bending, and torsional loading, the cylinder and connecting couplings shall have a factor of safety of not less than 5, based on ultimate strength.

3.18.3.1.2 For pressure calculations, the cylinder and connecting coupling shall have a factor of safety not less than that calculated as specified in 8.2.8.5.

3.18.3.2 Cylinder Design. Cylinders shall be designed and constructed in accordance with the formula in 8.2.8.2.

3.18.3.3 Clearance at Bottom of Cylinder. Clearance shall be provided at the bottom of the cylinder so that the bottom of the plunger will not strike the safety bulkhead of the cylinder when the car is resting on its fully compressed buffer (see 3.22.1).

3.18.3.4 Safety Bulkhead. Cylinders buried in the ground shall be provided with a safety bulkhead having an orifice of a size that would permit the car to descend at a speed not greater than 0.075 m/s (15 ft/min), nor less than 0.025 m/s (5 ft/min). A space of not less than 25 mm (1 in.) shall be left between the welds of the safety bulkhead and the cylinder head. Safety bulkheads shall conform to 3.18.3.6.

A safety bulkhead shall not be required where a double cylinder is used and where both inner and outer cylinders conform to 3.18.3.

3.18.3.5 Cylinder Packing Heads. Cylinder packing heads shall conform to appropriate requirements of 3.18.4 and 8.2.8.3.

3.18.3.6 Closed Cylinder and Plunger Heads. Closed heads of cylinders, and heads of plungers subject to fluid pressure, shall conform to 3.18.3.6.1 through 3.18.3.6.3.

3.18.3.6.1 Closed Cylinder Heads. Closed heads of cylinders shall be only of dished seamless construction, concave to pressure, except if the bottom of the cylinder is supported, and if the cylinder is not buried.

3.18.3.6.2 Design Formulas. They shall be designed and constructed in accordance with the applicable formulas in 8.2.8.3, provided that steel heads shall in no case have a thickness less than that required for the adjoining shell.

3.18.3.6.3 Dished Seamless Heads, Convex to Pressure. Dished seamless heads, convex to pressure, if used on plungers, shall have a maximum allowable working pressure of not more than 60% of that for heads of the same dimensions with pressure on the concave side.

3.18.3.7 Collection of Oil Leakage. Means shall be provided to collect for removal any oil leakage from the cylinder head seals or packing gland. The amount collected before removal shall not exceed 19 L (5 gal).

3.18.3.8 Cylinders Buried in the Ground

3.18.3.8.1 Cylinders buried in the ground shall be protected from corrosion due to galvanic or electrolytic action, salt water, or other underground conditions.

3.18.3.8.2 The methods specified in 3.18.3.8.3 shall be considered as acceptable, provided that they

(a) are designed and installed with means for monitoring and maintaining them in accordance with recognized industry standards applicable to the methods

(b) are effective for specific conditions where the cylinder is installed

(c) provide means for checking ongoing compliance with 3.18.3.8.1

3.18.3.8.3 The following are the specified methods:

(a) the cylinder shall be constructed of a material that is immune to the stated conditions; or

(b) the cylinder shall be completely covered or encased in a material that completely surrounds the exterior surface and is immune to the stated conditions. If the space between the protective casing and the cylinder is empty, the casing must be designed to withstand a static head of water from ground level to the bottom of the cylinder, based on the manufacturer's rating of the material used; or

(c) the cylinder shall be protected by a monitored cathodic protection system; or

(d) the cylinder shall be protected by a means that will provide an immunity level not less than that provided by the above methods for the stated conditions.

3.18.3.9 Means for Relief of Air or Gas. Cylinders shall be provided with a means to release air or other gas.

3.18.4 Plunger Stops

3.18.4.1 Metal Stops and/or Other Means. Metal stops and/or other means shall be provided at one end of the plunger and at the packing head end of the cylinder to prevent the plunger from traveling beyond the limits of the cylinder.

The metal stops and/or other means shall be so designed and constructed as to stop the plunger traveling in the up direction at maximum speed under full load pressure, should the normal terminal stopping device (see 3.25.1) fail to operate, or at a reduced speed when a terminal speed-reducing device is provided as required by 3.25.2. No running test onto the stop ring is required [see 8.10.3.2.2(s)].

3.18.4.2 Hydraulic System. The connections to the hydraulic machine, plunger, plunger connection, couplings, plunger joints, cylinder, cylinder connecting couplings, or any other parts of the hydraulic system shall be designed and constructed to withstand, without damage, a plunger stop in accordance with 3.18.4.1.

3.18.5 Welding

All welding of hydraulic jack components shall conform to 8.8.

SECTION 3.19
VALVES, PRESSURE PIPING, AND FITTINGS

3.19.1 Materials and Working Pressures

3.19.1.1 Materials. Pressure piping, valves, fittings, and mufflers shall be designed and made of materials having properties such that a factor of safety not less than that calculated per 8.2.8.5 is achieved.

Piping and fittings of a grade not subjected to listed/certified testing (ASTM or equivalent) shall not be used for hydraulic pressure piping and fittings.

NOTE (3.19.1.1): Examples of two acceptable pipe standards are ASTM A106 and ASTM A 53, Type E or S.

3.19.1.2 Working Pressures. The working pressure (see 1.3) shall not exceed the component rated pressure (see 1.3) of the pipes, valves, mufflers, and fittings used on the pressure side of the hydraulic system.

3.19.1.3 Component Proof Test. For elongations greater than or equal to 10%, the component design shall be substantiated either in accordance with 8.2.8.5 or by an unrestrained proof test of 5 times the component rated pressure without resulting in fracture. For elongations of less than 10%, the test value shall be 1.5 times the value indicated by 8.2.8.5 multiplied by the component rated pressure.

3.19.1.4 Component Markings. Valves, fittings, and mufflers shall be pressure rated, and shall bear the manufacturer's name or trademark by which the organization that manufactured the product can be identified, and identification symbols to indicate the materials and service designations for which the manufacturer's rating applies.

NOTE: Valves and fittings rated for a different system may be used in hydraulic elevator systems when substantiated in accordance with the elevator code.

3.19.2 Pressure Piping

3.19.2.1 Wall Thickness. The minimum wall thickness shall conform to 8.2.8.4.

3.19.2.2 Threading. Pipe lighter than Schedule 40 shall not be threaded.

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

3.19.2.4 Pipe, Tubing, or Fittings. Pipe, tubing, or fittings shall be permitted to be used for instrument or control purposes and shall conform to ASME B31.1, para. 122.3.

3.19.2.5 Hydraulic Pipeline Identification. A marking shall be applied, to accessible piping that is located outside the elevator machine room or hoistway, stating "Elevator Hydraulic Line" in letters that are at least 19 mm (0.75 in.) high in a contrasting color. The marking shall be visible after installation and applied at intervals not greater than 3 000 mm (120 in.).

3.19.2.6 Where the hydraulic machine is located in the hoistway and any piping, tubing, or fitting permitted by 3.19.2.4 is located outside the hoistway, means shall be provided to

(a) protect the specified piping, tubing, or fittings from damage, which would cause unsafe elevator operation; or

(b) prevent uncontrolled movement of the elevator in the event of failure of the specified piping, tubing, or fittings.

3.19.3 Connections and Fittings

3.19.3.1 Connections. All piping connections shall be of the welded, grooved, threaded, or bolted flange type. Threads of valves, piping, and fittings shall conform to the requirements of ASME B1.20.1, ASME B1.20.3, or ASME B1.20.4. Hydraulic tube fittings shall conform to SAE J514.

3.19.3.2 Grooved Pipe Fittings

3.19.3.2.1 Grooved pipe fitting assemblies shall be permitted to be used for hydraulic connections. They shall be installed in conformance with the manufacturer's specifications. They shall be installed in locations that will permit disassembly and inspection of all of their component parts.

3.19.3.2.2 Grooved pipe fittings shall be so designed and constructed that failure of a sealing element will not permit separation of the parts connected. The devices or means used for preventing the separation of the parts connected shall be removable only with the use of tools. Devices or means removable with hand operated quick-release levers or toggles are prohibited.

3.19.3.3 Flexible Hydraulic Connections. Flexible hose and fitting assemblies, and flexible couplings, shall be permitted to be used for hydraulic connections. Where installed between the check valve or control valve and the cylinder, they shall conform to 3.19.3.3.1 and 3.19.3.3.2.

3.19.3.3.1 Flexible hose and fitting assemblies shall

(a) not be installed within the hoistway, nor project into or through any wall. Installation shall be accomplished without introducing any twist in the hose, and shall conform with the minimum bending radius of SAE 100, R2 type, high pressure, steel wire reinforced, rubber covered hydraulic hose specified in SAE J517.

(b) have a bursting strength sufficient to withstand not less than 10 times working pressure (see 1.3). They

shall be tested in the factory or in the field prior to installation at a pressure of not less than 5 times working pressure and shall be marked with date and pressure of test.

(c) conform to the requirements of SAE 100, R2 type hose specified in SAE J517 and be compatible with the fluid used.

(d) be of nonreusable-type fittings.

(e) be permanently labeled/marked, indicating

(1) the name or trademark by which the manufacturer of the hose and fittings can be identified

(2) the type of hose and fitting

(3) the minimum factory test pressure

(4) the minimum bending radius of hose

(5) the date of installation

(6) the inspection procedure

(7) the name of elevator contractor

(f) have a line overspeed valve conforming to 3.19.4.7.

3.19.3.3.2 Flexible couplings are permitted for hydraulic connections. Such couplings shall be so designed and constructed that failure of the sealing element will not permit separation of the connected parts. The devices or means used to prevent the separation of the connected parts shall be removable only with the use of tools. Any devices or means that are removable with hand-operated quick-released levers are prohibited.

3.19.4 Valves

3.19.4.1 Shutoff Valve. A manually operated shutoff valve shall be provided between the hydraulic machines and the hydraulic jack and shall be located outside the hoistway and adjacent to the hydraulic machine.

Where the hydraulic machine is located in the hoistway, the manually operated shutoff valve shall be permitted to be located inside the hoistway, provided that it is accessible from outside the hoistway to elevator personnel only (see 8.1).

3.19.4.2 Pump Relief Valve

3.19.4.2.1 Each pump or group of pumps shall be equipped with one or more relief valve(s) conforming to the following requirements:

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

(b) 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 50% above the working pressure. Two or more relief valves shall be permitted to be used to obtain the required capacity.

(c) Sealing. Relief valves shall be sealed after being set to the correct pressure.

3.19.4.2.2 No relief valve is required for centrifugal pumps driven by induction motors, provided the shut-off, or maximum pressure that the pump can develop, is not greater than 135% of the working pressure at the pump.

3.19.4.3 Check Valve. A check valve shall be provided and shall be so installed that it will hold the elevator car with rated load at any point when the pump stops and the down valves are closed or the maintained pressure drops below the minimum operating pressure.

3.19.4.4 Manual Lowering Valve. A manually operated valve, located on or adjacent to the control valves, shall be provided and identified, which permits lowering the car at a speed not exceeding 0.10 m/s (20 ft/min). This valve shall be so marked to indicate the lowering position. Where the hydraulic machine is located in the hoistway, the manual lowering valve shall only be accessible to elevator personnel from outside the hoistway (see 8.1).

3.19.4.5 Pressure Gauge Fittings. A pressure gauge fitting with shutoff valve shall be provided on jack side of the check valve or immediately adjacent to the hydraulic control valve. Where the hydraulic machine is located in the hoistway, the pressure gauge fittings shall only be accessible to elevator personnel from outside the hoistway (see 8.1).

3.19.4.6 Type Tests, Certification, and Marking Plates for Control Valves

3.19.4.6.1 Each type or model and make of hydraulic control valve shall be subjected to the engineering tests and to the certification process as specified in 8.3.5.

3.19.4.6.2 Hydraulic control valves shall be plainly marked in a permanent manner with the following information:

(a) certifying organization's name or identifying symbol

(b) the name, trademark, or file number by which the organization that manufactured the product can be identified

(c) statement of compliance with ASME A17.1 or CSA B44

(d) type designation

(e) component rated pressure

(f) electrical coil data

3.19.4.7 Overspeed Valves. When provided, overspeed valves and their connections and attachments shall conform to 3.19.4.7.1 through 3.19.4.7.6.

3.19.4.7.1 Overspeed Valve Tests. Each type or model of overspeed valve shall be subjected to the engineering tests specified in 8.3.9.

3.19.4.7.2 Marking of Overspeed Valves. The overspeed valves shall be plainly marked in a permanent manner with the following:

(a) the name or trademark by which the organization that manufactured the product can be identified

(b) type designation

(c) component rated pressure

(d) maximum and minimum rated flow

3.19.4.7.3 Installation of Overspeed Valves. Overspeed valves shall be installed and mounted as follows:

(a) Single Jack Arrangements. Where a single valve is used, it shall be located in the pressure piping within 300 mm (12 in.) of the hydraulic jack. Multiple parallel valves are permitted in lieu of a single valve. These shall be located so as to minimize the distance from the valves to the hydraulic jack.

(b) Multiple Jack Arrangements. Multiple jack arrangements shall conform with one of the following:

(1) A single overspeed valve shall be located in the pressure piping within 300mm(12 in.) of each hydraulic jack. Multiple parallel valves are permitted in lieu of single valves at each hydraulic jack. These shall be located so as to minimize the distance from the valves to each hydraulic jack.

(2) A single overspeed valve shall be located in the pressure piping on the hydraulic machine side of, and immediately before, the tee junction, wye junction, or branch junction that connects the branch pressure pipes to the jacks. Multiple parallel valves are permitted in lieu of a single valve at the junction. For dual hydraulic jack systems, the total length of branch pressure pipe between the tee or wye junction and the jacks shall not exceed the distance between the jacks, measured horizontally, plus 1 m (39 in.). For multiple jack systems, the length of branch pressure piping shall be minimized.

3.19.4.7.4 Strength of Overspeed Valve Pressure Piping and Fittings Between the Overspeed Valve and the Jacks. The factor of safety of the overspeed valve pressure piping and fittings shall be not less than 1.5 times the value obtained using 8.2.8.5, provided that the minimum factor of safety is not less than 4.5, and the minimum percentage elongation is not less than 5 for the overspeed valve and fittings and not less than 20 for the pressure piping.

3.19.4.7.5 Performance Requirements. The overspeed valve shall be constructed, installed, and adjusted to ensure that the elevator obtains the following performance:

(a) The overspeed valve tripping speed shall be not less than 110% nor greater than 140% of the elevator operating speed in the down direction, but in no case shall exceed 0.3 m/s (60 ft/min) above the rated elevator speed.

(b) The average deceleration rate shall be not less than 1.96 m/s2 (6.44 ft/s2) nor more than 9.81 m/s2 (32.2 ft/s2).

(c) Any peak deceleration rate in excess of 24.53 m/s2 (80.5 ft/s2) shall have a duration of not greater than 0.04 s.

3.19.4.7.6 Sealing of the Overspeed Valve. Field adjustable overspeed valves shall be sealed after field setting.

3.19.5 Piping Buried in the Ground

3.19.5.1 Protection. Piping buried in the ground shall be provided with protection from corrosion by one or more of the following methods:

(a) monitored cathodic protection

(b) a coating to protect the piping from corrosion that will withstand the installation process

(c) a protective casing, immune to galvanic or electrolytic action, salt water, and other known underground conditions, completely surrounding the exterior surfaces of the piping

3.19.5.2 Seals. Piping buried in the ground shall not include seals or other elements potentially requiring service or replacement.

3.19.6 Welding

3.19.6.1 All welding of valves, pressure piping, and fittings shall conform to 8.8.

3.19.6.2 Field welding of pressure piping and fittings shall also be permitted to be performed by welders certified to the requirements pertaining to pressure systems.

3.19.7 Electrical Requirements

Hydraulic control valves shall conform to the electrical requirements in Clause 4 of CSA C22.2 No. 139.

SECTION 3.20
ROPES AND ROPE CONNECTIONS

Where a counterweight is provided, the counterweight shall be connected to the car by not less than two steel wire ropes.

The wire ropes and their connections shall conform to 2.20, except that the factor of safety of the wire ropes shall be not less than 7.

SECTION 3.21
COUNTERWEIGHTS

3.21.1 Counterweights

Counterweights, where provided, shall conform to 2.21. In the event of the separation of the counterweight from the car, the static pressure shall be not more than 140% of the working pressure.

3.21.2 Counterweight Sheaves

Sheaves for counterweight ropes shall conform to 2.24.2, 2.24.3, and 2.24.5.

SECTION 3.22
BUFFERS AND BUMPERS

3.22.1 Car Buffers or Bumpers

Car buffers or bumpers shall be provided and shall conform to 2.22, provided that in applying the requirements of 2.22 to hydraulic elevators 3.22.1.1 through 3.22.1.5 are complied with.

3.22.1.1 The term "operating speed in the down direction with rated load" shall be substituted for the words "rated speed" wherever these words appear.

3.22.1.2 In place of 2.22.3.2, the requirements specified in 3.22.1.2.1 and 3.22.1.2.2 shall be substituted.

3.22.1.2.1 Buffers shall be capable of withstanding without being compressed solid the loading per 8.2.3.2.

3.22.1.2.2 Buffers shall be compressed solid with a loading of 2 times that described in 8.2.3.2.

3.22.1.3 Requirement 2.22.4.1.2 shall not apply. Reduced stroke buffers shall not be provided on hydraulic elevators. Car buffers or bumpers shall be so located that the car will come to rest on the bumper or fully compressed buffer, or to a fixed stop, before the plunger reaches its down limit of travel.

3.22.1.4 When multiple buffers are used, each shall be identical and designed for an equal proportion of the loading described in 3.22.1.2.

3.22.1.5 Plunger weight, less buoyant effects of the plungers at the buffer strike point, shall be added, if applicable, and used in buffer calculations.

3.22.1.6 Solid bumpers are permitted on hydraulic elevators having an operating speed in the down direction of 0.25 m/s (50 ft/min) or less. See 2.22.2 for solid bumper material.

3.22.2 Counterweight Buffers

Where counterweights are provided, counterweight buffers shall not be provided. (See 3.4.6 for required counterweight runby.)

SECTION 3.23
GUIDE RAILS, GUIDE-RAIL SUPPORTS, AND FASTENINGS

3.23.1 Direct-Acting Hydraulic Elevators

Guide rails, guide-rail supports, and their fastenings shall conform to 2.23, with the exceptions specified in 3.23.1.1 through 3.23.1.4.

3.23.1.1 Requirement 2.23.4.1 shall apply only where car safeties are used and the maximum load on the car side for direct-acting hydraulic elevators is the maximum weight of the car and its rated load plus the weight of the plunger or cylinder as applicable.

3.23.1.2 Requirement 2.23.4.2 shall apply only where safeties are used.

3.23.1.3 Requirement 2.23.9.1.1(a) shall apply only where safeties are used.

3.23.1.4 Requirement 2.28 shall not apply.

3.23.2 Roped-Hydraulic Elevators

3.23.2.1 Car and counterweight guide rails, guiderail supports, and their fastenings shall conform to 2.23.

3.23.2.2 The traveling sheave, if provided, shall be guided by means of suitable guide shoes and guide rails adequately mounted and supported.

SECTION 3.24
HYDRAULIC MACHINES AND TANKS

3.24.1 Hydraulic Machines (Power Units)

3.24.1.1 Marking Plates. The working pressure that is developed in the system shall be measured at the acceptance inspection and test. This pressure shall be legibly and permanently labeled/marked on a data plate that shall be mounted on the hydraulic machine.

3.24.2 Tanks

3.24.2.1 Capacity. Tanks shall be of sufficient capacity to provide for an adequate liquid reserve in order to prevent the entrance of air or other gas into the system.

3.24.2.2 Minimum Level Indication. The permissible minimum liquid level shall be clearly indicated.

3.24.3 Atmosphere Storage and Discharge Tanks

3.24.3.1 Covers and Venting. Tanks shall be covered and suitably vented to the atmosphere. Where tanks are located in the hoistway, they shall be vented to prevent accumulation of fumes in the hoistway and their covers shall be of sufficient strength to resist falling objects.

3.24.3.2 Factor of Safety. Tanks shall be so designed and constructed that when completely filled, the factor of safety shall be not less than 4, based on the ultimate strength of the material.

3.24.3.3 Means for Checking Liquid Level. Tanks shall be provided with means for checking the liquid level. Such means shall be accessible without the removal of any cover or other part.

3.24.4 Welding

All welding of hydraulic machine components shall conform to 8.8.

SECTION 3.25
TERMINAL STOPPING DEVICES

3.25.1 Normal Terminal Stopping Devices

3.25.1.1 Where Required and Function. Upper and lower normal terminal stopping devices shall be provided and arranged to slow down and 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 from any speed attained in normal operation. Such devices shall function independently of the operation of the normal stopping means and the terminal speed reducing device, where provided. The device shall be so designed and installed that it will continue to function until the car reaches its extreme limits of travel.

The device shall be permitted to be rendered inoperative during recycling operation (see 3.26.7).

3.25.1.2 Location of Stopping Devices. Stopping devices shall be located on the car, in the hoistway, in the machine room or control room, or in overhead spaces, and shall be operated by movement of the car.

3.25.1.3 Requirements for Stopping Devices on the Car or in the Hoistway. Stopping devices located on the car or in the hoistway and operated by cams on the car or in the hoistway shall conform to 2.25.1.

3.25.1.4 Requirements for Stopping Devices in a Machine Room, Control Room, or Overhead Space. Stopping devices located in a machine room, control room, or in an overhead space shall conform to 2.25.2.3, except that the device required by 2.25.2.3.2 shall cause the electric power to be removed from the main control valve or from its control switch operating magnets and, in the case of electrohydraulic elevators, where stopping the car is effected by stopping the pump motor, from the pump motor and associated valves.

3.25.2 Terminal Speed Reducing Devices

3.25.2.1 Where Required. Terminal speed reducing devices shall be installed for the up direction where the car speed exceeds 0.25 m/s (50 ft/min), to ensure that the plunger does not strike its solid limit of travel at a speed in excess of 0.25 m/s (50 ft/min) (see 3.18.4.1).

3.25.2.2 Requirements. Terminal speed reducing devices shall conform to 3.25.2.2.1 through 3.25.2.2.5.

3.25.2.2.1 They shall operate independently of the normal terminal-stopping device and shall function to reduce the speed of the car if the normal terminal stopping device fails to slow down the car at the terminals as intended.

3.25.2.2.2 They shall provide retardation not in excess of 9.81 m/s2 (32.2 ft/s2).

3.25.2.2.3 They shall be so designed and installed that a single short circuit caused by a combination of grounds or by other conditions shall not render the device ineffective.

3.25.2.2.4 Control means for electrohydraulic elevators shall conform to the following:

(a) For the up direction of travel, at least two control means are required; one or both to be controlled by the terminal speed reducing device and the other or both by the normal terminal stopping device.

If, in the up direction, the pump motor is the only control means, the pump motor control shall conform to the following:

(1) Two devices shall be provided to remove power independently from the pump motor. At least one device shall be an electromechanical contactor.

(2) The contactor shall be arranged to open each time the car stops.

(3) The electrical protective devices shall control both devices [see 3.25.2.2.4(b)(1)] in accordance with 3.26.4.

If, however, the pump motor is one control means, and there is a second control means (e.g., a valve), at least one of the means shall be directly controlled by an electromechanical contactor or relay.

(b) For the down direction, the terminal speed reducing and normal terminal stopping devices shall each directly, or through separate switches, affect the control valve. Where two devices are used, the terminal speed reducing and normal terminal stopping devices each shall be permitted to control one or both.

3.25.2.2.5 Where magnetically operated, optical or solid-state devices are used for position sensing, a

single short circuit caused by a combination of grounds or by other conditions, or the failure of any single magnetically operated, optical, or solid-state device, shall not

(a) render the terminal speed reducing device inoperative; or

(b) permit the car to restart after a normal stop.

3.25.3 Final Terminal Stopping Devices

Final terminal stopping devices are not required.

SECTION 3.26
OPERATING DEVICES AND CONTROL EQUIPMENT

3.26.1 Operating Devices and Control Equipment

Operating devices and control equipment shall conform to 2.26, except as modified by the following:

(a) Requirement 2.26.1.3 does not apply.

(b) Requirement 2.26.1.4 applies as specified by 3.26.2.

(c) Requirement 2.26.1.6 applies as specified by 3.26.3.

(d) Requirement 2.26.2 applies as specified by 3.26.4.

(e) Requirement 2.26.6 does not apply.

(f) Requirement 2.26.8 does not apply.

(g) Requirements 2.26.9.1, 2.26.9.2, 2.26.9.5, 2.26.9.6, and 2.26.9.7 do not apply.

(h) Requirement 2.26.10 does not apply.

3.26.2 Inspection Operation

Top-of-car operating devices shall be provided and shall conform to 2.26.1.4. In-car and those inspection operations conforming to 2.26.1.4.4 shall be permitted.

The bottom normal terminal stopping device shall be permitted to be made ineffective while the elevator is under the control of the inspection operation device.

3.26.3 Anticreep and Leveling Operation

3.26.3.1 Anticreep Operation. Each elevator shall be provided with an anticreep operation to correct automatically a change in car level. It shall conform to 2.26.1.6.2 and 2.26.1.6.3, and 3.26.3.1.1 through 3.26.3.1.5.

3.26.3.1.1 The anticreep device shall operate the car at a speed not exceeding 0.125 m/s (25 ft/min).

3.26.3.1.2 The anticreep device shall maintain the car within 25 mm (1 in.) of the landing, irrespective of the position of the hoistway door.

3.26.3.1.3 For electrohydraulic elevators, the anticreep device shall be required to operate the car only in the up direction.

3.26.3.1.4 Operation dependent on the availability of the electric power supply is permitted, provided that

(a) the mainline power disconnecting means is kept in the closed position at all times except during maintenance, repairs, and inspection

(b) a sign is placed on the switch stating, "KEEP SWITCH CLOSED EXCEPT DURING MAINTENANCE, REPAIRS, AND INSPECTIONS"

(c) the sign shall be made of durable material and securely fastened and have letters with a height of not less than 6 mm (0.25 in.)

3.26.3.1.5 Only the following, when activated, shall prevent operation of the anticreep device:

(a) the electrical protective devices listed in 3.26.4.1

(b) recycling operation (see 3.26.7)

(c) inspection transfer switch

(d) hoistway access switch

(e) low oil protection means

(f) oil tank temperature shutdown devices

3.26.3.2 Operation in Leveling or Truck Zone. Operation of an elevator in a leveling or truck zone at any landing by a car-leveling or truck-zoning device, when the hoistway doors, or the car doors or gates, or any combination thereof, are not in the closed position, is permissible, subject to the requirements of 2.26.1.6.1 through 2.26.1.6.5. A leveling or truck-zoning device shall operate the car at a speed not exceeding 0.125 m/s (25 ft/min).

3.26.4 Electrical Protective Devices

Electrical protective devices shall be provided in conformance with 2.26.2, and the following requirements, except the words "driving machine motor and brake" in 2.26.2 shall be replaced with "hydraulic machine," and shall conform to 3.26.4.1 and 3.26.4.2.

3.26.4.1 When in the open position, the electrical protective devices shall prevent operation by all operating means, except as specified in 3.26.4.2.

3.26.4.2 When in the open position, the following devices shall initiate removal of power from the hydraulic machine in such a manner as to produce an average deceleration rate not greater than 9.8 m/s2 (32.2 ft/s2) and shall prevent operation by all operating means except the anticreep device:

(a) emergency stop switches, where required by 2.26.2.5

(b) broken rope, tape, or chain switches provided in connection with normal stopping devices, when such

devices are located in the machine room, control room, or overhead space

(c) hoistway door interlocks or hoistway door contacts

(d) car door or gate electric contacts; or car door interlocks

(e) hinged car platform sill electric contacts

(f) in-car stop switch, where required by 2.26.2.21

3.26.5 Phase Reversal and Failure Protection

Hydraulic elevators powered by a polyphase AC motor shall be provided with the means to prevent overheating of the drive system (pump and motor) due to phase rotation reversals or failure.

3.26.6 Control and Operating Circuits

The design and installation of the control and operating circuits shall conform to 3.26.6.1 and 3.26.6.2.

3.26.6.1 Springs, where used to actuate switches, contactors, or relays to stop an elevator at the terminals or to actuate electrically operated valves, shall be of the compression type.

3.26.6.2 The completion or maintenance of an electric circuit shall not be used to interrupt the power to the control valve operating magnets, or to the pump driving motor of electrohydraulic elevators, or both under the following conditions:

(a) to stop the car at the terminals

(b) to stop the car when the emergency stop switch or any of the electrical protective devices operate

3.26.7 Recycling Operation for Multiple or Telescopic Plungers

Recycling operation shall permit the car to be lowered more than 25 mm (1 in.) below the bottom landing, but not require lowering in order to restore the relative vertical position of the multiple plunger sections, provided that

(a) the car is at rest at bottom landing

(b) the doors and gates are closed and locked

(c) no car calls are registered

(d) the speed during recycling does not exceed normal down leveling speed but in no case shall be more than 0.10 m/s (20 ft/min)

(e) normal operation cannot be resumed until car is returned to bottom landing and normal terminal stopping devices are restored to normal operation

3.26.8 Pressure Switch

When cylinders are installed with the top of the cylinder above the top of the storage tank, a pressure switch shall be provided in the line between the cylinder and the valve, which shall be activated by the loss of positive pressure at the top of the cylinder. The switch shall prevent automatic door opening and the operation of the lowering valve or valves. The door(s) shall be permitted to open by operation of the in-car open button, when the car is within the unlocking zone.

3.26.9 Low Oil Protection

3.26.9.1 A means shall be provided to render the elevator on normal operation inoperative if for any reason the liquid level in the tank falls below the permissible minimum. Suitable means include, but are not limited to, the following:

(a) direct sensing of liquid level

(b) a pump-run timer

Actuation of the means shall automatically bring the car down to the lowest landing, when the doors are closed.

3.26.9.2 When at the lowest landing, the doors shall comply with the following:

(a) For elevators with power-operated doors that automatically close, the door(s) shall open and shall initiate automatic closing within 15 s.

(b) For elevators with manual doors or with doors that do not automatically close, they shall be provided with a signal system to alert an operator to close the doors.

3.26.9.3 The car shall then shut down. The means shall require manual reset before returning the car to service. For elevators with power-operated doors, the in-car door open button(s) shall remain operative, but the doors shall not be able to be power-opened from the landing.

3.26.10 Auxiliary Power Lowering Operation

Where the auxiliary power supply is provided solely for the purpose of lowering the car, in the case of main power supply failure, the auxiliary lowering operation shall conform to 3.26.10.1 through 3.26.10.3.

3.26.10.1 Auxiliary lowering shall be permitted to be initiated, provided that all operating and control devices, including door open and close buttons, function as with normal power supply, except that the following devices shall be permitted to be bypassed or made inoperative:

(a) landing and car floor registration devices (or call buttons)

(b) devices enabling operation by designated attendant (hospital service, attendant operation)

(c) devices initiating emergency recall operation to the recall level, unless otherwise specified in 3.27

(d) "FIRE OPERATION" switch, unless otherwise specified in 3.27

3.26.10.2 When the auxiliary lowering operation has been initiated, the car shall descend directly to the lowest landing, except that the operating system shall be permitted to allow one or more intermediate stops, and then, after a predetermined interval, the car shall proceed to the lowest landing, provided the auxiliary power supply is of sufficient capacity to open and close doors at each intermediate stop.

3.26.10.3 If the car and landing doors are power operated, and if the auxiliary power supply is of adequate capacity, the doors shall open when the car stops at the lowest landing and shall close after a predetermined interval.

NOTE (3.26.10): For the main disconnect switch auxiliary contact, see ANSI/NFPA70 and CSA C22.1 requirements, where applicable (see Part 9).

SECTION 3.27
EMERGENCY OPERATION AND SIGNALING DEVICES

Emergency operation and signaling devices shall conform to 2.27, except as modified by the following: The requirements of 3.26.9 and 3.18.2.7 shall be modified when Phase I Emergency Recall Operation and Phase II Emergency In-Car Operation are in effect, as specified in 3.27.1 through 3.27.4.

3.27.1 Phase I Emergency Recall Operation After Device Actuation

If Phase I Emergency Recall Operation is activated while the elevator is responding to any of the following devices, the car shall return to the recall level:

(a) low oil protection (see 3.26.9)

(b) plunger follower guide protection, provided the car is capable of being moved (see 3.18.2.7)

(c) auxiliary power lowering device (see 3.26.10)

If the elevator is incapable of returning to the recall level, the car shall descend to an available floor. Upon arrival, automatic power-operated doors shall open, and then reclose within 15 s. The door open button shall remain operative.

3.27.2 Phase I Emergency Recall Operation Prior to Device Actuation

If any of the devices specified in 3.27.1(a), (b), or (c) is activated, while Phase I Emergency Recall Operation is in effect, but before the car reaches the recall level, the car shall

(a) complete Phase I Emergency Recall Operation, if the car is above the recall level; or

(b) descend to an available floor, if the car is below the recall level.

Upon arrival, automatic power-operated doors shall open, and then reclose within 15 s. The door open button shall remain operative.

3.27.3 Device Actuation at Recall Level

If either of the devices specified in 3.27.1(a) or (c) is activated while the car is stationary at the recall level and Phase I Emergency Recall Operation is in effect, the following shall apply:

(a) automatic power-operated doors shall close within 15 s

(b) the door open button shall remain operational

(c) the visual signal [see Fig. 2.27.3.1.6(h)] shall illuminate intermittently

3.27.4 Device Actuation With Phase II Emergency In- Car Operation in Effect

If any of the devices specified in 3.27.1(a), (b), or (c) activate while the elevator is on Phase II Emergency In-Car Operation, a traveling car shall stop and all calls shall be canceled. The visual signal [see Fig. 2.27.3.1.6(h)] shall illuminate intermittently. The elevator shall accept calls only to landings below its location and respond in compliance with the requirements for Phase II Emergency In-Car Operation.

SECTION 3.28
LAYOUT DATA

3.28.1 Information Required on Layout Drawing

Elevator layout drawings shall, in addition to other data, indicate the following:

(a) required clearances and basic dimensions

(b) the bracket spacing (see 3.23)

(c) the estimated maximum vertical forces on the guide rails on application of the safety, where provided (see 3.23)

(d) in the case of freight elevators for Class B or Class C loading (see 2.16.2.2), the horizontal forces on the guide-rail faces during loading and unloading, and the estimated maximum horizontal forces in a post-wise direction on the guide-rail faces on the application of the safety device, where provided (see 3.23)

(e) the size and weight per meter (foot) of any rail reinforcement, where provided (see 3.23)

(f) the impact loads imposed on machinery and sheave beams, supports, and floors or foundations (see 2.9)

(g) the impact load on buffer supports due to buffer engagement at the maximum permissible load and operating speed in the down direction (see 8.2.3)

(h) the net vertical load from the elevator system, which includes the total car weight and rated load; plunger, cylinder, and oil; and any structural supports

(i) the outside diameter and wall thickness of the cylinder, plunger, and piping, and the working pressure

(j) the total static and dynamic loads from the governor, ropes, and tension system

(k) rated speed and operating speed in the down direction

(l) the minimum "grade" of pipe (ASTM or recognized standard) required to fulfill the installation requirements for pressure piping, or in lieu of a specific "grade" of pipe, the minimum tensile strength of pipe to be used for the installation (see 3.19)

(m) the horizontal forces on the building structure stipulated by 2.11.11.8

(n) the length of the plunger and cylinder

(o) the clearance between the bottom of the plunger and the bottom head of the cylinder as required by 3.18.3.3

SECTION 3.29
IDENTIFICATION

Identification of equipment and floors shall conform to 2.29, as applicable.

Part 8
General Requirements

See A17.1–2004 and A17.1a–2005 for any additional requirements that apply.

SECTION 8.1
SECURITY

8.1.2 Group 1: Restricted

Group 1 covers access or operation of equipment restricted to elevator personnel. This key shall not be part of a master key system.

NOTE: See the following:

(a) Requirement 2.2.4.4(e), pit access doors.

(b) Requirement 2.7.3.4.6(c), hoistway access doors.

(c) Requirement 2.7.5.1.4, equipment access panels.

(d) Requirement 2.7.6.3.2(b), motor controller cabinet door(s) or panel(s).

(e) Requirement 2.7.6.4.3(b), access to the means to move the car from outside the hoistway.

(f) Requirement 2.7.6.4.3(d), access to removable means to move the car from outside the hoistway.

(g) Requirement 2.7.6.5.2(b), inspection and test panel enclosure.

(h) Requirement 3.19.4.4, access to a manual lowering valve.

(i) Requirement 3.19.4.5, access to pressure gauge fittings.

(j) Requirement 2.11.1.2(h), emergency access doors. (Shall also be made available to emergency personnel during an emergency.)

(k) Requirement 2.12.6.2.4, hoistway door unlocking device operating means. (Shall also be made available to emergency personnel during an emergency.)

(l) Requirement 2.12.7.2.2, hoistway access switch.

(m) Requirement 2.12.7.3.3, hoistway access enabling switch.

(n) Requirement 2.26.1.4.3(b), in-car inspection operation transfer switch.

(o) Requirement 2.26.2.21, in-car stop switch.

(p) Requirement 4.2.5.2, screw machine controllers located away from hoistway, machine room, or machinery space.

(q) Requirement 4.2.5.5, screw machine access panels.

(r) Requirement 5.1.10.1(b), inclined elevator hoistway access switch.

(s) Requirement 5.1.11.1.2(d), inclined elevator uphill end emergency exit.

(t) Requirement 5.7.8.3, special-purpose personnel elevator access to hoistways for emergency and inspection purposes.

(u) Requirement 7.1.12.4, power and hand dumbwaiters without automatic transfer devices hoistway access switch.

(v) Requirement 7.9.2.15, electric material lifts with automatic transfer devices car-mounted operating devices.

(w) The requirements of 2.14.1.10 (side emergency exit doors) apply.

8.1.3 Group 2: Authorized Personnel

Group 2 covers access or operation of equipment by authorized personnel.

NOTE: See the following:

(a) Requirement 2.7.3.4.2, machine room and control room access doors.

(b) Requirements 2.7.3.4.3 and 2.7.3.4.4, machinery spaces and control spaces as specified.

(c) Requirement 2.11.1.4, access openings for cleaning of car and hoistway enclosures.

(d) Requirement 2.14.2.6(b), access openings for cleaning of car and hoistway enclosure.

(e) Requirement 2.14.7.2.1(b), car light control switch.

(f) Requirement 3.19.4.1, access to manually operated shutoff valve.

(g) Requirement 5.6.1.25.2(b), rooftop elevator keyed operation switch.

(h) Requirement 6.1.6.2.1(d), escalator starting switch.

(i) Requirement 6.1.7.3.3, escalator side access door to interior.

(j) Requirement 6.2.6.2.1(d), moving walk starting switch.

(k) Requirement 6.2.7.3.3, moving walk side access door to interior.

SECTION 8.6
MAINTENANCE, REPAIR, AND REPLACEMENT

8.6.1.6.3 Controllers, Wiring, and Wiring Diagrams

(a) Up-to-date wiring diagrams detailing circuits of all electrical protective devices (see 2.26.2) and critical operating circuits (see 2.26.3) shall be available in the machinery space, machine room, control space, or control room as appropriate to the installation.

(b) The interiors of controllers and their components shall be cleaned when necessary to minimize the accumulation of foreign matter that can interfere with the operation of the equipment.

(c) Temporary wiring and insulators or blocks in the armatures or poles of magnetically operated switches, contactors, or relays on equipment in service are prohibited.

(d) When jumpers are used during maintenance, repairs, or testing, all jumpers shall be removed and

the equipment tested prior to returning it to service. Jumpers shall not be stored in machine rooms, hoistways, machinery spaces, control spaces, escalator/moving walk wellways, or pits (see also 8.6.1.6.1).

(e) Control and operating circuits and devices shall be maintained in compliance with applicable Code requirements (see 8.6.1.1.2).

8.6.1.6.5 Fire Extinguishers. In jurisdictions not enforcing the NBCC, Class "ABC" fire extinguishers shall be provided in elevator machine rooms, control rooms, and control spaces outside the hoistway intended for full bodily entry, and walk-in machinery and control rooms for escalators and moving walks; and they shall be located convenient to the access door.

8.6.4 Maintenance of Electric Elevators

8.6.4.8 Machinery Spaces, Machine Rooms, Control Spaces, and Control Rooms

8.6.4.8.1 Floors and machinery and control spaces shall be kept free of water, dirt, rubbish, oil, and grease.

8.6.4.8.2 Articles or materials not necessary for the maintenance or operation of the elevator shall not be stored in machinery spaces, machine rooms, control spaces, and control rooms.

8.6.4.8.3 Flammable liquids having a flashpoint of less than 44°C (110°F) shall not be kept in such rooms or spaces.

8.6.4.8.4 Access doors shall be kept closed and locked.

8.6.8.4.5 Machinery spaces and control spaces located in the hoistway shall not be used for storage purposes (see also 8.6.4.7.1).

8.6.11 Special Provisions

8.6.11.6 Operating Instructions for Means Specified in 2.7.5.1.1 or 2.7.5.2.1. A written procedure for operating the means shall be provided and kept on the premises where the elevator is located (see 2.7.5.1.2 or 2.7.5.2.1).

8.6.11.7 Egress and Reentry Procedure From Working Areas in 2.7.5.1.3 or 2.7.5.2.3. A written procedure to outline the method for egress and reentry shall be provided and kept on the premises where the elevator is located (see 2.7.5.1.3 or 2.7.5.2.3).

8.6.11.8 Operating Instructions for Retractable Platforms. A written procedure to outline the method for the use of retractable platforms shall be provided and kept on the premises where the elevator is located (see 2.7.5.3.1).

NONMANDATORY APPENDIX Q
EXPLANATORY FIGURES FOR THE DEFINITIONS OF ELEVATOR MACHINERY SPACE, MACHINE ROOM, CONTROL SPACE, CONTROL ROOM, REMOTE MACHINE ROOM, OR REMOTE CONTROL ROOM

Table Q-1

	Location			Equipment Used Directly in Connection With the Elevator, Dumbwaiter, or Material Lift		Equipment Contained Within	
	Inside or Outside the Hoistway	Attached to or Within the Hoistway	Entry into the Space, Full or Partial	Mechanical Other Than Electric Driving Machine or Hydraulic Machine	Electrical Other Than Motor Controller	Electric Driving Machine or Hydraulic Machine	Motor Controller
Machinery Space [Note (1)]	Either	Either	Either	Permitted	Permitted	Permitted	Permitted
Control Space						Not permitted	Required
Machine Room [Note (1)]	Outside the hoistway	Attached to but not within	Full bodily entry required			Required	Permitted
Control Room						Not permitted	Required
Machine Room, Remote		No				Required	Permitted
Control Room, Remote						Not permitted	Required
Machinery Space, Remote			Either			Permitted	Permitted
Control Space, Remote			Either			Not permitted	Required

NOTE:
(1) A machinery space outside the hoistway containing an electric driving machine and a motor controller or a hydraulic machine and a motor controller is a machine room.

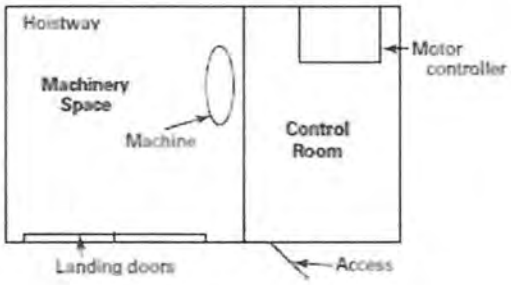


Fig. Q-1

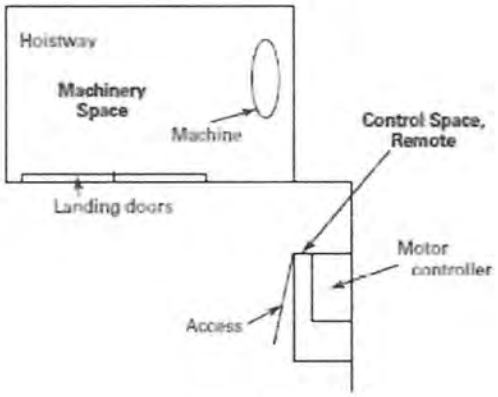


Fig. Q-3

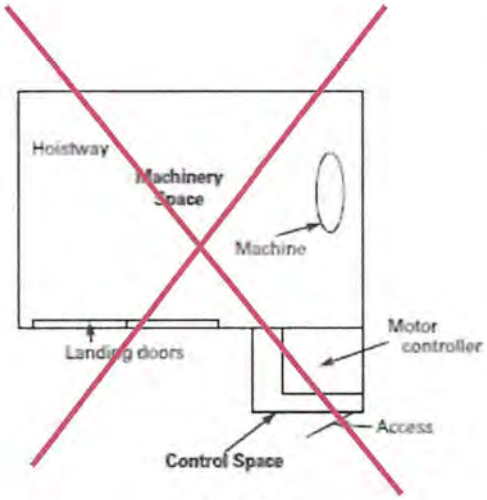


Fig. Q-2

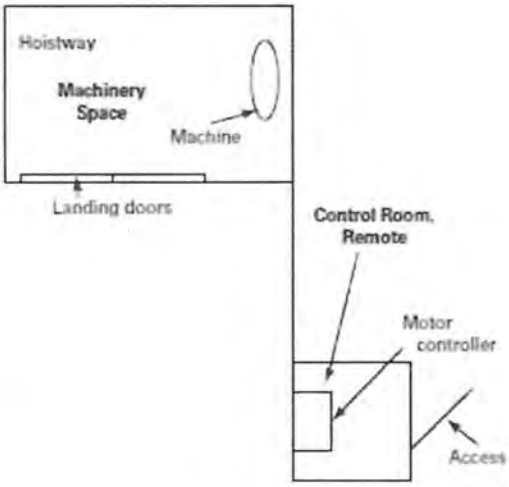


Fig. Q-4

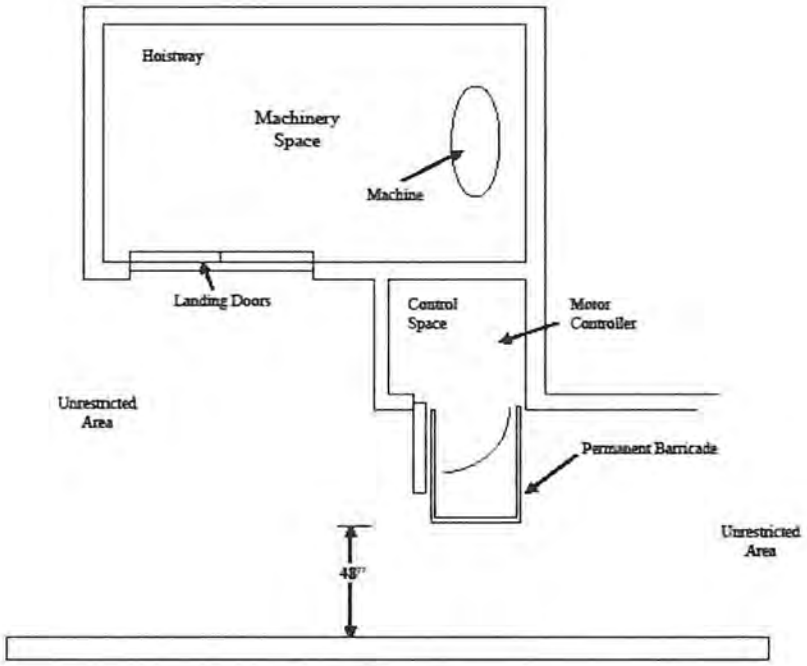

Hoistway
Machinery Space
Machine
Landing Doors
Control Space
Motor Controller
Unrestricted Area
Permanent Barricade
Unrestricted Area
48"

Figure Q-2

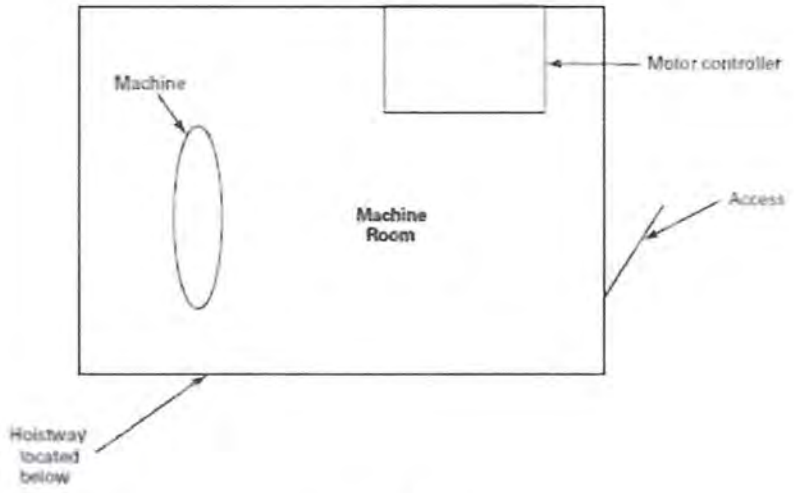

Motor controller
Machine
Machine
Room
Access
Hoistway
located
below

Fig. Q-5

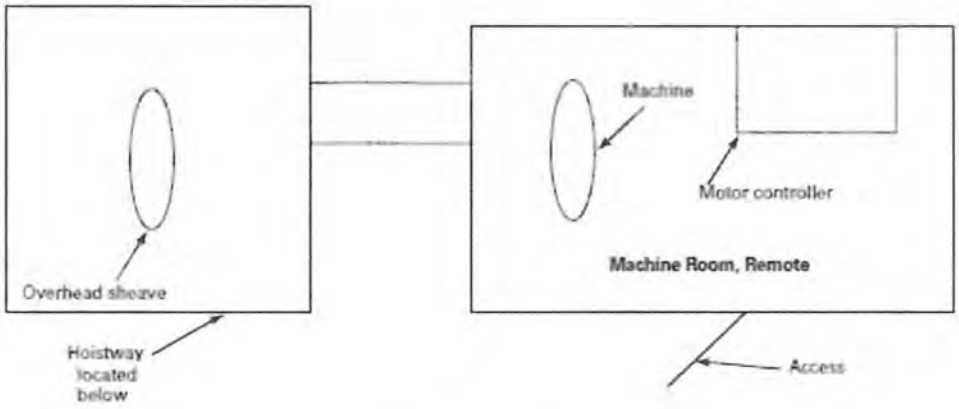

Machine
Motor controller
Overhead sheave
Machine Room, Remote
Hoistway
located
below
Access

Fig. Q-6

Table R-1 Inspection Operation and Hoistway Access Switch Operation Hierarchy

											BYPASS Operation, 2.26.1.5		
Operation Modes Activated	Top-of-Car, 2.26.1.4.2	In-Car, 2.26.1.4.3	Hoistway Access, 2.12.7.3	Machine Room, 2.26.1.4.4	Control Room, 2.26.1.4.4	Machinery Space Outside Hoistway, 2.26.1.4.4	Control Space Outside Hoistway, 2.26.1.4.4	Landing, 2.26.1.4.4	Pit, 2.26.1.4.4	Working Platform, 2.26.1.4.4	Top-of-Car	In-Car	Operation Modes Activated
Top-of-Car	Top-of-Car	Top-of-Car	Top-of-Car	Top-of-Car	Top-of-Car	Top-of-Car	Top-of-Car	Top-of-Car	No Operation	No Operation	Top-of-Car	Top-of-Car	Top-of-Car
In-Car	Top-of-Car	In-Car	In-Car	In-Car	In-Car	In-Car	In-Car	In-Car	No Operation	No Operation	Top-of-Car	In-Car	In-Car
Hoistway Access	Top-of-Car	In-Car	Hoistway Access	Hoistway Access	Hoistway Access	Hoistway Access	Hoistway Access	Hoistway Access	No Operation	No Operation	Top-of-Car	In-Car	Hoistway Access
Machine Room	Top-of-Car	In-Car	Hoistway Access	Machine Room	No Operation	No Operation	No Operation	No Operation	No Operation	No Operation	Top-of-Car	In-Car	Machine Room
Control Room	Top-of-Car	In-Car	Hoistway Access	No Operation	Control Room	No Operation	No Operation	No Operation	No Operation	No Operation	Top-of-Car	In-Car	Control Room
Machinery Space Outside Hoistway	Top-of-Car	In-Car	Hoistway Access	No Operation	No Operation	Machinery Space	No Operation	No Operation	No Operation	No Operation	Top-of-Car	In-Car	Machinery Space Outside Hoistway
Control Space Outside Hoistway	Top-of-Car	In-Car	Hoistway Access	No Operation	No Operation	No Operation	Control Space	No Operation	No Operation	No Operation	Top-of-Car	In-Car	Control Space Outside Hoistway
Landing	Top-of-Car	In-Car	Hoistway Access	No Operation	No Operation	No Operation	No Operation	Landing	No Operation	No Operation	Top-of-Car	In-Car	Landing
Pit	No Operation	No Operation	No Operation	No Operation	No Operation	No Operation	No Operation	No Operation	Pit	No Operation	No Operation	No Operation	Pit
Working Platform	No Operation	No Operation	No Operation	No Operation	No Operation	No Operation	No Operation	No Operation	No Operation	Working Platform	No Operation	No Operation	Working Platform