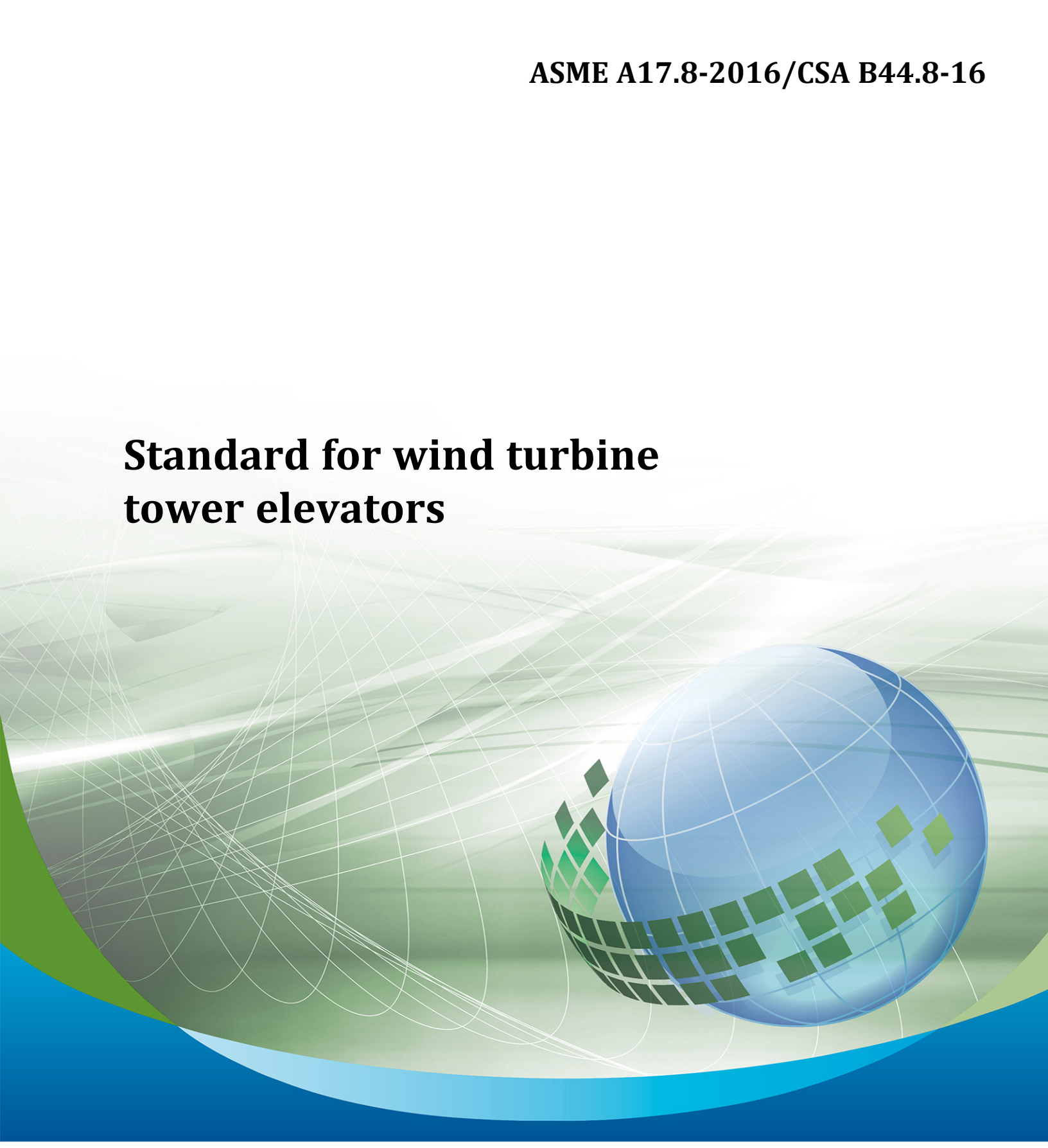
ASME A17.8-2016/CSA B44.8-16

Standard for wind turbine tower elevators



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ASME A17.8-2016/CSA B44.8-16

Standard for wind turbine tower elevators

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L. Yang	CSA Group, Toronto, Ontario	*Associate*
M. Zingarelli	MAD Elevator Fixtures Inc., Etobicoke, Ontario	*Associate*
O. Simonetta	CSA Group, Toronto, Ontario	*Project Manager*

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ASME Foreword

Equipment covered by this standard was originally codified and incorporated into ASME A17.1-2013/ CSA B44-13, Section 5.11, in October 2013. The first edition of this Code was published in November 2016 and prepared by The American Society of Mechanical Engineers (ASME), Wind Turbine Tower Elevator Committee with the assistance of representatives of a number of interests including manufacturers, certifying organizations, regulatory bodies, and technical consultants from North America and Europe.

The work to develop this Code originated when the A17 Standards Committee was presented information on the numbers of these elevators already installed and the estimate of projected number of elevators to be constructed in North America.

The A17 Standards Committee voted that these elevators were under the Scope of ASME A17.1/CSA B44, Safety Code for Elevators and Escalators and in January 2009, assigned the project of developing language to the Special Purpose Personnel Elevator (SPPE) Committee. The SPPE Committee created a Project Team consisting of A17/B44 representatives, technical advisors from the American Wind Energy Association (AWEA), specialists in the design of these types of elevators, manufacturers from Denmark, Belgium, Spain, and Canada, and two members from Accredited Elevator/Escalator Certifying Organizations (AECOs) from the Netherlands and the United States.

The first Project Team meeting was held in March 2009. A number of meetings of the Team were held during the next three years, using the Special Purpose Personnel Elevator language, Section 5.7, as a basis for developing Wind Turbine Elevator Code language. The Team performed hazard assessment to establish equivalent levels of safety considering the very unique environment these elevators are installed where current A17.1/B44 codes do not address specific circumstances and structural requirements. In 2012, the Project Team was converted to a full Working Committee of A17, and the A17.1/B44, Section 5.11 was completed, approved by ANSI, and published as an American National Standard, ASME A17.1-2013/CSA B44-13. In 2013, the A17 Standards Committee approved the conversion of Section 5.11 into ASME A17.8/CSA B44.8 to provide a global code to international manufacturers in an effort to harmonize worldwide construction, installation, operation, testing, inspection, maintenance, alteration, and repair requirements.

ASME A17.8-2016 was approved as an American National Standard by the American National Standards Institute (ANSI) on January 8, 2016.

ASME Preface

General

This Code is one of numerous codes and standards developed and published by The American Society of Mechanical Engineers (ASME) under the general auspices of the American National Standards Institute (ANSI).

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Proposing Revisions

Revisions are made periodically to the Code to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the procedures, and in order to conform to developments in the elevator art. Approved revisions will be published periodically.

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

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Upon request, the A17 Committee will render an interpretation of any requirement of the Code. Interpretations can only be rendered in response to a written request sent to the Secretary of the A17 Standards Committee at: http://go.asme.org/Inquiry.

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Subject:	Cite the applicable Section number(s) and a concise description.
Edition:	Cite the applicable edition and supplement of the Code 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 question shall be phrased, where possible, to permit a specific "yes" or "no" answer. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

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

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 or subcommittee. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

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The A17 Standards Committee and the various Working Committees regularly hold meetings and/or telephone conferences all of which are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the Standards Committee. Future committee meeting dates and locations can be found on the committee page at https://cstools.asme.org/.

CSA Preface

This is the first edition of ASME A17.8/CSA B44.8, *Standard for wind turbine tower elevators*.

Originally, wind turbine tower elevators were covered in ASME A17.1-2013/CSA B44-13, Section 5.11, published in October 2013. This Code supersedes those requirements. This is a fully harmonized binational Standard.

This Code was prepared for use in Canada by the CSA Technical Committee on the Elevator Safety Code under the jurisdiction of the CSA Strategic Steering Committee on Mechanical Industrial Equipment Safety. It has been formally approved by the CSA Technical Committee.

Notes:

1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*

2) *Although the intended primary application of this Code is stated in its Scope, it is important to note that it remains the responsibility of the users of the Code to judge its suitability for their particular purpose.*

3) *This publication was developed by consensus, which is defined by* CSA Policy governing standardization — Code of good practice for standardization *as "substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity". It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this publication.*

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a) *define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;*

b) *provide an explanation of circumstances surrounding the actual field condition; and*

c) *where possible, phrase the request in such a way that a specific "yes" or "no" answer will address the issue.*

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization *and are available on the* Current Standards Activities *page at* ***standardsactivities.csa.ca***.

5) *This Code is subject to review five years from the date of publication. Suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line:*

a) *designation;*

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d) *rationale for the change.*

6) *Attention is drawn to the possibility that some of the elements of this Code may be the subject of patent rights. CSA Group is not to be held responsible for identifying any or all such patent rights. Users of this Code are expressly advised that determination of the validity of any such patent rights is entirely their own responsibility.*

ASME A17.8-2016/CSA B44.8-16
Standard for wind turbine tower elevators

1 Scope, definitions, and references

1.1 Scope

ASME A17.8/CSA B44.8 applies to elevators permanently installed in a wind turbine tower to provide vertical transportation of authorized personnel and their tools and equipment only.

Such elevators are typically subjected to extreme temperatures, humidity variations, and substantial horizontal motions where, by reason of their limited use and the types of construction of the structures served, full compliance with ASME A17.1/CSA B44 Part 2 is not practicable or necessary.

1.1.1 Effective date

The requirements of this edition and subsequent addenda to the Code are effective as of the date noted on the copyright page of this document. The AHJ will establish the effective date for its local regulations.

1.2 Definitions

The following definitions shall apply in this Code:

Authorized personnel — persons who have been instructed in the operation of the equipment and designated by the owner to use the equipment.

Brake, driving machine, elevator, dumbwaiter, or material lift — an electromechanically or electrohydraulically released spring, or gravity applied device, that is part of the electric driving machine of the elevator, dumbwaiter, or material lift used to apply a controlled force at a braking surface to hold or retard the elevator, dumbwaiter, or material lift.

> **Electromechanically released —** a means of brake release in which an electric current applied to an actuator (such as a solenoid) causes an electromagnetic force that overcomes a resisting force (such as a spring) as long as the electric current flows.

Buffer — a device designed to stop a descending car or counterweight beyond its normal limit of travel by storing or by absorbing and dissipating the kinetic energy of the car or counterweight.

> **Spring buffer —** a buffer utilizing one or more springs to cushion the impact force of the descending car or counterweight.

Bumper — a device other than an oil or spring buffer designed to stop a descending car or counterweight beyond its normal limit of travel by absorbing the impact.

Cable, traveling — see **Traveling cable**.

Capacity — see **Rated load**.

Car, elevator — the load-carrying unit including its platform, car frame, enclosure, and car door or gate.

Car enclosure — the top and the walls of the car resting on and attached to the car platform.

Car frame — the supporting frame to which the car platform, upper and lower sets of guide shoes, car safety, and the hoisting ropes or hoisting-rope sheaves, or the plunger or cylinder of a direct-acting elevator, are attached.

Car platform — the structure that forms the floor of the car and that directly supports the load.

Certified — see **Listed/certified**.

Certifying organization — an approved or accredited, independent organization concerned with product evaluation that maintains periodic inspection of production of listed/certified equipment or material and whose listing/certification states whether that equipment meets appropriate standards or has been tested and found suitable for use in a specified manner.

Note: *For the purpose of this definition, accredited means that an organization has been evaluated and approved by an Authorized Agency to operate a Certification/Listing program, and is designated as such in a publication of the Authorized Agency.*

Clearance, top car, inclined elevators — the shortest distance in the direction of travel between the upward most portion of the chassis (car frame) and the nearest obstruction when the car is level with the top terminal landing.

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

Control, motion — that portion of a control system that governs the acceleration, speed, retardation, and stopping of the moving member.

Control, operation — that portion of a control system that initiates the starting, stopping, and direction of motion in response to a signal from an operating device.

Operation, automatic — operation control wherein the starting of the elevator, dumbwaiter, or material lift car is effected in response to the momentary actuation of operating devices at the landing, and/or of operating devices in the car identified with the landings, and/or in response to an automatic starting mechanism, and wherein the car is stopped automatically at the landings.

Operation, automatic call — operation control wherein the starting of a wind turbine tower elevator car is effected in response to the momentary actuation of operating devices not mounted on the car and wherein the car is stopped automatically at the terminal landing or at the next landing in the direction of travel.

Operation, automatic send — operation control wherein the starting of a wind turbine tower elevator car is effected in response to the momentary actuation of operating devices mounted on the car and only accessible from outside the car, wherein the car is stopped automatically at the terminal landing or at the next landing in the direction of travel.

Controller — a device or group of devices that serves to control in a predetermined manner the apparatus to which it is connected.

Controller, motor — the operative units of a motion control system comprising the starter devices and power conversion equipment required to drive an electric motor.

Door — the movable portion(s) of an entrance that closes the openings. It consists of one or more solid face panels that are permitted to be equipped with a vision panel.

Door, horizontally sliding — a door that moves horizontally.

Door or gate, self-closing — a manually opened door or gate that closes when released.

Door, swinging — a door that pivots around a vertical axis.

Door or gate electric contact — an electrical device, the function of which is to prevent operation of the driving machine by the normal operating device unless the door or gate is in the closed position.

Driving machine — see **Machine, driving**.

Driving machine, traction climbing — an uncounterweighted driving machine where traction results from the weight of the car and its load.

Elevator — a hoisting and lowering mechanism, equipped with a car, that moves within guides and serves two or more landings and is classified by the following type:

Elevator, wind turbine tower — a hoisting and lowering mechanism equipped with a car installed in a wind turbine tower.

Elevator personnel — persons who have been trained in the construction, maintenance, repair, inspection, or testing of equipment.

Emergency stop switch — a device located as required and readily accessible for operation that, when manually operated, causes the electric power to be removed from the driving-machine motor and brake of an electric elevator; or from the electrically operated valves and pump motor of a hydraulic elevator; or of a dumbwaiter; or of a material lift.

Endurance limit of a component — the maximum stress that can be alternated or reversed within specified limits without producing fracture of the component material.

Engineering test — a test carried out or witnessed by a registered or licensed professional engineer, testing laboratory, or certifying organization to ensure conformance to Code requirements.

Factor of safety — the ratio of the ultimate strength to the working stress of a member under maximum static loading, unless otherwise specified in a particular requirement.

Gate — the moveable portion(s) of an entrance that closes the opening. A gate has through openings.

Governor — see **Speed governor**.

Guide rope fixes — wire guide rope attachment hardware securing the guiding system to the structure.

Hoistway (shaft), elevator, dumbwaiter, or material lift — an opening through a building or structure for the travel of elevators, dumbwaiters, or material lifts, extending from the pit floor to the roof or floor above.

Hoistway door or gate locking device — a device that secures a hoistway door or gate in the closed position and prevents it from being opened from the landing side except under certain specified conditions.

Hoistway door combination mechanical lock and electric contact — a combination mechanical and electrical device with two related, but entirely independent functions that are

a) to prevent operation of the driving machine by the normal operating device unless the hoistway door is in the closed position
b) to lock the hoistway door in the closed position and prevent it from being opened from the landing side unless the car is within the landing zone

Note: *As there is no positive mechanical connection between the electric contact and the door locking mechanism, this device ensures only that the door will be closed, but not necessarily locked, when the car leaves the landing. Should the lock mechanism fail to operate as intended when released by a stationary or retiring car-cam device, the door can be opened from the landing side even though the car is not at the landing. If operated by a stationary car-cam device, it does not prevent opening the door from the landing side as the car passes the floor.*

Hoistway enclosure — the fixed structure consisting of vertical walls or partitions that isolates the hoistway from all other areas or from an adjacent hoistway and in which entrances are installed.

Installation — a complete elevator, dumbwaiter, escalator, material lift, or moving walk, including its hoistway, hoistway enclosures and related construction, and all machinery and equipment necessary for its operation.

Labeled/marked — equipment or material to which has been attached a label, symbol, or other identifying mark of an approved or accredited independent certifying organization, concerned with product evaluation, that maintains periodic inspection of production of labeled/marked equipment or material, and by whose labeling/marking the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Note: *For the purpose of this definition, "accredited" means that an organization has been evaluated and approved by an Authorized Agency to operate a Certification/Listing program, and is designated as such in a publication of the Authorized Agency.*

Landing, elevator or material lift — that portion of a floor, balcony, or platform used to receive and discharge passengers or freight.

Landing, bottom terminal — the lowest landing served by the elevator or material lift that is equipped with a hoistway entrance.

Landing, top terminal — the highest landing served by the elevator or material lift that is equipped with a hoistway entrance.

Listed/certified — equipment or materials accepted for inclusion in a publication by a certifying organization.

Note: *The means for identifying listed/certified equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed/certified unless it is also labeled/marked. The authority having jurisdiction utilizes the system employed by the listing/certifying organization to identify a listed/certified product.*

Load, dynamic — the load applied as a result of acceleration or deceleration.

Load, impact — a suddenly applied load.

Load, static — the load applied as a result of the weight.

Machine, driving — the power unit that applies the energy necessary to drive an elevator or other equipment covered by the scope of this Code.

Driving machine, electric — a driving machine in which the energy is applied by an electric motor. It includes the motor, driving-machine brake, and the driving sheave or drum, together with its connecting gearing, belt, or chain, if any.

Driving machine, rack-and-pinion — an electric driving machine in which the motion of the car is obtained by a power-driven rotation pinion(s) mounted on the car, traveling on a stationary rack mounted in the hoistway.

Traction machine — a direct driving machine in which the motion of a car is obtained through friction between the suspension ropes and a traction sheave.

Maintenance — a process of routine examination, lubrication, cleaning, and adjustment of parts, components, and/or subsystems for the purpose of ensuring performance in accordance with the applicable Code requirements. (See also **Repair** and **Replacement**.)

Maintenance control program (MCP) — a documented set of maintenance tasks, maintenance procedures, examinations, and tests to ensure that equipment is maintained in compliance with the requirements of ASME A17.1/CSA B44, 8.6.

Maintenance procedure — an instruction or sequence of instructions for performing a specific task(s).

Manually (manual) reset, elevator —

a) a type or feature of an elevator part or component that, when actuated, requires intervention of a person in order to reinstate it to its nonactuated state.
b) a type of action required to be taken by a person to reinstate an elevator part or component from an actuated state to its nonactuated state.

May — indicates permission, not a mandatory requirement.

Means, suspension — tensile components that support, raise, and lower a car, counterweight, or both.

Mechanical lock — see **Hoistway door combination mechanical lock and electric contact**.

Member, suspension — an individual load-carrying component of the suspension means (e.g., a single rope or belt).

Normal stopping means — that portion of the operation control that initiates stopping of the car in normal operation at landings.

Operating device — the car switch, push buttons, key or toggle switches, or other devices used to actuate the operation control.

Operation, inspection — a special case of continuous-pressure operation used for troubleshooting, maintenance, repair, adjustments, rescue, and inspection.

Overhead structure — all of the structural members, walls, platforms, etc., supporting the elevator machinery, sheaves, and equipment at the top of the hoistway.

Pit, elevator — the portion of a hoistway extending from the sill level of the bottom terminal landing to the floor at the bottom of the hoistway.

Platform, landing — permanent deck installed in wind turbine towers to access tower components.

Rated load, elevator, dumbwaiter, material lift, or escalator — the load that the equipment is designed and installed to lift at the rated speed.

Rated speed — the speed at which the elevator, dumbwaiter, escalator, moving walk, or material lift is designed to operate under the following conditions:

Elevator, dumbwaiter, or material lift — the speed in the up direction with rated load in the car.

Readily accessible — capable of being reached quickly for operation, renewal, or inspection without requiring those to whom ready access is a requisite to climb over or remove obstacles or resort to portable ladders, chairs, etc.

Repair — reconditioning or renewal of parts, components, and/or subsystems necessary to keep equipment in compliance with applicable Code requirements. (See also **Replacement** and **Maintenance**.)

Replacement — the substitution of a device or component and/or subsystems, in its entirety, with a unit that is basically the same as the original for the purpose of ensuring performance in accordance with applicable Code requirements. (See also **Repair** and **Maintenance**.)

Rope, suspension (hoisting) — wire rope used to raise and lower an elevator, dumbwaiter, or material lift car or its counterweight, or both.

Safety, car or counterweight — a mechanical device attached to the car, car frame, or to an auxiliary frame; or to the counterweight or counterweight frame; to stop and hold the car or counterweight under one or more of the following conditions: predetermined overspeed, free fall, or if the suspension ropes slacken.

Shaft — see **Hoistway**.

Shall — indicates a mandatory requirement.

Should — indicates a recommendation, not a mandatory requirement.

Slack-rope switch — a device that automatically causes the electric power to be removed from the elevator driving machine motor and brake when the suspension ropes of a winding drum machine become slack.

Speed governor — a continuously operating speed monitoring and detection device that, at predetermined speeds, provides signals to the controller and imparts a retarding force to activate the car or counterweight safety.

Tail line — the slack portion of the suspension member extending below the traction climbing driving machine.

Terminal landing — see **Landing, elevator or material lift**.

Terminal stopping device, final — a device that automatically causes the power to be removed from a driving machine motor and brake, or from a hydraulic machine, after the car has passed a terminal landing.

Terminal stopping device, normal — device(s) to slow down and stop an elevator, dumbwaiter, or material lift car automatically at or near a terminal landing.

Travel path — in a wind turbine tower elevator, the space defined by the projected footprint of the car, inclusive of any horizontal displacement of the car, from the bottom landing platform to the uppermost point of travel or the final limit.

Traveling cable — a cable made up of electric conductors that provides electrical connection between an elevator, dumbwaiter, material lift car, or counterweight and a fixed outlet in the hoistway or machine room.

Type test — a test carried out or witnessed by a certifying organization concerned with product evaluation and the issuing of certificates to ensure conformance to Code requirements.

1.3 References

The following is a list of publications referenced in this Code:

16 CFR Part 1201 (Sections 1201.1 and 1201.2), Safety Standard for Architectural Glazing Materials
29 CFR OSHA 1910.66 (Appendix C), Powered Platforms for Building Maintenance
Publisher: U.S. Government Publishing Office
732 N. Capitol Street, NW
Washington, DC 20401
Telephone: (202) 512-1800 / (866) 512-1800
http://www.gpo.gov/

AGMA 218.01 (withdrawn), Rating the Pitting Resistance and Bending Strength of Spur and Helical Involute Gear Teeth
Publisher: American Gear Manufacturers Association
1001 N Fairfax Street
Alexandria, VA 22314-1587
Telephone: (703) 684-0211
http://www.agma.org

ANSI Z535.2 (latest edition), Environmental and Facility Safety Signs
Publisher: American National Standards Institute
25 West 43rd Street
New York, NY 10036
Telephone: (212) 642-4900
http://www.ansi.org

AISC S326 (withdrawn), Specification for Design, Fabrication, and Erection of Structural Steel for Buildings
Publisher: American Institute of Steel Construction
One East Wacker Drive
Chicago, IL 60601-1802
Telephone: (312) 670-2400
http://www.aisc.org

ANSI/AWS D1.1 (latest edition), Structural Welding Code — Steel
ANSI/AWS D1.3 (latest edition), Structural Welding Code — Sheet Steel
Publisher: American Welding Society
8669 NW 36 Street, #130
Miami, FL 33166
Telephone: (800) 443-9353
http://www.aws.org

ASME A17.1/CSA B44 (2013), Safety Code for Elevators and Escalators
ASME A17.6 (latest edition), Standard for Elevator Suspension, Compensation, and Governor Systems
Publisher: The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016
Telephone: (212) 591-8500
http://www.asme.org

ASTM E8/E8M (latest edition), Standard Test Methods for Tension Testing of Metallic Materials
Publisher: American Society for Testing and Materials
100 Barr Harbor Drive
P.O. Box C700
West Conshohocken, PA 19428-2959
Telephone: (610) 832-9585
http://www.astm.org

CAN/CGSB 12.1 (latest edition), Tempered or Laminated Safety Glass
CAN/CGSB 12.11 (latest edition), Wired Safety Glass
CAN/CGSB 12.12 (latest edition), Plastic Safety Glazing Sheets
Publisher: Canadian General Standards Board
11 Laurier Street
Gatineau, Québec K1A 1G6
Telephone: (819) 956-0425
http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html

CSA B44.1/ASME A17.5 (latest edition), Elevator and Escalator Electrical Equipment
CSA C22.1 (latest edition), Canadian Electrical Code, Part I
CSA C22.2 No. 141-15, Emergency Lighting Equipment
CAN/CSA S16.1-94 (replaced by CSA S16-14), Limit States Design of Steel Structures
CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel
CSA W59-13, Welded Steel Construction (Metal Arc Welding)
CSA Z259.16 (latest edition), Design of Active Fall-Protection Systems
CAN/CSA-Z321 (withdrawn), Signs and Symbols for the Workplace
Publisher: CSA Group
178 Rexdale Boulevard
Toronto, Ontario M9W 1R3
Telephone: (416) 747-4044 / (800) 463-6727
shop.csa.ca

BS EN 12016 (latest edition), Electromagnetic compatibility — Product family standard for lifts, escalators and moving walks — Immunity
BS EN 13411-3 (latest edition), Terminations for steel wire ropes — Safety — Part 3: Ferrules and ferrule-securing
Publisher: British Standards Institution
389 Chiswick High Road
London, W4 4AL United Kingdom
Telephone: +44 020 8996 9000
http://www.bsi-global.com

NFPA 70 (latest edition), National Electrical Code
Publisher: National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471
Telephone: (617) 770-3000
http://www.nfpa.org

UL 924, Emergency Lighting and Power Equipment
Publisher: Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062-2096
Telephone: (847) 272-8800
http://www.ul.com

2 Wind turbine tower elevators

2.1 Construction of hoistways

2.1.1 Hoistway enclosure not required

Full hoistway enclosures are not required.

2.1.2 Enclosures required at landings

Partial hoistway enclosures shall be required at landing platforms and shall conform to 2.11.

2.1.3 Floor over travel path not required

A floor over the travel path is not required; however, when provided shall conform to 2.1.3.1 and 2.1.3.2.

2.1.3.1

Overhead floors shall be capable of sustaining a concentrated load of 1 000 N (225 lb) on any 2 000 mm^2 (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 not less than 6 kPa (125 lb/ft^2) in all open areas.

2.1.3.2

Floors shall be of metal construction and if perforated, the openings shall reject a ball 25 mm (1 in) in diameter or be provided with a guard surrounding the perforation a minimum of 50 mm (2 in) in height.

2.2 Pits

2.2.1

Pits shall not be provided.

2.3 Location and enclosing of counterweights

2.3.1 Counterweight runways

Counterweights, where provided, shall have their runways fully enclosed and shall run in separate guides.

2.3.2 Access to enclosed counterweights and ropes

Access shall be provided for inspection, maintenance, and repair of an enclosed counterweight and its ropes. Doors or gates in the counterweight enclosures shall be self-closing and shall be provided with

a) an electric contact, the opening of which will remove power from the elevator driving-machine motor and brake
b) a self-locking keyed tumbler lock.

2.4 Vertical clearances for cars and counterweights

2.4.1 Top car clearance (maintenance/inspection access required)

Where access to the car top is required for maintenance or inspection and when the car has reached its maximum upward movement, the clearance above the car top, measured vertically up to the horizontal plane described by the lowest part of the overhead structure or other obstruction and measured within the projection of the car enclosure top exclusive of the area outside the standard railing (see 2.10.2), where provided, shall be not less than 1 100 mm (43 in). In no case shall the following additional clearances be less than:

a) 600 mm (24 in) above the car crosshead assembly except when the crosshead is located over the car enclosure top or the distance which any sheave assembly mounted in or on the 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 sheave assembly.
b) 300 mm (12 in) above the car crosshead assembly where the crosshead is adjacent to the car enclosure top. The crosshead shall not overlap the car enclosure top by more than 100 mm (4 in) horizontally.
c) 600 mm (24 in) above equipment attached to and projecting above the car enclosure top, exclusive of
    i) standard railings
    ii) areas outside of the standard railing, the vertical clearance shall be not less than 100 mm (4 in)
    iii) roller and sliding guide assemblies.

Where access to the car top is required for maintenance and inspection of equipment, a railing conforming to 2.10.2 within 50 mm (2 in) of the perimeter of the car enclosure top shall be provided. When the car has reached its maximum upward movement, there shall be a clearance not less than 100 mm (4 in) from the highest projection of the car top railing to the nearest part of the overhead structure.

2.4.2 Top car clearance (maintenance/inspection access not required)

Where access to the car top is not required for maintenance or inspection

a) equipment mounted on the car top shall not strike any part of the overhead structure or the equipment located in the travel path when the car has reached its maximum upward movement, and
b) a sign shall be provided with the words “DANGER LOW CLEARANCE”* prominently posted on the car top equipment. The sign shall conform to ANSI Z535.2 or CAN/CSA-Z321, whichever is applicable. 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 legible.

    * *The equivalent French wording is “DANGER, JEU RÉDUIT”.*

2.4.3 Top counterweight clearance

Top counterweight clearance, where counterweights are provided, shall not be less than 600 mm (24 in).

2.5 Horizontal car and counterweight clearances

Clearances shall conform to 2.5.1 through 2.5.4.

2.5.1 Between car and landing platforms

The clearance between the car and the landing platform shall be greater than or equal to 25 mm (1 in) on the sides used for loading and unloading (see Nonmandatory Annex A).

2.5.2 Between car and any stationary object

There shall be a minimum of 25 mm (1 in) clearance between the car structure and any stationary objects. Clearances are permitted to be maintained by rollers or similar devices mounted on the car. Clearance shall be measured from the car structure.

2.5.3 Between car and counterweight and counterweight guard

The clearance between the car and the counterweight shall be not less than 40 mm (1.5 in) at all times and under all operating conditions. 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).

2.5.4 Measurement of clearances

The clearances shall be measured with no load on the car platform.

2.6 Protection of spaces below the travel path

Where the travel path does not extend to the lowest floor of the structure and there is space below the travel path that is accessible, the floor shall be capable of sustaining

a) a concentrated load of 1 kN (225 lb) on any 2 000 mm^2 (3 in^2) area, and
b) a live load not less than 6 kPa (125 lb/ft^2) in all open areas.

2.7 Machinery spaces, machine rooms, control spaces, and control rooms

Elevator machine rooms and control rooms are not permitted in wind turbine towers.

2.7.1 Equipment location

Elevator equipment shall be located in machinery spaces and control spaces on the car or outside the travel path and shall conform to 2.7.1.1 and 2.7.1.2.

2.7.1.1 Motor controller location

The motor controller shall be

a) located in a machinery space and control space, in an enclosure with a door(s) or panel(s) that is (are) not self-closing and that shall be kept closed
b) readily accessible for maintenance and inspection at all times
c) lit by permanently installed electric lighting with a lighting intensity of at least 200 lx (19 fc) at the cabinet when power is applied to the motor controller or temporary lighting with a lighting intensity of at least 200 lx (19 fc) at the cabinet when power is removed from the motor controller.

2.7.1.2 Temperature and humidity

All equipment shall be designed for the ambient air temperature and humidity range specified by the wind turbine manufacturer. The temperature and humidity range shall be permanently posted on the cabinet. The height of the letters and figures shall be not less than 3 mm (0.125 in).

2.8 Equipment in the travel path, machinery space, and control spaces

2.8.1 Electrical equipment and wiring

Installation of electrical equipment and wiring shall conform to NFPA 70 or CSA C22.1, whichever is applicable. Turbine electrical generation equipment is permitted in spaces outside the travel path provided the nonelevator equipment does not interfere with the operation of the elevator equipment.

2.9 Machinery and sheave beams, supports, and foundations

Overhead machinery beams and supports shall conform to 2.9.1 through 2.9.4.

2.9.1 Securing of machinery beams and type of supports

2.9.1.1

All machinery and sheaves shall be so supported and secured as to effectively prevent any part becoming loose or displaced.

2.9.1.2

Overhead beams directly supporting machinery shall be of steel.

2.9.1.3

Machinery or equipment shall be secured to and supported on, or from the top of, overhead beams, except for the following equipment:

a) secondary or deflecting sheaves of traction elevators
b) devices and their accessories for limiting or retarding car speed
c) driving machines on the car.

2.9.1.4

Cast iron in tension shall not be used for supporting members for sheaves where they are hung beneath beams.

2.9.2 Loads on overhead beams and supports

Overhead beams, floors, and their supports shall be designed for not less than the load imposed by the guide ropes of rope-guided systems plus twice the sum of the following loads:

a) the load secured to or supported by the beams and supports, that 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 or control space supported thereon; and
b) the sum of the tensions in all suspension members supported by the beams and their supports with rated load in the car.

Note: (2.9.2) *The object in doubling the suspended load is to allow for impact, accelerating stresses, etc.*

2.9.3 Factor of safety of overhead beams and supports

The factor of safety for overhead beams and their supports shall be not less than 5 for steel.

2.9.4 Allowable stresses and deflections for machinery and sheave beams, their supports, and any support members that transmit load to the turbine tower walls

2.9.4.1
The unit stresses for all machinery and sheave beams and their supports, based on the loads computed as specified in 2.9.2, tensions shall not exceed 80% of those permitted for static loads by AISC S326 or CAN/CSA-S16.1, whichever is applicable.

2.9.4.2
The allowable deflections of machinery and sheave beams, their immediate supports, and any support members loaded in bending that transmit load to guide rails or turbine tower walls under static load shall not exceed 1⁄1666 of the span.

2.10 Guarding of equipment and standard railing

2.10.1 Guarding of equipment
In machinery and control spaces, the following shall be guarded to protect against accidental contact:
a) exposed sheaves and pinch points
b) exposed gears, sprockets, and chains
c) exposed keys, keyways, and screws in projecting shafts.

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
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
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
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
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.

2.10.3 Landing platform protection

A standard railing protecting the openings in landing platforms shall be provided and conform to 2.11.5.

2.11 Protection of landing platform openings

Protection of landing openings shall conform to 2.11.1 through 2.11.5.

2.11.1 Landing platform doors or gates

A landing platform door or gate shall be permanently installed and shall be one of the following types:

a) horizontally sliding
b) horizontally swinging
c) combination horizontally sliding and swinging.

2.11.2 Door or gate closers

Landing platform doors and gates shall be openable with not more than 50 N (11 lbf) and be self-closing or provided with a means to assure the door is closed when the car is not at a landing.

2.11.3 Horizontal platform inside enclosure

The horizontal distance between the travel path side of the door or gate and the edge of the landing platform shall be less than or equal to 65 mm (2.5 in) (see Nonmandatory Annex A).

2.11.4 Platform lighting

The landing platform shall be so lighted that the illumination, when the elevator is in service, shall be not less than 27 lx (2.5 fc) at the standing surface.

2.11.5 Landing platform enclosures

Where the travel path is adjacent to areas accessible by authorized or elevator personnel, the landing platform enclosure shall conform to 2.11.5.1 through 2.11.5.7.

2.11.5.1

It shall be enclosed to a height not less than 1 070 mm (42 in) above the floor or stair treads with a standard railing (see 2.10.2).

2.11.5.2

It shall be at the bottom landing and have a solid or openwork enclosure that rejects a ball 25 mm (1 in) in diameter.

2.11.5.3

It shall be of sufficient strength to prevent contact between the enclosure and the car or counterweight when the enclosure is subjected to a force of

a) 890 N (200 lbf) applied within 50 mm (2 in) of the top edge, and
b) 1 112 N (250 lbf) applied at right angles at any point over an area of 100 mm × 100 mm (4 in × 4 in).

2.11.5.4

It shall have a horizontal clearance not less than 90 mm (3.5 in) and no more than 150 mm (6 in) between loading side of the car and inside of landing platform enclosure (see Nonmandatory Annex A).

2.11.5.5
It shall be provided with a means of entrance to the car complying with 2.11.2.

2.11.5.6
Landing platform horizontally sliding doors and gates shall have means provided to prevent the hangers from jumping the track and stops provided in the assembly to prevent hangers from overrunning the end of the track.

2.11.5.7
The hoistway face or hardware of the landing platform doors or gates shall not project into the travel path beyond the edge of the landing platform.

2.12 Landing platform door locking devices and electric contacts

2.12.1 Landing platform door and gate locking devices
Landing platform door mechanical lock and electric contacts are not required except where automatic call operation is provided.

2.12.2 Where required (for automatic call operation)
Where required by 2.26.1.2 c), landing platform door mechanical lock and electric contacts shall be provided and conform to 2.12.3.

2.12.3 General design requirements
Combination mechanical locks and electric contacts shall conform to 2.12.3.1 through 2.12.3.5.

2.12.3.1
They shall be so designed that the locking member and the electric contact are mounted on and attached to a common base in such a manner that there is a fixed relation between the location of the contact and the location of the locking member.

They shall be so installed and adjusted that the electric contact cannot close until the door is in the closed position and so that the locking member is in a position to lock the door when or before the contact closes. In order to prevent motion of the door from opening the electric contact while the door is locked in the closed position, multiple-locking points shall, where necessary, be provided on the locking mechanism.

2.12.3.2
The electric contact shall be positively opened by the locking bar of the mechanical lock or by a lever or other device attached to and operated by the door, and the electric contact shall be maintained in the open position by the action of gravity or by a restrained compression spring, or both, or by positive mechanical means.

2.12.3.3
The mechanical lock shall hold the door in the locked position by means of gravity or by a restrained compression spring, or both.

2.12.3.4
Mercury tube switches shall not be used.

2.12.3.5 Listing/certification door locking devices and door or gate electric contacts

2.12.3.5.1 Type tests

Each type and make of landing platform door combination mechanical lock and electric contact shall conform to the type tests specified in ASME A17.1/CSA B44, 8.3.3. The tests shall be done by or under the supervision of a certifying organization.

2.12.3.5.2 Listing/certification

Each type and make of landing platform door combination mechanical lock and electric contact shall conform to the general requirements for tests and certification specified in ASME A17.1/CSA B44, 8.3.1.

2.12.3.5.3 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 label 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) the certifying organization name or identifying 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 actuating device mounted on the car when tested per ASME A17.1/CSA B44, 8.3.3.4.7, except the term “retiring cam” shall be replaced with words “actuating device mounted on the car”
g) date (month and year) devices subjected to type test specified in 2.12.3.5.1
h) if the device has only been type tested and listed/certified for use on a wind turbine tower elevator, the label shall indicate the restricted use.

2.13 Power operation of landing platform doors and car doors or gates

Power operation of landing platform doors and car doors or gates is prohibited.

2.14 Car enclosures, car doors and gates, and car illumination

2.14.1 Car enclosure

Cars shall be enclosed with metal at the sides and top. The enclosure walls shall be designed to reject a 25 mm (1 in) ball up to a height of 2 135 mm (84 in).

2.14.2 Car height

The minimum clear height inside the car shall be no less than 2 000 mm (78 in). The clear height shall be permitted to be reduced to 1 930 mm (76 in) provided all projections below 2 000 mm (78 in) are marked with yellow and black diagonal stripes not less than 25 mm (1 in) in width.

2.14.3 Vision panels

Vision panels are permitted in the enclosure walls provided they are located 1 000 mm (39 in) above the floor.

2.14.4 Enclosure panels

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 complies with CAN/CGSB-12.1, CAN/CGSB-12.11, or CAN/CGSB-12.12, whichever is applicable
b) be mounted in the structure so that the assembly shall withstand the required elevator tests without damage
c) have markings as specified in the applicable glazing standard that shall be on each separate piece, and shall remain visible after installation.

2.14.5 Strength of car top

The car enclosure top shall be so designed and installed as to be capable of sustaining a load of 135 kg (300 lb) on any area 600 mm × 600 mm (24 in × 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.

2.14.6 Top of car railing

Where the car top is intended to be used for operation of the car for maintenance or inspection, it shall be provided with a car top standard railing conforming to 2.10.2.

2.14.7 Car illumination

Illumination in the car shall be provided from a permanent light source inside or outside the car. The light source shall provide illumination of at least 27 lx (2.5 fc) at the floor of the car platform with car door or gate in the closed position.

2.14.8 Emergency lighting

Illumination in the car shall be provided from an emergency light source in the car or from outside the car. The light source shall provide a minimum level of illumination of 2 lx (0.2 fc), measured at any point between 890 mm (35 in) and 1 225 mm (48 in) above the car floor and approximately 300 mm (12 in) centered horizontally in front of a car.

2.14.8.1

Emergency lights shall be automatically turned on when normal car lighting power fails.

2.14.8.2

The power system shall be capable of maintaining the minimum light intensity specified for a period of at least 30 min.

2.14.8.3

Not less than two lamps of approximately equal wattage shall be used.

2.14.8.4

Battery-operated units mounted on the car, where provided, shall

a) conform to CSA C22.2 No. 141 or UL 924
b) be permanently connected to a car light circuit provided from the elevator controller.

2.14.9 Car emergency exit

Means for emergency exit from the car shall be provided and shall conform to 2.14.9.1 and either 2.14.9.2 or 2.14.9.3.

2.14.9.1

Rated personnel protective equipment anchorage point(s), appropriate to the number of persons the car is designed to carry, shall be provided for safe emergency exit conforming to 29 CFR OSHA 1910.66 (Appendix C) or CSA Z259.16.

2.14.9.2

Emergency exit through the car door or gate is permitted where the distance from the point of emergency exit to the accessible means of evacuation does not exceed 1 100 mm (43 in).

2.14.9.3

Access through the top or bottom of a ladder-guided car is permitted where

a) the distance from the point of access to the accessible means of evacuation is equal to or less than 1 100 mm (43 in) and the exit,
b) the opening has an area not less than 227 000 mm^2 (352 in^2), and shall not measure less than 380 mm (15 in) on any side,
c) be so located as to provide a clear passageway, unobstructed by fixed elevator equipment located in or on top of the car,
d) the access covers are hinged, or otherwise attached, to the car and open in the upward direction only, and
e) the access cover(s) is (are) equipped with a switch or contact that, when opened, removes power from the driving-machine motor and brake.

2.14.10 Car doors and gates

Each car shall be equipped with a car door or gate conforming to the following:

a) when closed, guard the opening to its full height,
b) be mechanically prevented from unintentional opening,
c) be openable from inside the car and from outside the car at any point in the travel path,
d) be of solid or openwork construction that will reject a ball 25 mm (1 in) in diameter,
e) when made of materials other than metal, conform to 2.14.3 and 2.14.4,
f) not be power operated, and
g) when 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, doors and gates shall not be permanently deformed or be displaced from their guides or tracks.

2.14.11 Car door and gate electric contacts

Each car door or gate shall be provided with a door or gate electric contact conforming to the following:

a) it shall remove power from the driving-machine motor and brake when the car door or gate is not in the closed position,
b) it shall be positively opened by a device attached to and operated by the door or gate,
c) it shall be maintained in the open position by the action of gravity or by a restrained compression spring, or both, or by positive mechanical means, and
d) it shall not utilize mercury tube switches.

2.14.11.1
Each type and make of car door or gate electric contact shall be type tested per 2.30. The tests shall be done by or under the supervision of a certifying organization.

2.14.11.2
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 label 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) the certifying organization name or identifying symbol
c) a distinctive type, model, or style letter or number
d) rated voltage and current, and whether AC or DC.

2.14.12 Clear openings
The clear opening of the car door or gate shall be a minimum of 450 mm (18 in) wide.

2.14.13 Sectioning
Car doors or gates are permitted to be sectioned provided each section partially covering the car enclosure entrance conforms to 2.14.1 through 2.14.14. The lower door section shall be a minimum of 1 100 mm (43 in) in height.

2.14.14 Ventilation
Natural ventilation openings shall be provided in the car enclosures with a total area of not less than 3.5% of the inside car floor area divided equally between the bottom and top of the car enclosure.

2.15 Car frames and platforms
Car frames and platforms shall conform to 2.15.1 through 2.15.11.

2.15.1 Car frames and platforms
Car frames and car platforms shall be metal.

2.15.2 Use of cast iron
Cast iron shall not be used in the construction of any member of the car frame or platform other than for guide shoes and guide-shoe brackets.

2.15.3 Number of compartments
The car shall not have more than one compartment.

2.15.4 Guiding means
Car frames shall be guided on each side by upper and lower guiding members attached to the frame.

2.15.5 Strength of guiding means
Guiding members shall be designed to withstand the forces imposed during normal operation of the elevator, emergency stopping, and the application of safeties.

2.15.6 Car frame

All structural components of the car frames and platforms shall have a minimum factor of safety of 5.

2.15.7 Guiding members

Failure of any guiding member shall not permit the car and car frame to strike any portion of the tower structure. Obstruction-detection devices (see 2.15.9) shall be permitted to detect when the car is outside the travel path.

2.15.8 Kickboard

The car platform shall be provided with a kickboard with a minimum of 25 mm (1 in) and a maximum of 100 mm (4 in) in height, located on the side used for loading and unloading and shall be marked yellow.

2.15.9 Obstruction-detection devices

The top and bottom of the car shall be provided with a means to detect an obstruction in the travel path and stop the car by causing the power to be removed from the driving-machine motor and brake. Each obstruction-detection device shall

a) be provided with a switch actuated by the obstruction-detection device whose contacts are positively opened mechanically; their opening shall not be solely dependent on springs,
b) be designed in such a manner that it cannot be reset until the obstruction-detection mechanism has been returned to the unapplied position,
c) be designed to withstand the forces imposed on it,
d) have a maximum actuation force of 70 N (15 lbf) and a throw not to exceed 100 mm (4 in). The switch shall actuate upon movement of the obstruction-detection device,
e) detect a ball greater than 100 mm (4 in) in diameter within the projected area of the car, and
f) not permit restarting of the elevator when an obstruction device resets, after being actuated.

2.15.10 Warning devices

Cars shall be provided with an external visual warning device or an audible warning device (or both) that operates while the car is in motion.

2.15.10.1

The illumination of the external visual warning device shall be a minimum of 500 lx (46 fc) measured at a point 2.5 m (8 ft) from the horizontal surfaces of the car with a flash frequency between 50 to 80 times per minute and be visible above and below the car.

2.15.10.2

The audible warning device shall have a minimum sound level of 70 dBA at 1 000 mm (39 in) in the travel path and below the elevator, with a 50% duty cycle and a frequency between 1 kHz and 4 kHz and be audible above and below the car.

2.15.10.3

Means shall be provided to assure operation of the visual or audible warning device during primary power loss for a minimum of 30 min. If a battery is used for this purpose, testing, replacement, and inspection procedures shall be provided in the MCP (see ASME A17.1/CSA B44, 8.6.1.2).

2.15.11 Ladder-guided platforms

Platforms for ladder-guided systems are permitted to have perforations or be of fabricated openwork construction. Openings shall reject a ball 10 mm (3/8 in) in diameter.

2.16 Capacity and loading

2.16.1 Capacity and data plates

Every car 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.

2.16.2 Information required on plates

2.16.2.1 Capacity plates

Capacity plates shall be marked in a legible and permanent manner with letters and figures not less than 25 mm (1 in) in height indicating the rated load of the elevator in kilograms or pounds, or both.

2.16.2.2 Data plates

Data plates shall be marked in a legible and permanent manner with letters and figures not less than 3 mm (0.125 in) in height indicating

a) the weight of the complete car, including the driving machine and all auxiliary equipment attached to the car,
b) the rated load and speed,
c) the suspension-means data required,
d) the name or trademark of the manufacturer and year manufactured, and
e) guiding means lubrication instructions.

2.16.3 Limitation of load, speed, and platform area

The rated load shall not exceed 454 kg (1 000 lb). The inside net platform area shall not exceed 1.2 m^2 (13 ft^2). The minimum rated load shall not be less than that based on 3.4 kPa (70 lbf/ft^2) of inside net platform area or 113 kg (250 lb), whichever is greater. The rated speed shall not exceed 0.4 m/s (80 ft/min).

2.16.4 Overload detection means

A means to detect an overload shall be provided and the overload value determined by the manufacturer's recommendations. A visual or audible signal device shall be provided so that authorized personnel are notified of an overload condition.

2.16.5 Speed-limiting device

A means shall be provided to limit the descent speed of the car to less than safety tripping speed when the manual brake release system is operated.

2.17 Car and counterweight safeties

Each car, and where required by 2.6 each counterweight, shall be provided with a safety conforming to 2.17.1 or 2.17.2 and the applicable requirements of 2.17.3 through 2.17.5.

2.17.1 Wire rope gripping safety

The safety shall be operated without delay by the breakage of the suspension means or by the action of an internal centrifugal governor when the car exceeds rated speed up to a maximum of 0.9 m/s (175 ft/min).

2.17.1.1

The safety shall act on an independent safety wire rope upon loss of suspension or overspeed (see 2.20.2.8).

2.17.1.2

Safeties shall be applied mechanically. Electric, hydraulic, or pneumatic devices shall not be used to apply the safeties or to hold such safeties in the retracted position.

2.17.1.3

When car safeties are applied, no 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.

2.17.1.4

Safeties shall be so designed that, on their application, the forces that provide the stopping action shall be compressive forces and shall not cause permanent deformation of the safety wire rope upon whose dimensional stability the stopping capability of the safeties is dependent.

2.17.1.5

The safety shall be located where it is readily accessible and it cannot be struck by any moving object in normal operation or under conditions of overtravel.

2.17.1.6

The minimum factors of safety and stresses of safety parts and rope connections shall not be less than 3.5, and the materials used shall have an elongation not less than 15% in a length of 50 mm (2 in) when tested in accordance with ASTM E8. Forged, cast, or welded parts shall be stress relieved.

2.17.1.7

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.

2.17.1.8

The factors of safety shall be based on the maximum stresses developed in the parts during the operation of the safety when stopping rated load from overspeed.

2.17.2 Rack-and-pinion safety

Where a single rack-and-pinion drive machine is used, the car shall be provided with one or more safeties conforming to 2.17.1 or a safety consisting of a freely rotating safety pinion, a governor, and a clamping device that shall be permitted to form an integral unit mounted on the car.

2.17.2.1

The safety shall operate without delay when the car exceeds rated speed up to a maximum of 0.9 m/s (175 ft/min) bringing the car to a gradual stop on the vertical rack.

2.17.2.2

Where multiple rack-and-pinion driving machines are provided, a safety is not required when

a) each driving machine is independently able to prevent a car that is loaded to 125% of rated load from descending uncontrolled,
b) each driving machine is capable of moving the car to the bottom floor under manual control, and
c) the failure of one driving machine is detected and power is removed from the other driving-machine motor and brake.

2.17.2.3

The stopping distance of the car measured from the time the safety or alternate means actuates to a full stop shall be a minimum of 25 mm (1 in) and a maximum of 380 mm (15 in).

2.17.3 Safety marking plates

Marking plates shall be metal and be securely attached or adjacent 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 3 mm (0.125 in) in height indicating

a) the type of safety, based on 2.17,
b) the maximum tripping speed in m/s (ft/min) for which the safety is permitted,
c) the maximum weight in kg (lb) that the safety is designed and installed to stop and sustain,
d) the manufacturer's name or trademark,
e) the year of manufacture, and
f) the force in N (lbf) required to activate the safety if applicable.

2.17.4 Opening of driving-machine motor and brake control circuits on safety application

Safeties shall be provided with a switch that opens (actuates) causing the power to be removed from the driving-machine motor and brake at the time the safety actuates and shall be of a type that cannot be reset until the safety mechanism has been returned to the unapplied position and conforms to 2.26.2.3.

2.17.5 Application of safety

A safety device that depends on the completion or maintenance of an electric circuit for the application of the safety is not permitted. Safeties shall be applied mechanically.

2.18 Reserved for future use

2.19 Reserved for future use

2.20 Suspension means and their connections

Suspension means shall conform to ASME A17.6, and 2.20.1 through 2.20.3, as applicable. Access for suspension-means inspection purposes shall be provided.

2.20.1 Suspension means for counterweighted traction elevators

For counterweighted traction elevators, suspension means shall be galvanized and conform to ASME A17.6 Part 1, and 2.20.1.1 through 2.20.1.5 for steel wire rope.

2.20.1.1

The minimum diameter of any steel wire rope shall be not less than 9.5 mm (0.375 in).

2.20.1.2

The factor of safety of the steel wire rope shall not be less than 7.95.

2.20.1.3

The arc of contact of a steel wire rope on a traction sheave and the shape of the grooves shall be sufficient to produce adequate traction under all load conditions.

2.20.1.4

No car or counterweight steel wire rope shall be lengthened or repaired by splicing. If one rope of a set is worn or damaged and requires replacement, the entire set of ropes shall be replaced.

2.20.1.5

The car or counterweight ends of steel wire ropes shall be fastened by properly attached fittings as recommended by wire-rope manufacturers.

2.20.2 Suspension means for uncounterweighted traction elevators

For uncounterweighted traction elevators, the suspension members shall be galvanized preformed steel wire rope and conform to ASME A17.6 Part 1, and 2.20.2.1 through 2.20.2.13 for steel wire rope.

2.20.2.1

The minimum diameter of any suspension steel wire rope shall not be less than 8 mm (0.3125 in).

2.20.2.2

The factor of safety of the suspension means shall be not less than 10. The factor of safety shall be calculated by the following formula:

$$F = \frac{(S \times N)}{W}$$

where

N = number of runs of suspension members under load

S = manufacturer's rated breaking force in kN (lbf) of one suspension member

W = maximum static load in kN (lbf) imposed on all suspension members with the car and its rated load at any position in the hoistway

2.20.2.3

The arc of contact of a steel wire rope on a traction sheave and the shape of the groove shall be sufficient to produce adequate traction under all load conditions.

2.20.2.4

No car suspension rope shall be lengthened or repaired by splicing.

2.20.2.5

Suspension steel wire rope terminated at the upper end shall be fastened by properly attached fittings as recommended by wire-rope manufacturers or by swage fittings complying with the following:

a) Use of swage fittings only on regular lay, synthetic core, or IWRC ropes are permitted.
b) They are swaged in a shop with a press under controlled conditions to guarantee reliable attachment.
c) Where rope adjustment is required, it may only be used at one end of the rope.
d) Swages shall be designed and tested in accordance with the design and testing requirements of BS EN 13411-3.
e) The swaging company shall be identified on the swage or on the rope data tag.
f) Swaging shall not be performed in the field.
g) The manufacturer shall provide verification means to assure the swage is crimped to manufacturer's specification.

2.20.2.6

U-bolt type rope clamps or similar devices shall not be used on the load side of suspension rope or safety wire rope fastenings.

2.20.2.7

Fastenings shall develop a minimum of at least 80% of the rope manufacturer's rated breaking force.

2.20.2.8

Means shall be provided to prevent the fastenings from having any physical contact resulting in wear of the rope or its fastening.

2.20.2.9

Use of a single suspension steel wire rope is permitted when a galvanized safety steel wire rope of equivalent size and grade as the suspension steel wire rope is provided (see 2.20.2.10).

2.20.2.10

a) Suspension members' replacement criteria shall conform to ASME A17.6. Other manufacturers' recommended criteria shall be included in the maintenance control program (see ASME A17.1/ CSA B44, 8.6.1), with sufficient detail to ensure that inspection criterion is provided.
b) When the steel wire suspension rope is replaced, the safety steel wire rope shall also be replaced.
c) A readily visible hour meter shall be provided on all suspended elevator cars and the suspension steel wire ropes shall be replaced after 250 h of operation or after 5 years, whichever occurs first.

2.20.2.11

A safety rope shall be provided and used only in the event of loss of primary suspension or overspeed safety actuation and shall

a) consist of a steel wire rope upon which a safety device (see 2.17.1) actuates to stop the car, and
b) conform to 2.20.2, except 2.20.2.3.

2.20.2.12

Only steel wire ropes in ASME A17.6 are permitted to be used in wind turbine tower elevators.

2.20.2.13

Pertinent data located on the suspension means and safety rope shall be provided by a data tag securely attached to the fastenings or adjacent to the controller. The following data shall be provided:

a) type of suspension
b) the diameter of the rope in millimeters or inches
c) the suspension-means manufacturer's minimum breaking force in kN or lbf
d) the grade of material used
e) construction classification
f) for steel wire rope, nonpreformed, if applicable
g) for steel wire rope, finish coating, if applicable
h) name or trademark of the rope manufacturer
i) name of person or organization who installed the ropes
j) the month and year the ropes were installed
k) lubrication information
l) swaging company, if applicable.

2.20.3 Chains used for suspension

Reserved for future use.

2.21 Counterweights

Counterweights, where provided, shall conform to the following.

2.21.1 Counterweight guides

Counterweights shall be guided to prevent any horizontal movement that would inhibit proper operation or cause counterweight to move from designated travel path and shall not be of sufficient weight to cause undue slackening of the hoisting ropes during acceleration or retardation of the car.

2.21.2 Types of counterweight construction

2.21.2.1

One-piece solid or laminated steel counterweights shall be permitted.

2.21.2.2

Where counterweight sections are used, means shall be provided to retain the sections in place if they become broken, whether carried in a frame or not. If tie rods are used, the sections shall be fastened together by a minimum of two tie rods that pass through all weight sections. Tie rods shall be provided with locknuts and cotter pins at each end.

2.21.2.3

The frame members and their connections shall be designed with a factor of safety not less than 5 with the elevator at rest and the counterweight at the top of its travel.

2.21.2.4

The counterweight frame shall be designed with a factor of safety not less than 2.5 at bumper or buffer engagement or safety application if provided.

2.22 Buffers, bumpers, and retardations

Cars and counterweights shall be provided with bumpers conforming to 2.22.1 or spring buffers conforming to 2.22.2.

2.22.1 Bumpers

Bumpers shall conform to the following:

a) they shall be located so as to retard the car and counterweight without exceeding allowable design stresses in the car frame and counterweight frame,
b) they 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 overspeed where provided, and
c) the material used shall be of a type that will resist deterioration or be so treated as to resist deterioration.

2.22.2 Spring buffers

Spring buffers shall conform to the following:

a) the stroke of the buffer spring shall be equal to or greater 38 mm (1.5 in)
b) the buffer shall be capable of supporting, without being compressed solid or to a fixed stop, a static load having a minimum of two times the total weight of the car and its rated load for car buffers and the total weight of the counterweight for counterweight buffers
c) the buffer shall be compressed solid or to a fixed stop with a static load of three times the weight of the car and its rated load for car buffers and the counterweight for total weight of the counterweight buffers
d) the buffer shall be provided with a marking plate showing its load rating and stroke; markings shall be made in a permanent and legible manner.

2.22.3 Retardations

Bumpers and buffers shall develop an average retardation not in excess of 9.81 m/s^2 (32.2 ft/s^2), and shall develop no peak retardation greater than 19.6 m/s^2 (64.4 ft/s^2), having a duration exceeding 0.04 s with any load in the car.

2.23 Car and counterweight guidance systems, supports, and fastenings

Means shall be provided to assure hazards due to relative movement between the tower ladder and elevator are provided. Guiding systems shall consist of one of the following:

a) wire-rope-guided conforming to 2.23.1
b) ladder-guided conforming to 2.23.2.

2.23.1 Wire rope guidance system for uncounterweighted traction drive machines

2.23.1.1

Guide ropes shall be galvanized steel wire rope conforming to ASME A17.6.

2.23.1.2

Guide ropes shall be tensioned with an applied load to maintain a minimum horizontal clearance of 25 mm (1 in) from the cab enclosure to other structures in the tower at all times. A means shall be provided to indicate the minimum and maximum allowable tension in the guide ropes.

2.23.1.3
Guide ropes shall have a minimum factor of safety of 8.

2.23.1.4
Guide ropes shall be a minimum of 8 mm (0.3125 in) in diameter.

2.23.1.5
Guide rope fixes shall
a) have a spacing no greater than 30 m (98 ft) apart,
b) be attached at each landing platform,
c) be capable of resisting the forces imposed without permanent deformation,
d) maintain alignment of the wire guide rope throughout the life cycle of the elevator, and
e) allow for axial movement.

2.23.1.6
a) Upper terminal guide rope fastenings shall conform to 2.20.2.5.
b) Lower terminal guide rope fastenings shall
   i) be provided with a fixed termination that retains the applied load with a factor of safety of 3
   ii) have a means to retension the rope
   iii) be permanently anchored.

2.23.1.7
Wire guide rope systems shall be designed to be permanently installed and extend beyond the travel path of the car such that no equipment on the car shall strike wire guide systems terminal fastenings.

2.23.1.8
A minimum of two guide ropes shall be provided.

2.23.1.9
Guide ropes shall be replaced according to the replacement criteria of ASME A17.6 and replacement ropes shall be new steel wire rope of the same type and grade.

2.23.1.10
Reuse of guide ropes as suspension or safety ropes is prohibited.

2.23.1.11
Guide ropes shall be positioned to prevent uncontrolled rotation of the car.

2.23.2 Ladder guidance systems
Ladder guidance systems shall conform to 2.23.2.1 through 2.23.2.8.

2.23.2.1
Ladder guidance systems shall be of steel or aluminum. Steel shall have an elongation not less than 20% in a length of 50 mm (2 in) and aluminum shall have an elongation not less than 12% in a length of 50 mm (2 in).

2.23.2.2

Ladder guidance systems and their brackets, rail clips, fishplates, and their fastenings to the support structure shall provide a minimum factor of safety of 4 for steel and 5 for all other metals for all applicable loads.

2.23.2.3

Guide surfaces shall be securely fastened to the ladder, and the ladder guides shall not exceed a design deflection of *L*/160 of span and the combined deflection shall not deflect more than 12 mm (0.5 in) under normal operation, and shall have their joints well-fitted and strongly secured. Guide surfaces and their joints and fastenings shall withstand without failure the application of the car safety when stopping the car with its rated load.

2.23.2.4

Guide surfaces shall extend from the bottom of the travel path to a sufficient height above the top landing to prevent the guide shoes from running off the guide surfaces when the car is at its extreme upper position.

2.23.2.5

A means of visually monitoring the travel path of the car shall be provided from the point of manual lowering actuation means.

2.23.2.6

Emergency evacuation shall be provided through top and bottom hatches except when the elevator is guided on the nonclimbing side of the ladder and when the door opening is perpendicular to the ladder rungs.

2.23.2.7

The car shall maintain a minimum of 175 mm (7 in) clearance from the ladder rung when the travel path is on the nonclimbing side.

2.23.2.8

A sign with letters 25 mm (1 in) in height complying with ANSI Z535.2 or CAN/CSA-Z321 shall be posted at each ladder access point saying "**CAUTION:** Elevator is guided on this ladder; beware of moving equipment."*

* *The equivalent French wording is "**AVERTISSEMENT :** Ascenseur ou monte-charge guidé sur cette échelle ; attention au matériel en mouvement."*

2.24 Driving machines, sheaves, and brakes

Driving machines shall be of the traction, traction climbing, rack-and-pinion, or chain climbing drive type and shall conform to 2.24.1, 2.24.2, or 2.24.3 and the applicable requirements of 2.24.4 through 2.24.9. The installation of belt-drive, winding drum, and screw drive machines are prohibited.

2.24.1 Rack-and-pinion driving machines

Rack and-pinion machines shall conform to 2.24.1.1 through 2.24.1.9.

2.24.1.1
The rack-and-pinion drive shall consist of one or more power-driven rotating pinions mounted on the car and arranged to travel on a stationary rack mounted on the supporting structure. The drive shall have at least one pinion, one rack, and two backup rollers, which shall act on the same section of rack as the drive pinion. Driving machines utilizing a two-sided rack, where two drive pinions are located so that they are opposite each other and act as backup rollers, shall be deemed to have met this requirement.

2.24.1.2
The pinions and racks shall be of steel or of material having equivalent mechanical properties or better with a minimum factor of safety of 8 for the pinion and the rack. They shall be designed to conform to AGMA 218.01, including surface hardening and an assumption of a minimum of 200 000 life cycles.

2.24.1.3
All moving parts of the driving machine shall be properly protected with solid or perforated metal that will reject a ball of 13 mm (0.5 in) diameter and shall be securely fastened.

2.24.1.4
The rack and pinion shall be so designed that the separation of the pinion from the rack in all directions in excess of 25% of the tooth depth or 6 mm (0.25 in), whichever is the lesser, cannot occur. A guard shall be provided to prevent foreign material from lodging between the teeth, and clearance between the moving parts and the guard shall not exceed 5 mm (0.1875 in).

2.24.1.5
Rack sections shall be fastened to the supporting structure with a factor of safety of 5 with dowels at each joint.

2.24.1.6
The manufacturer shall provide the measurement for checking tooth wear on pinion and rack. The measuring instruction shall be indicated on a marking plate securely fastened and conspicuously displayed in the car with letters not less than 3 mm (0.125 in) high and conform to the design requirements of 2.31.3.

2.24.1.7
Each drive unit shall be provided with a driving-machine brake capable of safely stopping and maintaining the weight of the car plus 125% of rated load.

2.24.1.8
Each drive unit shall be provided with a centrifugal brake capable of safely lowering the weight of the car plus 125% of rated load.

2.24.1.9
Where a multiple drive system is provided, means shall be provided to detect failure of a drive unit and remove power from all motors and brakes.

2.24.2 Traction driving machines, sheave and brakes
Traction machines shall conform to 2.24.2.1 through 2.24.2.7.

2.24.2.1

Driving-machine sheaves shall be integral with or directly attached to driving-machine shafts. Traction sheaves shall be constructed of metal and provided with finished grooves, steel shafts, and metal bearings. Overhead or deflecting sheaves are permitted to be nonmetallic with steel shafts and metal bearings.

2.24.2.2

Traction sheaves used with suspension means shall have a pitch diameter not less than

a) 20 times the diameter of steel wire rope where used for suspension ropes
b) 10 times the diameter of steel wire rope where the sheave is an overhead or deflecting sheave when on the unloaded side (trailing) of the suspension rope for uncounterweighted systems.

2.24.2.3

Where steel wire rope is used and a groove is used to provide traction, sufficient traction shall be provided between the rope and groove to safely stop and hold the car with rated load from rated speed in the down direction.

2.24.2.4

In a counterweighted system, if either the car or the counterweight bottoms on its buffers or bumpers, or becomes otherwise immovable,

a) the suspension members shall slip on the drive sheave 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.

2.24.2.5

A means shall be provided to retain each suspension member in its respective position on all sheaves used in the suspension of the elevator when subjected to any retardation that can cause a slackening of the suspension members.

2.24.2.6

Driving-machine components subjected to alternating or reversing stresses shall have a factor of safety not less than 1.5. This factor of safety shall be the ratio of the endurance limit of the components 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, keyways, material variations, alignment tolerances, etc.

2.24.2.7

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. Shafts that support sheaves, gears, couplings, and other members, and that transmit torque shall be provided with tight-fitting keys.

2.24.3 Chain climbing machines

Reserved for future use.

2.24.4 Material and grooving for sheaves

Traction sheaves for uncounterweighted traction machines shall be of cast iron or steel and of a pitch diameter not less than 20 times the diameter of the steel wire suspension ropes. The rope grooves shall

be machined. Overhead and deflecting sheaves are permitted to be nonmetallic with steel shafts and metal bearings.

2.24.4.1

The pitch diameter shall have a pitch diameter not less than 10 times the diameter on the unloaded side (trailing) of the suspension rope for uncounterweighted systems.

2.24.5 Factor of safety for driving machines and sheaves

The factor of safety to be used in the design of driving machines and sheaves used with suspension means 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 E8.
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 E8.
c) 10 for sheaves of plastic, fiber-reinforced plastic, or combinations thereof. The material used shall ensure that the factor of safety is not less than 8 during the service life of the sheave.

The load to be used in determining the factor of safety shall be the resultant of the maximum tensions in the suspension means leading from the sheave with the car at rest and with the rated load in the car.

2.24.6 Bolts transmitting torque and set screws

The threaded portions of bolts transmitting torque and set screws 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 2.24.5.

2.24.7 Friction-gearing or clutch mechanism

Friction-gearing or clutch mechanisms shall not be used for connecting the drum or sheaves to the main driving mechanism.

2.24.8 Use of cast iron in gears

Worms and worm gears made of cast iron shall not be used.

2.24.9 Braking system of driving machines

All elevators shall be provided with a braking system.

2.24.9.1

The elevator braking system shall be capable of decelerating the car from its rated speed when it is carrying its rated load in the down direction. The loss of main line power shall not reduce the braking system capacity.

2.24.9.2

The driving-machine brake shall be a friction brake applied by a spring or springs, or by gravity, and released electromechanically. The driving-machine brake, on its own, shall be capable of holding the car at rest with its rated load plus 125% overload.

2.24.9.3
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 any leaking fluid.

2.24.9.4
The brake setting and method of measurement shall be permanently and legibly marked on the driving machine or on the car data tag.

2.24.9.5
Two means shall be provided to independently remove power from the brake.

2.24.9.6
The driving-machine brake shall apply automatically when
a) the emergency stop switch in the car is in the stop position,
b) a normal stopping means functions,
c) any electrical protective device is activated, or
d) there is a loss of power to the driving-machine brake.

2.24.9.7
The brake shall not be permanently connected across the armature or field of a direct-current elevator driving-machine motor.

2.24.10 Means for manual release of driving machine brake
Means for manual release of the driving-machine brake shall be provided. 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.

2.25 Terminal stopping devices

2.25.1 Final terminal stopping
Final terminal stopping devices shall conform to the following except no down final switch is required for systems with driving machines that do not maintain driving force in the down direction as a result of driving machine remaining powered when landed at the bottom landing. Final terminal stopping devices shall
a) be mechanically operated
b) have operating cams of metal
c) have switch contacts directly opened mechanically.

2.25.1.1
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.

The operation of final terminal stopping devices shall prevent movement of the car by the normal operating devices in both directions of travel.

2.25.1.2

Elevators shall have final terminal stopping switches operated by cams and shall be operated by the movement of the car. One of the assemblies (i.e., switch or cam or actuation device) shall be mounted on the car and the other in the travel path. Where the final terminal stopping switch signals are transmitted through wiring in the traveling cable, the design shall be such that any single ground or short circuit shall not render the final terminal stopping device ineffective.

2.25.1.3

The normal terminal stopping device and final terminal stopping devices shall not control the same controller devices unless two or more separate and independent controller devices are provided, two of which shall complete both the driving-machine motor and the driving-machine brake circuits in either direction of travel.

The control circuits shall be so designed and installed that a single ground or short circuit shall not prevent both the normal terminal stopping device and final terminal stopping device control circuits from stopping the car.

2.25.2 Normal terminal stopping

Normal terminal stopping devices conforming to the following shall be provided. Obstruction-detection devices (see 2.15.9) shall be permitted to function as the normal terminal stopping device.

2.25.2.1

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.

2.25.2.2

Such devices shall function independently of the operation of the normal stopping means and of the final terminal stopping device, except that the normal terminal stopping device shall be permitted to be used as the normal stopping means.

2.25.2.3

The device shall be so designed and installed that it will continue to function until the final terminal stopping device operates.

2.25.2.4

Normal terminal stopping devices shall be operated by cams and shall be operated by the movement of the car. One of the assemblies (i.e., switch or cam) shall be mounted on the car and the other in the travel path.

2.25.3 Slack rope detection

Uncounterweighted traction drive elevators shall be provided with a slack rope switch to detect movement of the tail line weight or a slack rope condition and cause power to be removed from the driving machine and brake in the down direction. The switches shall have contacts that are positively

opened mechanically; the opening shall not be solely dependent on springs, and be designed to actuate with a maximum of 100 mm (4 in) of vertical rope movement.

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.

2.26.1.2 Types of operation

Only the following types of operations shall be permitted: AUTOMATIC CALL, AUTOMATIC SEND, and MANUAL.

a) Where the operation selection switch is in the MANUAL position or where no operation selection switch is provided, continuous pressure operation is enabled. Operating devices shall be of the continuous pressure type and attached to the car.
b) Where the operation selection switch is in the AUTOMATIC position and when operating devices are attached to the car, automatic send operation is enabled. Operating devices shall be of the momentary pressure type.
c) Where the operation selection switch is in the AUTOMATIC position and when operating devices are not attached to the car, automatic call operation is enabled. Operating devices shall be
    i) of the momentary pressure type, and
    ii) subject to the requirements of 2.12.

2.26.1.3 Wireless operating devices

Where wireless operating devices are provided, the operating devices shall be of the continuous pressure type.

2.26.1.4 All operating devices

All operating devices shall be

a) labeled “UP” and “DOWN,” respectively, and
b) subject to the electrical protective devices required by 2.26.2.

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. Electrical protective devices shall have contacts that are positively opened mechanically; the opening shall not be solely dependent on springs, and be provided as specified in 2.26.2.1 through 2.26.2.6.

2.26.2.1 Emergency stop switch

An emergency stop switch shall be provided on wind turbine tower elevators. When open (“STOP” position), this switch shall cause the electric power to be removed from the elevator driving-machine motor and brake.

Emergency stop switches shall

a) be of the manually opened and closed type
b) have red operating handles or buttons

c) be conspicuously and permanently marked “STOP”, and shall indicate the “STOP” and “RUN” positions.

2.26.2.2 Stop switch on top of car

A stop switch conforming to 2.26.2.1 shall be provided on the top of every car where maintenance or inspection is to be performed from the top of the car.

2.26.2.3 Car safety mechanism switch

A switch conforming to 2.17.4 shall be required where a car safety or wire rope gripping safety is provided.

2.26.2.4 Final terminal stopping devices

Final terminal stopping devices conforming to 2.25 shall be provided for every electric elevator.

2.26.2.5 Car door and gate electric contacts

Car door or gate electric contacts conforming to 2.14.9 shall be provided for all elevators.

2.26.2.6 Ladder-guided access cover switch

Ladder-guided access cover switch(es) shall be provided conforming to 2.14.9.3.

2.26.3 Contactors and relays for use in critical operating circuits

Where electromechanical contactors or relays are provided to fulfill the requirements of 2.26.7.3 through 2.26.7.6, 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 NFPA 70 or CSA C22.1, whichever is applicable, except as specified in 2.26.4.1.1 and 2.26.4.1.2.

2.26.4.1.1

Traveling and trailing cables are not required to comply with 2.26.4.1 and shall have the essential properties to meet all the temperature, strength, and flexibility requirements for the application in accordance with sound engineering practice and shall be certified to a testing organization standard.

2.26.4.1.2

Where a trailing cable is provided, a means at the bottom of the travel path shall be provided to collect, mechanically protect, and prevent entanglement of the cable. The means shall be capable of holding two times the weight of the cable when the car is at its lowest limit of travel.

2.26.4.2

Electrical equipment shall be listed/certified and labeled/marked. CSA B44.1/ASME A17.5 defines the scope and applicable requirements for this listing/certification.

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.

2.26.4.4

Control equipment shall be tested in accordance with the testing requirements of BS 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 2.26.8.1 and 2.26.8.2 and shall not cause the car to move while on inspection operation.

a) The test for voltage dips in Table 6 of BS EN 12016 shall be conducted by either using the times specified in Table 6, or using a voltage reduction of 30% of the nominal input voltage for 0.5 cycles at 60 Hz and a voltage reduction of 60% of nominal input voltage for 5 cycles at 60 Hz.
b) 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.

Note: (2.26.4.4) *The test requirements for voltage dips in 2.26.4.4 a) are adjusted for 60 Hz operation.*

2.26.5 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 if a reversal of phase rotation or phase failure of the incoming polyphase AC power will cause the car to operate in the wrong direction.

2.26.6 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.

2.26.7 Control and operating circuits

2.26.7.1

If springs are used to actuate switches, contactors, or relays to break the circuit to stop the car at the terminal landings, they shall be of the compression type.

2.26.7.2

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 operate. Requirement 2.26.7.2 does not apply to dynamic braking.

2.26.7.3

The occurrence of a single ground or the failure of any single magnetically operated switch, contactor, or relay, or any single solid-state device not a part of a software system shall not permit the car to move if any electrical protective device is not in the closed position. Use of software systems are permitted, provided that a nonsoftware-controlled means is also used to remove power from the driving-machine motor and brake.

2.26.7.4

Methods used to satisfy 2.26.7.3 shall be checked prior to each start of the elevator. When a single ground or failure as specified in 2.26.7.3 occurs, the car shall not be permitted to restart.

2.26.7.5

Elevators employing alternating-current driving motors driven from a direct-current power source through a static inverter shall have two separate means 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 by an electromechanical relay arranged to

a) open each time the car stops, or
b) open, at the latest, each time the car reverses direction and it has been verified at each stop that there is no current flow exceeding normal leakage current through the other means.

The means used for conformance to 2.26.7.5 shall cause power to be removed from the driving-machine brake circuit.

2.26.7.6

Where relays are used to satisfy 2.26.7.3, after each time the relay is required to open in conformance with 2.26.7.4, 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. After each stop in conformance to 2.26.7.5, the car shall not respond to a signal to start if current flow exceeding normal leakage current through the other means is detected.

2.26.7.7

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 125% of rated speed.

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.

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 driving-machine brake shall apply automatically when

a) the operating device of a 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.

2.27 Emergency operation and signaling devices

Wired or wireless two-way communication between elevator personnel and a location staffed by authorized personnel attended while the tower is occupied shall be provided.

2.28 Layout drawings

Elevator layout drawings shall, in addition to other data, indicate the following:

a) the maximum bracket, wire fix, or tie-in spacing
b) the estimated maximum vertical forces on application of the safety or other retarding device to the safety wire
c) the total static and impact loads imposed on machinery and sheave beams, supports, and floors or foundations
d) the impact load due to buffer or bumper engagement at the maximum permissible speed and load
e) the total static and dynamic loads from the ropes and tension system
f) the horizontal forces imposed on the tower structure
g) for wire guided systems, tension loads on the bottom attachment point
h) the car dimensions and minimum required through-platform clearances.

2.29 Welding

All welding shall conform to 2.29.1 through 2.29.3.

2.29.1 Qualification of welders

Where required in ASME A17.1/CSA B44, 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 4 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) by a fabricator qualified to the requirements of CSA W47.1, whichever is applicable.

2.29.2 Welding steel

Where required in ASME A17.1/CSA B44, welding shall conform to either of the following, whichever is applicable:

a) the design and procedure requirements of the applicable section of ANSI/AWS D1.1 or ANSI/AWS D1.3, or
b) the design and procedure requirements of CSA W59.

2.29.3 Welding metals other than steel

Where required in ASME A17.1/CSA B44, welding of materials other than steel shall be done in accordance with the latest AWS or CSA Group requirements applicable to the specific materials used.

2.30 Engineering tests, type tests, and certification requirements

ASME A17.1/CSA B44, 8.3.1 through 8.3.3 apply, except as modified by 2.30.1.

2.30.1 Type tests of interlocks, combination mechanical locks, and electric contacts and door or gate electric contacts

Locking devices shall conform to ASME A17.1/CSA B44, 8.3.3, except as follows:

a) In ASME A17.1/CSA B44, 8.3.3.2, change the reference to ASME A17.1/CSA B44 Part 2 to ASME A17.8/CSA B44.8.
b) In ASME A17.1/CSA B44, 8.3.3.4.1, change the number of required cycles from 960 000 to 25 000 cycles of operation for wind turbine tower elevators.
c) In ASME A17.1/CSA B44, 8.3.3.4.3, change the required number of cycles from 25 000 to 20 000 cycles of operation for wind turbine tower elevators.

2.31 Maintenance, repair, replacement, and testing

Maintenance, repair, replacement, and testing shall conform to ASME A17.1/CSA B44, 8.6.

2.31.1 Required information

A data plate shall be provided and maintained for each elevator. The data plate shall indicate the Code and edition in effect at the time of installation. The data plate shall also indicate the Code in effect at the time of any alteration and indicate the applicable requirements of the alteration.

2.31.2 Location

The data plate shall be in plain view, securely attached to the main line disconnect or controller.

2.31.3 Material and construction

The data plate 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. The height of the letters and figures shall be not less than 3 mm (0.125 in).

All data plates not located in the controller shall be provided with either

a) a durable means to prevent common contaminants (such as paint, adhesives, oil, and grease) from adhering to the data plate parent surface and permit the removal of these contaminants, without obscuring the Code required data, or
b) letters and figures that are raised or depressed a minimum of 0.8 mm (0.03125 in) from the plate surface face, and have a minimum character-stroke width of 0.5 mm (0.02 in).

If the plates are exposed to weathering or a chemical atmosphere, then a durable means shall be provided to protect the information from deterioration while permitting the information to be easily read.

2.32 Acceptance inspections and tests

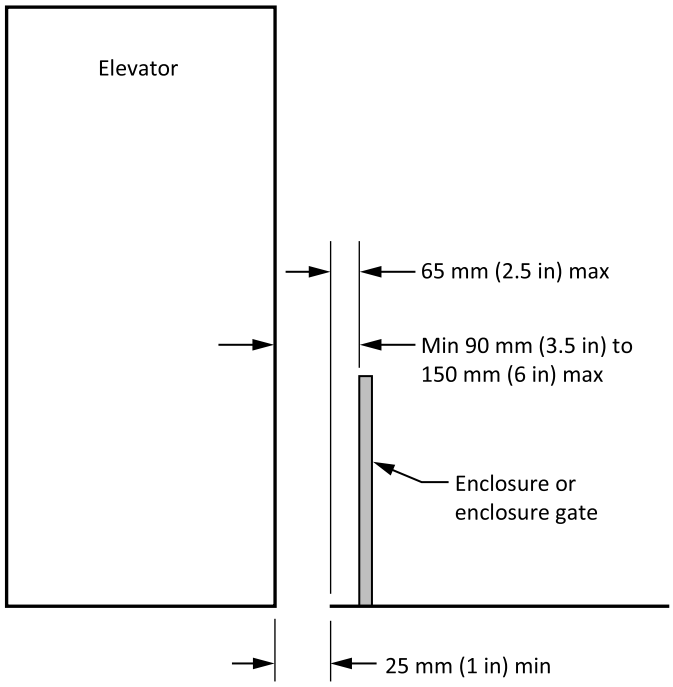
Acceptance inspections and tests shall conform to ASME A17.1/CSA B44, 8.10.

2.33 Periodic inspections and witnessing of tests

Periodic inspections and witnessing of tests shall conform to ASME A17.1/CSA B44, 8.11.

Annex A (informative)
Wind turbine tower elevator clearances

Note: *This Annex is not a mandatory part of this Code.*



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