CSA B44.10:24/ASME A17.10-2024

Escalator and moving walk braking systems

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CSA B44.10:24/ASME A17.10-2024
Escalator and moving walk braking systems

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Preface

This is the first edition of CSA B44.10/ASME A17.10, *Escalator and moving walk braking systems*.

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This Standard was prepared by the CSA/ASME Joint Committee on Escalator and Moving Walk Braking Systems under the jurisdiction of the CSA Technical Committee on the Elevator Safety Code, the CSA Strategic Steering Committee on Mechanical and Industrial Equipment Safety, and the ASME A17 Standards Committee. It is the intent of these committees to maintain a single harmonized Standard by coordinating their procedures for revising and interpreting this Standard. To this end, interpretations and revisions of this Standard will not be issued without the approval of both committees.

The purpose of this Standard is to provide testing requirements for escalator and moving walk brakes primarily for conformity assessment purposes. This Standard arose from the need to have identical Canadian and U.S. requirements for this equipment, thereby enabling manufacturers to have their products certified by an ANSI or SCC accredited certification organization to have the certification ratified for acceptance in either country.

Note: *For additional test procedures related to braking systems not required as part of this Standard, see Annex A.*

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CSA B44.10:24/ASME A17.10-2024
Escalator and moving walk braking systems

1 Scope

1.1 Overview

This Standard covers escalator and moving walk driving machine brake and driving machine motor-controlled dynamic braking systems in accordance with ASME A17.1/CSA B44, *Safety Code for Elevators and Escalators*.

1.2 Terminology

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the Standard.

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Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non- mandatory) to define their application.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto. Where “latest edition” is used, it shall mean the most recent edition in publication on the date this document is published.

ASME (The American Society of Mechanical Engineers)/CSA Group

ASME A17.1-2019/CSA B44:19
Safety Code for Elevators and Escalators

3 Definitions

The following definitions shall apply in this Standard.

Brake, main driveshaft, escalator and moving walk — a device located on the main driveshaft of the escalator or moving walk used to apply a controlled force to the braking surface to stop and hold the escalator or moving walk system.

Brake, driving machine, escalator and moving walk — an electromechanical device that is part of the electric driving machine of the escalator or moving walk, used to apply a controlled force to a braking surface to stop and hold the escalator or moving walk system.

Braking system — a driving machine brake alone, or in combination with electrically assisted braking, that operates to slow down and stop the escalator or moving walk system.

Capacity — see **Rated load, escalator** and **Rated load, moving walk**.

Comb, escalator and moving walk — the toothed portion of a combplate designed to mesh with a grooved step, pallet, or treadway surface.

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

Control, variable voltage, variable frequency (VVVF) — a motion control that changes the magnitude and frequency of the voltage applied to the motor.

Control system — the overall system governing the starting, stopping, direction of motion, acceleration, speed, and retardation of the moving member.

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

Dynamic braking — use of the motor and active motor control to affect the controlled deceleration of a load.

Note: *For this document, where the term "dynamic braking" is utilized, it is referring to escalator and moving walk driving machine motor-controlled dynamic braking.*

Electrical/electronic/programmable electronic (E/E/PE) — based on electrical (E), electronic (E), and/or programmable electronic (PE) technology.

Note: *The term is intended to cover any and all devices or systems operating on electrical principles. Examples of electrical/electronic/programmable electronic devices include*

a) *electromechanical devices (electrical);*
b) *solid-state nonprogrammable electronic devices (electronic); and*
c) *electronic devices based on computer technology (programmable electronic).*

Escalator — power-driven, inclined, continuous stairway used for raising or lowering passengers.

Fail-safe — a characteristic of a system or its elements whereby any failure or malfunction affecting safety will cause the system to revert to a state that is known to be safe.

Inertial mass-based driving machine brake — mechanical brake systems that utilize a fixed set brake torque and overall system inertia to manage stopping profiles within the no-load and full load limits established by code. Stopping distances and acceleration rates vary with the passenger load present on the escalator or moving walk.

Installation — a complete escalator or moving walk, including its wellway, wellway enclosures and related construction, and all machinery and equipment necessary for its operation.

Landing, escalator or moving walk — the stationary area at the entrance to or exit from an escalator, moving walk, or moving walk system.

Landing, lower, escalator — that landing of least elevation of the two landings.

Landing, lower, moving walk — that landing of least elevation of the two landings. On moving walks where the two landings are of equal elevation, the lower landing is that landing designated by the manufacturer.

Landing, upper, escalator — that landing of greatest elevation of the two landings.

Landing, upper, moving walk — that landing of greatest elevation of the two landings. On moving walks where the two landings are of equal elevation, the upper landing is that landing designated by the manufacturer.

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

Lower landing, escalator — see **Landing, escalator or moving walk** and **Landing, lower, escalator**.

Lower landing, moving walk — see **Landing, escalator or moving walk** and **Landing, lower, moving walk**.

Machine, driving — the power unit that applies the energy necessary to drive an escalator, or moving walk system or other equipment covered by the scope of this Standard.

Moving walk — a type of passenger-carrying device on which passengers stand or walk, and in which the passenger-carrying surface remains parallel to its direction of motion and is uninterrupted.

Pallet, moving walk — one of a series of rigid platforms that together form an articulated treadway or the support for a continuous treadway.

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

Rated load, moving walk — the load that the moving walk is designed and installed to move, horizontally or at an incline, at the rated speed.

Rise, escalator and moving walk — the vertical distance between the top and bottom landings of an escalator or moving walk.

Running gear, escalator — all the components of an escalator moving along the tracks.

Running gear, moving walk — all the components of a moving walk moving along the tracks.

Skirt, escalator and moving walk — the fixed, vertical panels located immediately adjacent to the escalator steps or moving walk treadways.

Skirt panel, dynamic — the moving vertical panels, with a positive mechanical connection to the running gear, adjacent to and moving with the steps.

Treadway, moving walk — the passenger-carrying member of a moving walk.

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

Upper landing, escalator — see **Landing, escalator or moving walk** and **Landing, upper, escalator**.

Upper landing, moving walk — see **Landing, escalator or moving walk** and **Landing, upper, moving walk**.

Variable torque electrically controlled driving machine brake — an electro-mechanical brake system that utilizes a variable torque brake system with electronic controls to maintain a set target

deceleration rate during stopping. Stopping distances and deceleration rates are intended to be held constant under varying loads.

Wellway — an opening in a floor provided for escalator or moving walk installation.

Width, moving walk — the exposed width of the treadway.

4 Construction

4.1 Electrical equipment

Electrical equipment shall be suitable for the intended application and shall comply with ASME A17.1/CSA B44 requirement 6.1.7.4.2.

4.2 Driving machine brake

4.2.1 Escalators

Escalator driving machine brakes shall be in accordance with ASME A17.1/CSA B44 requirement 6.1.5.3.1 a), b), c), and e).

Motor-controlled dynamic braking of an escalator by variable-frequency control of the escalator driving machine motor shall be in accordance with ASME A17.1/CSA B44 requirement 6.1.5.3.4.

4.2.2 Moving walks

Moving walk driving machine brakes shall be in accordance with ASME A17.1/CSA B44 requirement 6.2.5.3.1 a), b), c), and e).

Motor-controlled dynamic braking of an escalator by variable-frequency control of the escalator driving machine motor shall be in accordance with ASME A17.1/CSA B44 requirement 6.2.5.3.3.

4.3 Brake rated loads

Brake rated loads shall be in accordance with ASME A17.1/CSA B44 requirements 6.1.3.9.3 for escalators and 6.2.3.10.3 for moving walks.

5 Documentation and markings

5.1 Required documentation

5.1.1 Equipment configuration

The following information shall be provided to identify the specific system configuration being tested:

a) escalator or moving walk rated speed in m/s;
b) maximum stopping distance and minimum distance from applicable electrical protective device and comb for full load stopping distances in accordance with ASME A17.1/CSA B44 requirements 6.1.5.3.1 d) 5) for escalators and 6.2.5.3.1 d) 5) for moving walks;
c) maximum permissible step handling load capacity;
d) minimum and maximum rise of escalator or moving walk series;
e) width(s) of escalator or moving walk series;
f) minimum and maximum angle of incline for escalator or moving walk series;

g) driving machine brake data:
   i) the name of brake manufacturer (if different from escalator or moving walk manufacturer), catalogue numbers or model designations, factory address, certification/listing details;
   ii) brake type(s) (i.e., mechanical operation): disc, drum, band [spring(s)], permanent magnet, etc.;
   iii) specification for the brake lining (i.e., detailed ingredient, test data, etc.);
   iv) control type (e.g., inertial mass, electronic deceleration control, etc.); and
   v) recommended minimum time between consecutive brake applications under full rated load (i.e., cooling time);
h) dynamic braking data (when used):
   i) driving machine motor data:
      A) the name of motor manufacturer, catalogue numbers or model designations, factory address, certification/listing details;
      B) motor power (kW or HP) rating; and
      C) motor voltage;
   ii) motor drive (VVVF/VFD) data:
      A) the name of motor drive (VVVF/VFD) manufacturer, catalogue numbers or model designations, factory address, certification/listing details;
      B) motor drive (VVVF/VFD) power (kW or HP) rating;
      C) motor drive (VVVF/VFD) voltage ratings;
      D) motor drive (VVVF/VFD) type (e.g., regenerative or non-regenerative);
      E) for non-regenerative types, the name of braking resistor manufacturer, catalogue numbers or model designations, resistor voltage, resistor ohms, resistor power ratings, factory address, certification/listing details; and
      F) recommended minimum time between consecutive brake applications under full rated load (i.e., cooling time); and
i) brake rated loads (both with escalator or moving walks stopped and escalator or moving walks running).

5.1.2 Technical requirements

A set of drawings and descriptive data (specifications) shall be provided with details of the following:
a) type: fixed torque brake or variable torque brake;
b) assembly and detail drawings plus photographs of the disassembled brake (enlarged isometric view or exploded assembly illustrations are acceptable) containing bill of materials, parts description (material specifications) with emphasis on the critical elements, and spring description (including number of turns, coil diameter, spring material diameter, material specification, heat treatment, spring rate, size, spring force versus coil force, etc.);
c) full description (specification/composition) of the brake including all critical elements such as brake friction materials and surfaces, methods of fastening of the friction materials, size of the braking material surface, and drawing of the friction material with the brake arms;
d) brake maintenance manual indicating clearances, acceptable lining wear, etc.;
e) detailed description of brake torque adjustment and measurement procedures (mechanical/electrical) [e.g., (a) location, (b) break away type or dynamic type, (c) adaptor piece (if any) required for torque wrench application, and (d) clockwise/counterclockwise]:
   i) the location where the torque is to be measured shall be clearly stated (e.g., “End of Motor Shaft”, “Machine Input Shaft” etc.);
   ii) it is important that the test setup be such that the brake torque can be accurately measured. (i.e., that sufficient clearance is provided for the adaptor and torque wrench to be applied square to the adjustment); and

iii) indicate the back-up parameter (e.g., brake spring length);

f) detailed description of settings for variable torque electronic deceleration control adjustment and measurement procedures, where used;

g) detailed description of settings for dynamic brake control adjustment and measurement procedures, where used;

h) relationships between escalator rise and width, motor size, flywheel size, coil size, brake size for each escalator type including:
   i) formulas covering sliding, rotating masses versus brake size;
   ii) calculations covering all round rises (e.g., 2 m, 3 m, etc.) and widths to be certified;

i) dimensions for each critical mechanical part (i.e., parts directly involved in braking and operation or release of the brake, springs, etc.) (e.g., brake pads, disc, flywheel);

j) outline of the principle of operation (sketch or schematic);

k) wiring schematic of brake with the safety circuits/control panel diagram related to brake;

l) list of electrical equipment (e.g., electromagnetic release coil, controls, switches, hydraulic oil pump motor and power supply provided on the brakes);

m) identify the lowest step at which load weights can be applied while the escalator is at rest for brake testing; and

n) name plate with required markings in accordance with Clause 5.2.

5.1.3 Drive train description

Description of the entire drive train including the brake system shall be provided.

5.1.4 Landing area description

Description of the landing areas including the transition radius from incline to horizontal, flat steps, and step-to-comb interface shall be provided.

5.1.5 Dynamic braking

For escalator driving machine motor controlled dynamic braking, the following shall be provided:

a) A complete list of critical elements of dynamic braking circuits with their electrical ratings and wiring diagram shall be provided.

b) A description shall be provided to list and explain all the functions/devices allowing dynamic braking.

c) A procedure to simulate loss of dynamic brake control shall be provided to permit testing of the transition to the driving machine brake system.

d) When E/E/PE devices are used to achieve any of the above features, the unique software identifier/unique firmware version numbers shall be provided.

5.2 Marking

5.2.1 Nameplate

The markings shall appear on a nameplate readily visible and permanently attached to the machine brake and, when necessary, a duplicate nameplate shall be placed adjacent to the machine brake

5.2.2 Marking requirements

The marking shall include brake data marking requirements as specified in ASME A17.1/CSA B44 requirements 6.1.5.3.1 d) for escalators and 6.2.5.3.1 d) for moving walks which shall include “CSA B44.10/ASME A17.10”.

5.2.3 Language

Where a product is intended for use in Canada, equipment shall additionally be marked in French.

5.2.4 Brake control type

Brakes shall be marked to indicate use of dynamic braking control when utilized.

5.2.5 Deceleration rates

The brake name plate shall be marked with manufacturer-recommended maximum and minimum deceleration rate settings as tested by this Standard.

5.2.6 Model designation

The brake name plate shall be marked with the manufacturer's designation of type of model assigned to the brake.

6 Testing procedures

6.1 General

Escalators shall be subjected to the following tests to confirm that

a) the escalator brakes can be adjusted to conform to ASME A17.1/CSA B44 requirement 6.1.5.3.1;
b) the moving walk brakes can be adjusted to conform to ASME A17.1/CSA B44 requirement 6.2.5.3.1;
c) the relationship that exists between the range of brake settings and stopping distances complies with Clause 4.2; and
d) dynamic braking systems, if used, shall comply with ASME A17.1/CSA B44 requirements 6.1.5.3.4 for escalators and 6.2.5.3.4 for moving walks.

6.2 Stopping distance measurement

The stopping distance shall be measured by the movement of a step along its path of travel after a stop has been initiated.

6.3 Performance of tests

6.3.1 Test location

The tests may be made in the manufacturer's plant or on an escalator or moving walk installation.

6.3.2 Instrument mounting

Where hand mounting of instrumentation at the upper landing is utilized, test weights shall be loaded from the lower landing. Where instruments can be set after step loading, test weights may be loaded from the upper landing.

6.3.3 Drive capacity

The motor shall be capable of carrying 100% brake rated load with escalator or moving walk running in the up direction. Pulling the handrail may supplement the starting torque of the motor.

6.3.4 Speed measurement

Verify the nominal speed on the step or treadway of the escalator or moving walk.

6.3.5 Test weights

Test weight application and distribution shall be as follows:

a) No more than 2,250 N (500 lb) per step shall be applied for testing without written confirmation from the manufacturer that the applied test loads are acceptable for a given step design, including attachments to running gear/supporting structure.
b) A rubber mat or cardboard may be used between the weight and step.
c) The manufacturer shall provide a sketch of the load distribution per each step for each test condition (e.g., running, static) of the load tests.

6.4 Extension of type test

6.4.1 Applicability

Provided that the design loads of the brake are not exceeded, a number of heights and widths (by means of alternative loads) may be simulated on the test escalator, for the purpose of certification of an escalator type (design), provided that those escalators for the additional widths and heights use the same motor and machine.

6.4.2 Alternative loading

Alternative loads shall include calculations on test loads to address inertial changes in the system for the alternative width and rise.

6.5 Instrumentation

6.5.1 Requirements

Test instruments shall comply with ASME A17.1/CSA B44 requirement 8.3.1.5.

6.5.2 Type

The instruments used for speed and acceleration measuring shall comply with the following:

a) They shall be of the recording type.
b) They shall provide data for the plotting of the brake performance curves showing time intervals, stopping distance, speed, and deceleration of step during the escalator stopping. The accuracy of the instruments shall be within the following tolerances:
    i) Devices shall record readings for speed and acceleration with at least 0.010 second sample rate time intervals.
    ii) Time increments and total time shall be recorded with a tolerance of less than ±1%.
    iii) The position of the step at each time interval shall be recorded with a tolerance of less than ±1%.

6.5.3 Recording parameters

Time, travel, speed, and deceleration shall be determined by means of a device which will provide the accuracy specified in Clause 6.5.2. They shall indicate the “power off” moment (start of braking). (Second channel on the speed chart recorder.)

6.5.4 Data collection

The instrumentation set-up shall have, as a data collector, a digital tachometer (tachometer generator)

or a transducer with approximately 10 pulses/mm of step travel installed on either the main shaft or the flat step at the lower landing. (An electronic counter shall also be considered acceptable.)

Note: *Due to slippage, measurements on the handrail are not acceptable.*

6.5.5 Torque measurement

Brake torque measurements shall be made using a calibrated torque wrench capable of ±1% accuracy.

6.5.6 Weight requirements

Weights used to provide the rated load on the escalator steps or moving walk treadway shall be identified by the manufacturer with size, owner and owner's identification mark (if applicable), and calibration status.

6.6 Samples selection

6.6.1 Drive configuration

A given combination of brake/motor/gear/flywheel/chain/sprocket/etc. may be used by the manufacturer for a range of heights.

6.6.2 Applicable range

The type test program is designed to simulate the braking system response on the maximum and minimum height and width of escalator for which the braking system is intended to be used and to verify that this response complies with the criteria indicated in ASME A17.1/CSA B44.

6.6.3 Testing efficiency

The most economical method is to test as many representative escalators or moving walks from a model line as possible during a single investigation.

6.6.4 Test scope

The test is to determine the range of brake adjustments (alternate brake settings) that comply with the load/no load stopping distance limits (i.e., braking envelope), the maximum deceleration, and the maximum time duration of horizontal peak deceleration permitted by ASME A17.1/CSA B44 requirements 6.1.5.3.1, 6.1.5.3.4, and 6.1.6.3.6 for a specific series of escalators.

6.7 Parameter validation

For many designs, there is a mathematical relationship between the stopping distance and the load, torque, voltage, gap and spring length or visible spindle length, or visible thread length, etc.

Where such relationships are documented (e.g., by formula, tables, graphs, etc.), the test shall validate the relationship by comparing the theoretical brake envelope curve with a curve generated by tests.

Note: *Supporting design test data can help to expedite the task of selecting the appropriate models for testing.*

6.8 Driving machine brake testing

6.8.1 Envelope curves

Stopping distance points on the brake envelope curves shall be obtained by increasing the percentage of weights in a progressive series. The curve between Point A and Point B (see Figure 1) shall comply

with ASME A17.1/CSA B44 requirements 6.1.5.3.1(d) for escalators or 6.2.5.3.1(d) for moving walks (see Figure 1).

6.8.2 Inertial mass-based driving machine brakes

6.8.2.1 Maximum brake torque load performance

The maximum brake torque load performance test shall be conducted as follows:

a) Adjust the brake torque to the maximum specified value with the escalator or moving walk stopped and no load on the steps or treadways. Verify with the calibrated torque wrench. (Take at least three independent readings.)
b) Start the escalator or moving walk in the down direction and ensure that nominal speed has been reached. For a system with delayed latching into full automatic operation, ensure that the system has latched into automatic operation.
c) Initiate a stop of the step or treadway.
d) Measure the stopping distances by operating the escalator in the downward direction, with the load indicated in Items i) through v) below and initiating a stop caused by the escalator driving machine brake. Each point on the curve shall be tested at least twice in the down direction (e.g., two runs for 25% load, two for 50%, etc.). The average value of the stopping distance shall be used to determine the braking envelope curve:
    i) no load;
    ii) 25% of brake rated load (running);
    iii) 50% of brake rated load (running);
    iv) 75% of brake rated load (running); and
    v) 100% of brake rated load (running).
e) Points on the brake envelope curves shall be obtained by increasing the percentage of weights in a progressive series (see Figure 1).
f) Measure the average deceleration over total retardation time (shall be ≤ 0.91m/s^2) for each run.
g) Measure the time duration of peak horizontal deceleration over 0.91 m/s^2 (shall be less than 0.125 s) for each run.

6.8.2.2 Minimum brake torque load performance

The minimum brake torque load performance test shall be conducted as follows:

a) Adjust the brake torque to the minimum specified value with the escalator or moving walk stopped and no load on the steps or treadways. Verify with the calibrated torque wrench. (Take at least three independent readings).
b) Start the escalator or moving walk in the down direction and ensure that nominal speed has been reached. For a system with delayed latching into full automatic operation, ensure that the system has latched into automatic operation.
c) Initiate a stop of the step or treadway.
d) Measure the stopping distances by operating the escalator in the downward direction, with the load indicated in Items i) through v) below and initiating a stop caused by the escalator driving machine brake. Each point on the curve shall be tested at least twice in the down direction (e.g., two runs for 25% load, two for 50%, etc.). The average value of the stopping distance shall be used to determine the braking envelope curve:
    i) no load;
    ii) 25% of brake rated load (running);
    iii) 50% of brake rated load (running);
    iv) 75% of brake rated load (running); and
    v) 100% of brake rated load running.