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Safety of escalators and moving walks — Part 1: Construction and installation

Sicherheit von Fahrtreppen und Fahrsteigen — Teil 1: Konstruktion und Einbau

Sécurité des escaliers mécaniques et trottoirs roulants — Partie 1 : Construction et installation

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Contents

European foreword

This document (prEN 115-1:2016) has been prepared by Technical Committee CEN/TC 10 “Lifts, escalators and moving walks”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 115-1:2008+A1:2010.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

The need for a replacement was based on the following points:

a) improvement in safety due to changes in proven technology;

b) the need to reflect changes to the state of the art;

- new structure for electric requirements with clauses for protective, safety and control devices and functions;
- requirements for step inserts/fixings;
- expansion of operational brake by electrical braking;
- update on test material for skirting;
- inclusion of fire protection requirements;
- introduction of 2-direction-mode;
- inclusion of a stop switch indicator;
- introduction of inspection control activated by the use of both hands;
- description of barriers to prevent access of trolley;
- requirements for fixed devices in the unrestricted area;
- inclusion of seismic design requirements;

c) incorporation of essential health and safety requirements from the relevant EU Directives;

d) elimination of reported errors;

e) clarification of the text and incorporation of proposals resulting from interpretation requests 1);

f) improvement of the references to other standards according to the progress in that field;

g) adaption to CEN Guide 414:2014

This standard is part of the EN 115 series of standards: *"Safety of escalators and moving walks".*

EN 115 is currently composed with the following parts:

— *Part 1: Construction and installation* [the present document];

— *Part 2: Rules for the improvement of safety of existing escalators and moving walks;*

— *Part 3: Correlation between EN 115:1995 and its amendments and EN 115-1:2008* [Technical Report];

— *Part 4: Interpretations related to EN 115 family of standards* [Technical Specification].

1) Within CEN/TC 10 an interpretation committee has been established to answer questions about the spirit in which the experts have drafted the various clauses of this standard. All such interpretations are published within CEN/TS 115-4 [1] until incorporated by amendment into the standards concerned.

Introduction

This document is a type-C standard as stated in EN ISO 12100:2010.
This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium, and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in the case of machinery intended for use by consumers).

The above mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or -B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

The purpose of this standard is to define safety requirements for escalators and moving walks in order to safeguard people and objects against risks of accidents during installation, operation, maintenance and inspection work.

The contents of this standard are based on the assumption that persons using escalators and moving walks are able to do so unaided. However, physical and sensory abilities in a population can vary over a wide range, escalators and moving walks are also likely to be used by persons with a range of other disabilities.

Some individuals, in particular older people, might have more than one impairment. Some individuals are not able to use an escalator or moving walk independently and rely on assistance/support being provided by a companion. Furthermore some individuals can be encumbered by objects or be responsible for other persons, which can affect their mobility. The extent to which an individual is incapacitated by impairments and encumbrances often depends on the usability of products, facilities and the environment.

The use of wheelchairs on escalators and moving walks can lead to dangerous situations which cannot be mitigated by machine designs and therefore should not be permitted.
The use of lifts is the preferred method of vertical travel for most people with disabilities and in particular wheelchair users and persons with guide dogs.

Additional signs should be provided to indicate the location of other facilities, these facilities should be in close proximity to the escalators and moving walks and easy to find.

The risks arising from the configuration of escalators and moving walks within a building (e.g. obstructions or voids adjacent to escalators) should be risk assessed according to methodology of the ISO 14798 by the building designer/owner at the building design stage and measures identified to eliminate hazards or reduce risk to an acceptable level.

It is assumed that negotiations have been made for each contract between the customer and the supplier/installer (see also Annex A) about:

a) intended use of the escalator or moving walk;

b) environmental conditions;

c) civil engineering problems;

d) other aspects related to the place of installation.

Planning of traffic flows and evacuation/rescue purposes are under the responsibility of the building designer/owner.

If escalators or moving walks are intended to be operated under special conditions, such as directly exposed to the weather or explosive atmosphere, or in exceptional cases serve as emergency exits, appropriate design criteria, components, materials and instructions for use should be used that satisfy the particular conditions.

An Interpretation Committee has been established to clarify, if necessary, the spirit in which the clauses of the standard have been drafted and to specify the requirements appropriate to particular cases. Interpretation Requests can be sent to the National Standard Bodies which will contact the responsible Technical Committee CEN/TC 10. The formats of an interpretation request and the interpretation are given in Annex N.

1 Scope

1.1 This draft European Standard is applicable for new escalators and moving walks (pallet or belt type) as defined in Clause 3.

This draft European Standard deals with all significant hazards, hazardous situations and events relevant to escalators and moving walks when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

1.2 This document is not applicable to escalators and moving walks which were manufactured before the date of its publication. It is, however, recommended that existing installations be adapted to this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1929-2:2004, *Basket trolleys — Part 2: Requirements, tests and inspection for basket trolleys with or without a child carrying facility, intended to be used on passenger conveyors*

EN 1929-4:2005, *Basket trolleys — Part 4: Requirements and tests for basket trolleys with additional goods carrying facility(ies), with or without a child carrying facility, intended to be used on passenger conveyors*

EN 1990:2002[2)]), *Eurocode — Basis of structural design*

EN 1993-1-1:2005, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*

EN 1998-1:2004, *Design of structures for earthquake resistance — Part 1: General rules, seismic actions and rules for buildings*

EN 10025-1:2004, *Hot rolled products of structural steels — Part 1: General technical delivery conditions*

EN 10025-2:2004, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 10025-3:2004, *Hot rolled products of structural steels — Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels*

EN 10025-4:2004, *Hot rolled products of structural steels — Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels*

EN 10025-5:2004, *Hot rolled products of structural steels — Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance*

EN 10025-6:2004+A1:2009, *Hot rolled products of structural steels — Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition*

EN 10083-1:2006, *Steels for quenching and tempering — Part 1: General technical delivery conditions*

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2) This standard is currently impacted by the amendment EN 1990:2002/A1:2005.

EN 10083-2:2006, *Steels for quenching and tempering — Part 2: Technical delivery conditions for non alloy steels*

EN 10083-3:2006, *Steels for quenching and tempering — Part 3: Technical delivery conditions for alloy steels*

EN 12015:2014, *Electromagnetic compatibility — Product family standard for lifts, escalators and moving walks — Emission*

EN 12016:2013, *Electromagnetic compatibility — Product family standard for lifts, escalators and moving walks - Immunity*

EN 13015:2001*, Maintenance for lifts and escalators — Rules for maintenance instructions*

EN 13501-1:2007+A1:2009, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests*

EN 60068-2-6:2008, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:2007)*

EN 60068-2-14:2009, *Environmental testing — Part 2-14: Tests — Test N: Change of temperature (IEC 60068-2-14:2009)*

EN 60068-2-27:2009*, Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock (IEC 60068-2-27:2008)*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2006, modified)*

EN 60269-1:2007[3)], *Low-voltage fuses — Part 1: General requirements (IEC 60269-1:2006)*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 60664-1:2007*, Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests (IEC 60664-1:2007)*

EN 60747-5-5:2011, *Semiconductor devices — Discrete devices — Part 5-5: Optoelectronic devices — Photocouplers (IEC 60747-5-5:2007)*

EN 60947-4-1:2010[4)] *, Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters — Electromechanical contactors and motor-starters (IEC 60947-4-1:2009)*

EN 60947-5-1:2004[5)] *, Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices (IEC 60947-5-1:2003)*

EN 61249 *(all parts), Materials for printed boards and other interconnecting structures (IEC 61249, all parts)*

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3) This standard is currently impacted by the amendment EN 60269-1:2007/A1:2009 and EN 60269-1:2007/A2:2014.

4) This standard is currently impacted by the amendment EN 60947-4-1:2010/A1:2012.

5) This standard is currently impacted by the amendment EN 60947-5-1:2004/A1:2009.

EN 61558-1:2005, *Safety of power transformers, power supplies, reactors and similar products — Part 1: General requirements and tests (IEC 61558-1:2005)*

EN 62061:2005[6] , *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061:2005)*

EN 62326-1:2002, *Printed boards — Part 1: Generic specification (IEC 62326-1:2002)*

EN ISO 868:2003, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868:2003)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13850:2008, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

EN ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

ISO 3864-1:2011, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 3864-3:2012, *Graphical symbols — Safety colours and safety signs — Part 3: Design principles for graphical symbols for use in safety signs*

HD 60364-4-41:2007, *Low-voltage electrical installations — Part 4-41: Protection for safety — Protection against electric shock (IEC 60364- 4-41:2005, modified)*

3 Terms and definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and the following apply.

3.1.1
angle of inclination
maximum angle to the horizontal in which the steps, the pallets or the belt move

3.1.2
authorized person
suitably trained person with authorization to access restricted areas of escalators and moving walks (e.g. machinery spaces, separate machine rooms) and to work there for the purpose of inspection, testing and maintenance

NOTE Authorized persons should be competent for the tasks they have been authorized for (see also 3.1.8).

6) This standard is currently impacted by the amendment EN 62061:2005/A1:2013.

3.1.3
balustrade
part of the escalator/moving walk which ensures the user's safety by providing stability, protecting from moving parts and supporting the handrail

3.1.4
balustrade decking
transverse member of the balustrade which meets the handrail guidance profile and which forms the top cover of the balustrade

3.1.5
brake load
load on the step/pallet/belt which the brake system is designed to stop the escalator/moving walk

3.1.6
comb
pronged section at each landing that meshes with the grooves

3.1.7
comb plate
platform at each landing to which the combs are attached

3.1.8
competent person
a person which is in possession of the necessary technical knowledge, skills, qualification and experience to perform a work or task

NOTE National Regulation may require certification of competence

3.1.9
escalator
power-driven, inclined, continuous moving stairway used for raising or lowering persons in which the user carrying surface (e.g. steps) remains horizontal

NOTE Escalators are machines - even when they are out of operation - and cannot be considered as fixed staircases.

3.1.10
exterior panel
part of the exterior side of the enclosure of an escalator or moving walk

3.1.11
failsafe circuit
safety related electrical and/or electronic system with defined failure mode behaviour

3.1.12
handrail
power-driven moving rail for persons to grip while using the escalator or moving walk

3.1.13
interior panel
panel located between the skirting or lower inner decking and the handrail guidance profile or balustrade decking

3.1.14
lower inner decking
profile that connects the skirting with the interior panel when they do not meet at a common point

3.1.15
lower outer decking
profile that connects the exterior panels with the interior panel

3.1.16
machinery
escalator or moving walk machine(s) mechanisms and associated equipment

3.1.17
machinery spaces
space(s) inside or outside of the truss where the machinery as a whole or in parts is placed

3.1.18
maximum capacity
maximum flow of persons that can be achieved under operational conditions

3.1.19
moving walk
power-driven installation for the conveyance of persons in which the user carrying surface remains parallel to its direction of motion and is uninterrupted (e.g. pallets, belt)

NOTE Moving walks are machines - even when they are out of operation – and should not be used as a fixed access

3.1.20
newel
end of balustrade

3.1.21
nominal speed
speed in the direction of the moving steps, pallets or the belt stated by the manufacturer for which the escalator or moving walk has been designed, without load on the steps/pallets/belt at nominal frequency and nominal voltage

3.1.22
rise
vertical distance between the upper and lower finished floor levels

3.1.23
safety circuit
part of the electric safety system consisting of electrical safety devices

3.1.24
safety devices
part of a safety circuit consisting of safety switches and/or failsafe circuits

3.1.25
safety integrity level SIL
discrete level for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE

NOTE In this European Standard SIL 1 is representing the lowest level and SIL 3 the highest, even when it does not make use of SIL 3

3.1.26
safety related electrical, electronic and programmable electronic devices, E/E/PE
system for control, protection or monitoring based on one or more electrical, electronic or programmable electronic devices, including all elements of the system such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices, used in safety related applications as listed in Table 8 and Table 9

3.1.27
safety system
safety related part of the electrical control system as an arrangement of safety circuits and monitoring devices 3.1.8

3.1.28
skirting
vertical part of the balustrade interfacing with the steps, pallets or belt

3.1.29
skirt deflector
device to minimize the risk of trapping between the step and the skirting

3.1.30
structural rated load
load which the structure is designed for

3.2 Symbols and abbreviations

The following symbols and corresponding units of measurement of the following Table 1 are used in this standard.

Table 1 — Symbols and corresponding units of measurement used in this standard

Symbol	Designation	Unit	Figures
a_{gR}	Peak ground acceleration (reference peak ground acceleration on type A ground)	m/s^2	
b_1	Distance between the handrail centre lines	m	6
b_2	Width of the handrail	mm	6
b_3	Horizontal distance between skirting and interior panel	mm	6
b_4	Width of the horizontal part of the lower inner decking that directly joins the interior panel	mm	6
b_5	Horizontal distance between the inner edge of the handrail and the top edge of the interior panel	mm	6
b_6', b_6''	Horizontal distance between the handrail profile and guide or cover profiles	mm	6
b_7	Width of the grooves	mm	5
b_8	Web width	mm	5

Symbol	Designation	Unit	Figures
b_9	Horizontal distance between the outer edge of the handrail and a non-continuous obstruction, e.g. roof intersection, column	mm	A.1
b_{10}	Horizontal distance between the outer edge of the handrail and a continuous obstruction, e.g. wall	mm	Clause 5, A.1
b_{11}	Horizontal distance between the handrails of adjacent escalators/moving walks	mm	A.1
b_{12}	Perpendicular distance between the lower edge of the handrail and the balustrade decking	mm	6
b_{13}	Width of the lower outer decking	mm	7
b_{14}	Horizontal distance between the outer edges of interior panels on adjacent escalators or moving walks	mm	7
b_{15}	Horizontal distance between the building structure (wall) and the centreline of the handrail	mm	7
b_{16}	Horizontal distance between the centrelines of the handrails of adjacent escalators/moving walks	mm	7
b_{17}	Horizontal distance of the anti-slide device to the outer edge of the handrail	mm	7
b_{18}	Perpendicular distance between the lower edge of the handrail and the point where the handrail stand is connected to the balustrade	mm	6
h_1	Vertical distance between the top of the handrail and step nose or pallet surface or belt surface	m	5, 6
h_2	Perpendicular distance between top edge of skirting or bottom edge of cover joints and the line of the step nose or the tread surface of the pallets or belt	mm	6
h_3	Distance between the entry of handrail into the newel and the floor	m	5, 6
h_4	Free height above any point of step surfaces, pallets or belt over the area between both outer edges of the handrails including the area to the end of the newel and the unrestricted area at all points	m	5, A.1
h_5	Height of the deflector	m	5, 7
h_6	Clearance between the upper edge of the tread surface and the root of the comb teeth	mm	5
h_7	Depth of the grooves	mm	5
h_8	Mesh depth of the comb into the grooves of the tread	mm	5
h_9	Vertical distance between floor and lower end of the anti-climbing device	mm	7
h_{10}	Vertical distance between lower edge of the handrail and upper end of the access restriction device	mm	7
h_{11}	Height of the anti-slide device	mm	7
h_{12}	Height of the upper edge of the free space outside the handrail	mm	A.1

Symbol	Designation	Unit	Figures
h_{13}	Vertical distance between the upper and lower finished floor levels	m	5
L_1	Root of the comb teeth	-	5
l_1	Horizontal distance between supports	m	5
L_2	Comb intersection line	-	5
l_2	Distance between the furthest point reached by the handrail and the comb intersection line measured parallel to the tread surface	m	5
l_3	Length of the straight portion of the handrail in the direction of landing measured from the comb intersection line	m	5
l_4	Distance between the furthest point reached by the handrail and the point of entry into the newel measured parallel to the tread surface	m	5
l_5	Length of anti-climbing device on the lower outer decking	mm	7
Q_{SE}	Seismic step load	kg/step	-
v	Nominal speed	m/s	-
x_1	Step height	m	8
y_1	Step depth	m	8
z_1	Nominal width for the load carrying area (step, pallet or belt)	m	6, 8
z_2	Horizontal distance between skirting	m	6
z_3	Transverse distance between the supporting rollers	mm	11
α	Angle of inclination of the escalator or moving walk	°(degree)	5
β	Design angle of the teeth of the comb	°(degree)	5
γ	Cross-sectional angle of inclination of the lower inner decking	°(degree)	6
μ	Friction coefficient	-	-
ψ	Load factor (seismic)	-	-

4 List of significant hazards

4.1 General

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this standard, identified by risk assessment as significant for escalators and moving walks and which require action to eliminate or reduce the risk. These significant hazards are based upon EN ISO 12100:2010.

4.2 Mechanical hazards

Mechanical hazards on escalators and moving walks and in their immediate vicinity can occur because of the design of the machine or access to it.

These include:

- contact with moving machinery parts (e.g. driving unit, handrail drive) normally not accessible to the public (see 5.2.1.1, 5.2.1.2, 5.2.1.3, 5.2.1.5, 5.2.1.6, 5.2.3, 5.2.4, 5.8.1, 5.12.2.7.17, 5.12.3.12, A.3.2, A.3.3);

- crushing and shearing of fingers between handrail and balustrade and between balustrades (see 5.5.2.5, 5.6.2);

- cutting hazard caused by adjacent cover profile parts (see 5.5.2.4);

- impact on bodies caused by collision with building structures (wall, roof, criss-cross arrangement), or with persons on adjacent escalators/moving walks (see A.2.1, A.2.2, A.2.3, A.2.4);

- drawing-in at handrail entry into the balustrade (see 5.6.4.3, 5.6.5);

- trapping between skirting and steps, between comb and step/pallet (see 5.3.4, 5.3.5, 5.5.3, 5.5.5, 5.7.2.5, 5.7.3, Fig. G.2);

- trapping between the floor/fixed devices and the handrail (see 5.6.4.1, 5.6.4.2, A.5);

- trapping between step and step or pallet and pallet (see 5.3.2).

4.3 Electric hazards

Electric hazardous situations can occur due to:

- contact of persons with live parts (see 5.8.3.3, 5.11.1.3);

- indirect contact (see 5.11.1.4, A.6);

- inadequate emergency stops (see 5.12.3.8);

- wrong assembly of electric components (see 5.11.4.4);

- electrostatic phenomena (see 5.12.1.5);

- external influences on electric equipment (see 5.12.2.4, 5.12.2.6.1.3).Radiation hazards

4.4 Radiation hazards

4.4.1 Electromagnetic radiation generated by the machine

Electromagnetic radiation can be emitted by the escalator or moving walk during normal operation (see 5.11.1.2.3, 5.12.2.4).

4.4.2 Electromagnetic radiation received from outside

Immission of low frequency radiation, radio frequency radiation, and microwaves can occur (see 5.11.1.2.3, 5.12.2.4).

4.5 Fire hazard

Fire hazards can be generated by accumulation of combustible material inside the truss, by the insulation material for cables and overloading of drives (see 5.2.1.4, 5.9).

4.6 Hazards generated by neglecting ergonomic principles in machinery design

Hazardous situation can occur because of:

— neglecting ergonomic dimensions for the users (e.g. height of balustrade, width of handrail) (see 5.5.2.1, 5.6.2, 5.6.3);

— inadequate lighting in the working places and access to them (see 5.8.3.1, 5.8.3.2, A.3.3, A.3.4);

— insufficient space in working places (see 5.8.2.1, 5.8.2.2, 5.8.2.3, A.3.5, A.3.6, A.3.7);

— missing lifting equipment for heavy loads (see 5.8.2.2, 5.10).

4.7 Hazard generated by failure of control circuit

Hazardous situation can occur because of:

— no stopping in case of dangerous situations (see 5.11.2, 5.12.1.2);

— short circuit of electric wiring (see 5.11.1.4, 5.11.1.6, 5.11.4);

— overload of electric wiring (see 5.12.1.3, 5.11.4, 5.12.1.2, 5.12.3);

— unexpected start of machine after an interruption (see 5.12.3.5.1, 5.12.3);

— unexpected reversal of drive (see 5.4.2.3, 5.12.1.2);

— excessive speed (see 5.4.2.3, 5.12.1.2);

— excessive deceleration during stopping (see 5.12.1.2).

4.8 Hazards generated by break-up during operation

Even if the design of an escalator or moving walks follows the requirements of EN 115-1, there are specific hazards which can occur due to

— greater than specified user and structural loads on the truss (see 5.2.5);

— loads greater than specified onto the balustrade (see 5.5.2.3, 5.5.2.4);

— loads greater than specified on the steps/pallets by unforeseeable misuse (see 5.3.3);

— loads greater than specified on the drive unit (see 5.4.1.3, 5.4.3, 5.4.4).

4.9 Slipping, tripping and falling hazards

Most of the dangerous situations on escalators and moving walks are caused by the slipping and falling of persons.

These include:

— slipping on steps/pallets/belt, on the comb plate and floor plate (see 5.3.1, 5.5.4, 5.7.1);

— falling caused by handrail speed deviation (incl. standstill) (see 5.6.1, Fig. G.1, Fig. G.3);

— falling caused by change of the direction of movement (see 5.4.2.3);

— falling caused by increased acceleration/deceleration (see 5.2.2, 5.4.1.1, 5.4.1.2, 5.4.2.1, 5.4.2.2, 5.7.2.1, 5.7.2.2, 5.7.2.3, 5.7.2.4);

— falling caused by unexpected start/stopping or excessive speed of the machine (see 5.12.3.5.1);

— falling caused by inadequate lighting at the landings (see A.2.8, A.2.9).

4.10 Hazards specific for this type of machine

Many hazards are specific for that type of machine. These include:

— missing steps or pallets (see 5.3.6);

— trapping by hand winding device (see 5.4.1.4);

— misuse by transporting others items than persons (e.g. shopping or luggage trolleys, push chairs) (see 7.4.1 d), A.4, Fig. G.4, Annex I);

— climbing on the outside of the balustrade (see 5.5.2.2);

— sliding between balustrades (see 5.5.2.2);

— climbing over the balustrade (see 5.5.2.6);

— surfing on the handrail (see 5.5.2.2);

— storage of merchandise adjacent to the balustrade (see 7.4.1 d));

— creation of traffic jam at blocked landings or intermediate exits of consecutive escalators or moving walks (see A.2.5, A.2.6);

— disturbance of the person flow in connected escalators/moving walks (see A.2.5, A.2.6);

— lifting by the handrail at the newel ends and falling over adjacent fixed barrier or the balustrade of the escalator/moving walk (see A.2.7).

NOTE For the actual type of machinery, noise is not considered as a significant nor relevant hazard.

4.11 Significant hazards due to seismic events

— Damage to equipment (see M.2, M.3, M.5);

— Crushing by displacement of equipment (see M.4).

5 Safety requirements and/or protective/risk reduction measures

5.1 General

Escalators and moving walks shall comply with the safety requirements and/or protective/risk reduction measures of this clause.

In addition, escalators and moving walks shall be designed according to the principles of EN ISO 12100:2010, 6.2, for relevant but not significant hazards, which are not dealt with by this standard.

Certain escalators and moving walks are subject to special operational and environmental conditions. For these cases some additional recommendations are defined (see H.2 and Annex M).

5.2 Supporting structure (truss) and enclosure

5.2.1 General

5.2.1.1 All mechanically moving parts of the escalator or moving walk shall be completely enclosed within imperforate panels or walls. Exempt from this are the accessible steps, the accessible pallets, the accessible belt and that part of the handrail available for the user. Apertures for ventilation are permitted (see also 5.2.1.5).

5.2.1.2 Any gaps or openings are restricted to 4 mm where there is a risk of contact with moving parts The exterior panels shall withstand a force of 250 N at any point at right angles on a round or square area of 2 500 mm^2 without breakage. The fixing shall be designed in that way to carry at least twice the dead load of the enclosure.

5.2.1.3 It is permissible to omit an enclosure of the mechanically moved parts if other measures (such as rooms with locked doors accessible to authorized personnel only) make a hazard to the public impossible.

5.2.1.4 Accumulation of materials (e.g. grease, oil, dust, paper) represents a fire risk. Therefore it shall be possible to clean the inner part of the escalator/moving walk.

5.2.1.5 Ventilation apertures shall be built or arranged in such a way to comply with EN ISO 13857:2008, Table 5. However it shall not be possible to pass a straight rigid rod 10 mm in diameter through the enclosure and to touch any moving part through a ventilation aperture.

5.2.1.6 Any exterior panels which are designed to be opened (e.g. for cleaning purposes) shall be provided with a safety device according to 5.12.2.7.14.

5.2.2 Angle of inclination

The angle of inclination α of the escalator shall not exceed 30°, but for rises h_{13} not exceeding 6 m and a nominal speed not exceeding 0,50 m/s the angle of inclination is permitted to be increased up to 35° (see α in Figure 5).

The angle of inclination of moving walks shall not exceed 12°.

5.2.3 Access to the interior

Machinery spaces inside the truss shall only be accessible to authorized persons (e.g. by key, access control).

5.2.4 Inspection covers

Inspection covers shall be provided with a safety device according to 5.12.2.7.14.

It shall only be possible to open inspection covers by a key or a tool suited for that purpose. Parts of the balustrade (e.g. deckings, panels) which are required to be removed for maintenance purposes shall not be considered to be inspection covers.

If the inspection cover consists of more than one part, one safety device shall be provided on the one to be opened first. For the consecutive ones either removal shall be prevented, e.g. by mechanical interlocking, overlapping or each single part shall be provided with a safety device.

If rooms behind inspection covers can be entered, it shall be possible to open them from the inside without a key or a tool even when locked.

Inspection covers shall be imperforate. Inspection covers shall conform to the same conditions as required for the location (e.g. the balustrade, the cladding, the floor plate) where they are installed.

NOTE Floor plates can have the functionality of an inspection cover. In this case the same conditions for inspection covers apply.

5.2.5 Structural design

The supporting structure shall be designed in a way that it can support the dead weight of the escalator or moving walk plus a structural rated load of 5 000 N/m^2. It shall be calculated in accordance with EN 1993-1-1:2005.

NOTE Load carrying area = (nominal width z_1 (see Figure 6) of the escalator or moving walk) x (distance l_1 between the supports) (see Figure 5).

Based on the structural rated load, the maximum calculated or measured deflection shall not exceed $1/750$ of the distance l_1 between the supports.

Based on the structural rated load for the comb plate and floor plate the maximum deflection shall not exceed 4 mm and the meshing of the combs shall be ensured.

5.3 Steps, pallets, belt

5.3.1 General

In the user carrying area of the escalator, the step treads shall be horizontal with a tolerance of ± 1° in the direction of travel.

NOTE 1: The maximum permissible height between two consecutive steps at the landings is defined in 5.3.4 and 5.7.2.1.

Tread surfaces for escalators and moving walks shall provide a secure foothold.

NOTE 2: For definition of materials and test methods, see Annex J.

5.3.2 Dimensions

5.3.2.1 General

For escalators and moving walks the nominal width z_1 shall be not less than 0,58 m and not exceed 1,10 m.

For moving walks with an angle of inclination up to 6° widths up to 1,65 m are permitted.

5.3.2.2 Step treads and pallets (see Figure 5, detail X and Figure 8)

5.3.2.2.1 The step height x_1 shall not exceed 0,24 m.

5.3.2.2.2 The step depth y_1 shall be not less than 0,38 m.

5.3.2.2.3 The surface of the step treads and pallets shall have grooves in the direction of movement with which the teeth of the combs mesh.

5.3.2.2.4 The step risers shall be cleated and the surface of the cleat shall be smooth. The ends of the step tread shall mesh with the cleating of the next step riser.

5.3.2.2.5 The width b_7 of the grooves shall be at least 5 mm and not exceed 7 mm.

5.3.2.2.6 The depth h_7 of the grooves shall be not less than 10 mm.

5.3.2.2.7 The web width b_8 shall be at least 2,5 mm and not exceed 5 mm.

5.3.2.2.8 The step treads and step risers or pallets shall not finish with a groove at their side edges.

5.3.2.2.9 The edge between the surface of the step tread and the riser shall have any sharpness relieved.

5.3.2.3 Belts (see Figure 5, detail X)

5.3.2.3.1 The belts shall have grooves in the direction of travel with which the teeth of the comb mesh.

5.3.2.3.2 The width b_7 of the grooves shall be at least 4,5 mm and not exceed 7 mm, and shall be measured at the tread surface of the belt.

5.3.2.3.3 The depth h_7 of the grooves shall be not less than 5 mm.

5.3.2.3.4 The web width b_8 shall be at least 4,5 mm and not exceed 8 mm and shall be measured at the tread surface of the belt.

5.3.2.3.5 The belt shall not finish with a groove at the side edge of the belt.

Splicing of the treadway belt shall be such as to provide a continuous unbroken treadway surface.

5.3.3 Structural design

5.3.3.1 General

The materials shall retain their strength characteristics during their specified life cycle taking into account the environmental conditions, e.g. temperature, ultraviolet radiation, humidity, corrosion.

The steps, pallets and the belt shall be designed to withstand all possible loading and distortion effects, which may be imposed by the tracking, guiding and driving system during normal operation and shall be designed to support an equally distributed load corresponding to 6 000 N/m^2.

NOTE 6 000 N/ m^2 is derived from a structural rated load of 5 000 N/m^2 (see 5.2.5) plus an impact factor of 1,2.

To establish the dimensions of the belt and its supporting system, an area of effective width x 1,0 m length shall be taken as a basis for this corresponding load (in addition the requirements of 5.3.3.2.4 shall be complied with).

Assembled steps and pallets shall be designed such that all component parts e.g. inserts are securely attached and do not become loose during their life cycle. The inserts and fixings shall withstand the reaction force of operating the comb/comb plate safety device (5.12.2.7.7).

5.3.3.2 Static test

5.3.3.2.1 Steps

The step shall be tested for deflection with a single force of 3 000 N (including weight of the plate) applied perpendicular to the tread surface on a steel plate 0,20 m x 0,30 m in size and at least 25 mm thick, in the centre of the tread surface. The edge of the plate being 0,20 m long shall be arranged parallel to the front edge of the step, the edge of the plate being 0,30 m long at right angles to the front edge of the step.

During this test, the deflection measured at the tread surface shall be not more than 4 mm. There shall be no permanent deformation (initial setting tolerances are permitted).

The step shall be tested as a whole together with rollers (not rotating), axles or stub shafts (if existing) in a horizontal position (horizontal support) and at the maximum inclination (inclined support) for which the step shall be applied.

For all inclinations smaller than the maximum inclination permitted, a new test is not required. A test of the installed step, i.e. together with the guide rails and the supporting structure of the escalator, is also not necessary.

The tread surface on the side of the skirting shall not deflect in any position by more than 4 mm, when subjected to a single load of 1 500 N applied perpendicular to the tread surface at the beginning, on an area of 2 500 mm^2, using a square steel plate, minimum thickness 25 mm. See figure 1. In case of inserts/fixings on the tread surface the load shall be applied only on the insert/fixings itself, when assembled to the step. The area of the load shall be 50 mm by the width of the insert/fixings. The applied force should be fixed vertically. The direction of the applied force shall not change during the test. There shall be no permanent deformation. See figure 2

5.3.3.2.2 Step riser

The riser shall not deflect by more than 4 mm, when subjected to a single load of 1 500 N applied perpendicular to the surface at the beginning, on an area of 2 500 mm^2, using a square or round steel plate, minimum thickness 25 mm, shaped to fit the risers curvature. This load shall be applied in the middle of the full height of the step riser in three positions across its width in the middle and at both ends of a fully assembled step. The applied force should be fixed and the direction of the applied force shall not change during the test. The step shall be tested in a fixed position with axles or stub shafts (if existing). There shall be no permanent deformation.

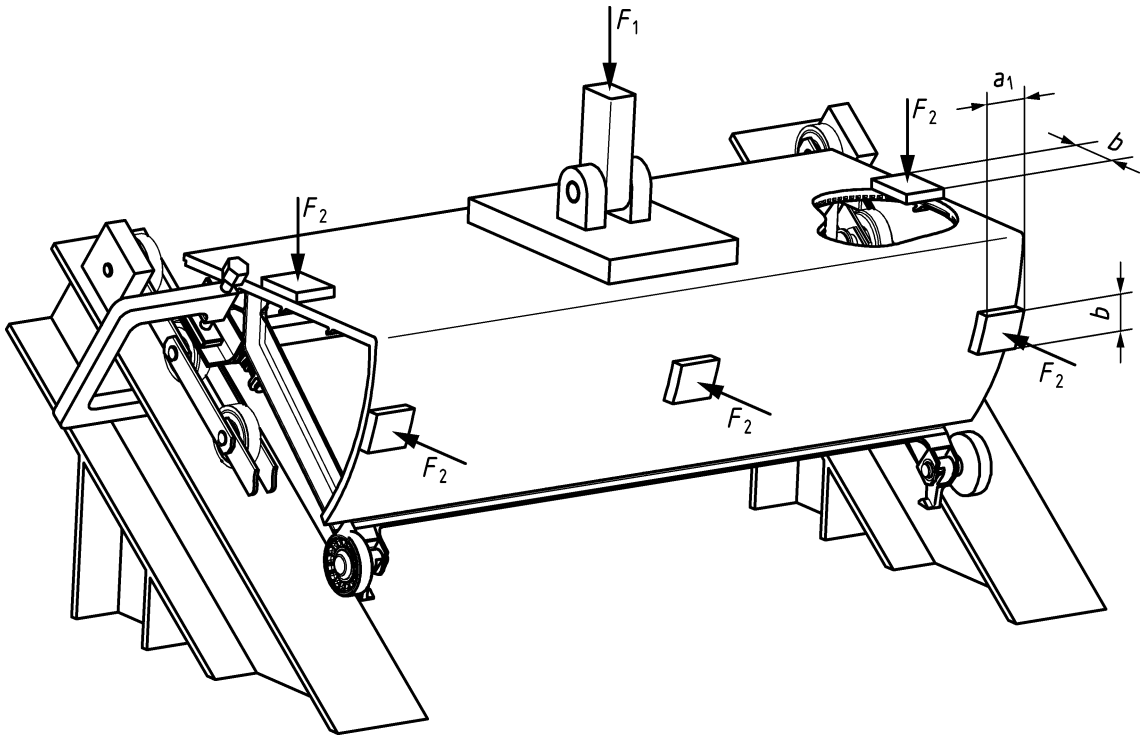


Figure 1 – Step test

Key:

F_1	3 000 n
F_2	1 500 N
a_1	50 mm
b	50 mm

In case of inserts/fixings on a step riser an additional test shall be undertaken on a fully assembled step with a load applied on the riser insert/fixings, in the middle of the full height of the step riser, to an area of 50 mm by the width of the insert/fixings.

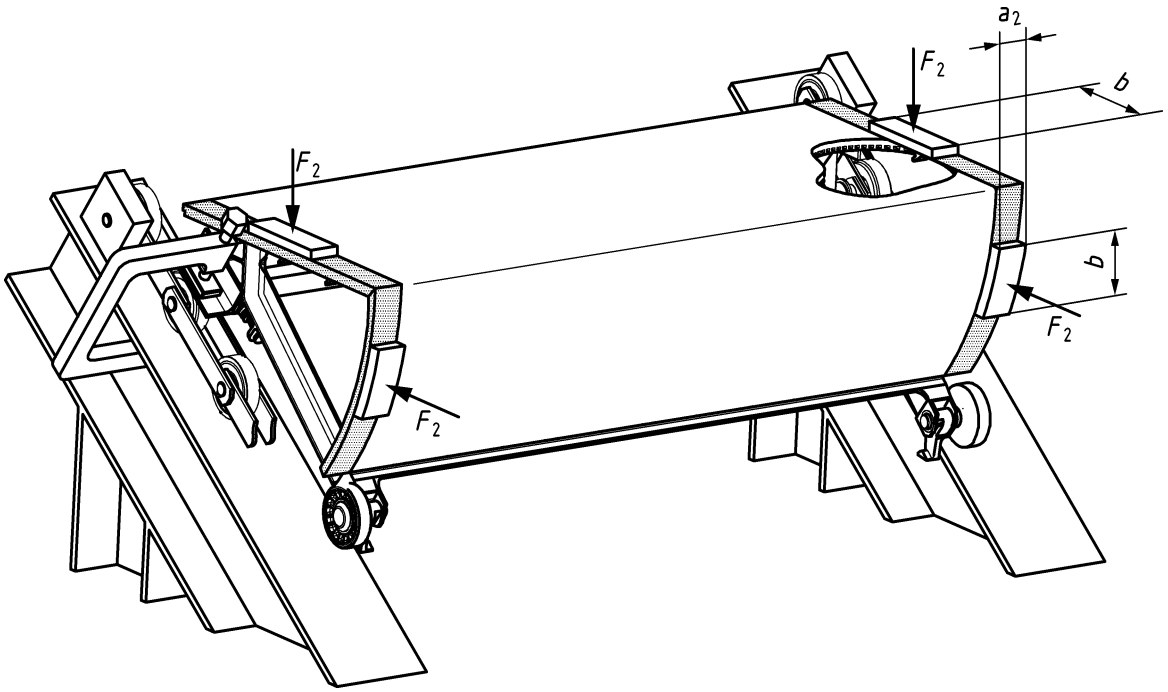


Figure 2 – Step test with inserts/fixings

Key:

F_1	3 000 N
F_2	1 500 N
a_2	width of the inserts/fixings
b	50 mm

5.3.3.2.3 Pallets

The pallet shall be tested for deflection with a single force which, for a pallet area of 1 m^2, shall be 7 500 N (including weight of the plate). The force shall be applied perpendicular to the tread surface on a steel plate 0,30 m x 0,45 m in size and at least 25 mm thick, in the centre of the tread surface, and the edge of the plate being 0,45 m long shall be arranged parallel to the lateral edge of the pallet.

For pallets with smaller or larger areas, the force and the loading area shall be changed proportionally, whereby for the loading area the ratio of edge length shall be 1:1,5; however, the force shall be not below 3 000 N (including weight of the plate), the size of the plate be not smaller than 0,20 m x 0,30 m and its thickness be not less than 25 mm.

For pallets with a depth smaller then 0,30 m the plate width shall be 0,20 m and the length of the plate shall be the depth of the pallet.

During this test the deflection measured at the tread surface shall be not more than 4 mm. There shall be no permanent deformation (initial setting tolerances are permitted).

The pallet shall be tested as a whole together with rollers (not rotating), axles or stub shafts (if existing) in a horizontal position. A test of the installed pallet, i.e. together with the guide rails and the supporting structure of the moving walk, is not required.

5.3.3.2.4 Belts

With the belt tensioned to suit operational conditions, a single force of 750 N (including weight of the plate) shall be applied on a steel plate 0,15 m x 0,25 m x 0,025 m in size. The plate shall be placed centrally between the edge supporting rollers in such a way that its longitudinal axis is parallel to the longitudinal axis of the belt. The deflection at the centre shall not exceed 0,01 z_3 where z_3 is the transverse distance between the supporting rollers (see z_3 in Figure 11).

5.3.3.3 Dynamic tests

5.3.3.3.1 Steps

5.3.3.3.1.1 Load test

The step shall be tested at the maximum inclination (inclined support) for which it shall be applied, together with rollers (not rotating), axles or stub shafts (if existing). It shall be subjected to a load pulsating between 500 N and 3 000 N at one frequency between 5 Hz and 20 Hz for at least 5 x 10^6 cycles whereby an undisturbed sinusoidal force flow shall be achieved. The load shall be applied perpendicular to the tread surface on a steel plate 0,20 m x 0,30 m in size and at least 25 mm thick, arranged as specified in 5.3.3.2.1, in the centre of the tread surface.

After the test the step shall show no indication of crack initiation.

Permanent deformation shall not be greater than 4 mm, measured at the tread surface. Steps or their component parts, e.g. inserts or fixings, shall be securely attached and not become loose.

If rollers are damaged during the test, it is permissible to replace them.

5.3.3.3.1.2 Torsional test

The step design shall be such that the structure can accommodate torsional loading equivalent to a ± 2 mm displacement of the trailer wheel centre, moving in an arc whose centre is the chain wheel centre. The ± 2 mm displacement is a relative to a trailer wheel to chain wheel centre distance of 400 mm. This ratio shall be maintained, when the 400 mm dimension is varied (see Annex F for test examples).

The dynamic test shall be adjustable to ensure that the specified deflections above are achieved throughout the test. It shall be applied with one frequency between 5 Hz and 20 Hz for at least 5×10^6 cycles whereby an undisturbed sinusoidal force flow shall be achieved.

After the test the step shall show no indication of crack initiation.

Permanent deformation shall not be greater than 4 mm, measured at the tread surface. Steps or their component parts, e.g. inserts or fixings, shall be securely attached and not become loose.

5.3.3.3.1.3 Load test

The pallet, irrespective of its size, shall be tested in a horizontal position together with rollers (not rotating), axles or stub shafts (if existing). It shall be subjected to a load pulsating between 500 N and 3 000 N at one frequency between 5 Hz and 20 Hz for at least 5×10^6 cycles whereby an undisturbed sinusoidal force flow shall be achieved. It shall be applied perpendicular to the tread surface on a steel plate 0,20 m x 0,30 m in size and at least 25 mm thick, in the centre of the tread surface.

For pallets with a smaller length then 0,30 m the plate width shall be 0,20 m and the length of the plate shall be the length of the pallet.

After the test, the pallet shall show no indication of crack initiation.

Permanent deformation shall not be greater than 4 mm, measured at the tread surface. Pallets or their component parts, e.g. inserts or fixings, shall be securely attached and not become loose.

If rollers are damaged during the test, it is permissible to replace them.

5.3.3.3.1.4 Torsional test

A torsional test is only required if the pallets are fitted with trailer rollers.

The pallet design shall be such that the structure can accommodate torsional loading equivalent to a ± 2 mm displacement of the trailer wheel centre, moving in an arc whose centre is the chain wheel centre. The ± 2 mm displacement is related to a trailer wheel to chain wheel centre distance of 400 mm. This ratio shall be maintained, when the 400 mm dimension is varied (see Annex F for test examples).

The dynamic load shall be adjusted to achieve a deflection with a tolerance of - 5 % during the test. It shall be applied with one frequency between 5 Hz and 20 Hz for at least 5×10^6 cycles whereby an undisturbed sinusoidal force flow shall be achieved.

For pallets with a smaller length then 0,30 m, the plate width shall be 0,20 m and the length of the plate shall be the length of the pallet.

After the test, the pallet shall show no indication of crack initiation.

Permanent deformation shall not be greater than 4 mm, measured at the tread surface. Pallets or their component parts, e.g. inserts or fixings, shall be securely attached and not become loose.

5.3.4 Guiding of steps, pallets and belt

The lateral displacement of the steps or pallets out of their guiding system shall not exceed 4 mm at either side and 7 mm for the sum of clearances measured at both sides and the vertical displacement shall not exceed 4 mm for steps and pallets and 6 mm for belts.

This requirement applies only to the usable area of the steps, pallets or belt.

Treadway supports for belts shall be provided at intervals not exceeding 2 m along the centre line of the treadway. These supports shall be located at a level not more than 50 mm below the underside of the treadway when it is loaded under the conditions required by 5.3.3.2.4.

5.3.5 Clearance between steps or pallets

The clearance between two consecutive steps or pallets in any usable position measured at the tread surface shall not exceed 6 mm (see Figure 5, details Y, Z, Figure 9, detail S and Figure 10, detail U). The measurement shall be carried out as the dimensions of the gaps are indicated in Figure 5. For pallets the measurements shall be done according to Figures 9 and 10.

Demarcation (e.g. groove in the step tread) shall be provided to highlight at the landings the rear edge of the steps.

In the area of the transition curves of moving walks with meshed front edges and rear edges of the pallets, this clearance is permitted to be increased to 8 mm (see Figure 10, detail V).

5.3.6 Missing step or pallet device

The operation of the escalator/moving walk is only permitted with a complete step/pallet band. Missing step/pallet shall be detected by a safety device or function in accordance with 5.12.2.7.11.

5.4 Drive unit

5.4.1 Driving machine

5.4.1.1 General

A drive unit shall not operate more than one escalator or moving walk.

5.4.1.2 Speed

5.4.1.2.1 The speed of an unloaded escalator shall not deviate by more than ± 5 % from the nominal speed at nominal frequency and nominal voltage.

5.4.1.2.2 The nominal speed of the escalator shall not exceed:

— 0,75 m/s for an escalator with an angle of inclination α up to 30°;

— 0,50 m/s for an escalator with an angle of inclination α of more than 30° up to 35°.

5.4.1.2.3 The nominal speed of moving walks shall be not higher than 0,75 m/s.

Deviating from the above a nominal speed up to 0,90 m/s is permitted provided the width of the pallets or the belt does not exceed 1,10 m, and at the landings, the pallets or the belt move horizontally for a length of at least 1,60 m before entering the combs.

The before mentioned requirements do not apply to moving walks with acceleration paths or moving walk systems with direct transition to moving walks travelling at different speeds.

5.4.1.3 Link between operational brake and step, pallet or belt drive

5.4.1.3.1 For the link between the operational brake and the step, pallet or belt drive, preferably non-friction driving elements should be used such as shafts, gear wheels, multiplex chains, two or more single chains. Where friction elements are used such as trapezoidal belts (flat belts are not permitted) an auxiliary brake in accordance with 5.4.2.2 shall be used.

5.4.1.3.2 The design of all driving elements shall be of nominal infinite fatigue life.

Safety factors of all driving elements shall be at least 5 for static calculations. In the case of trapezoidal belts, at least 3 belts shall be applied.

This safety factor is determined as the ratio between the breaking force of the driving element and the static force to which the driving element is subjected when the escalator or inclined moving walk carries the structural rated load according to 5.2.5 together with the tension force of the tensioning device.

For horizontal moving walks the dynamic forces according to 5.4.2.1.3.3 respectfully 5.4.2.1.3.4 together with the tension force of the tensioning device shall be used to determine the safety factor.

NOTE Driving elements are the parts which are moving and hence dynamically loaded, e.g. shaft, gear wheels, multiplex chains. The fixation of these parts in the truss has to be done according to the specific requirements of these components (e.g. Eurocode for the truss, welding and screws acc. to the relevant standards)

5.4.1.4 Hand winding device

If a hand winding device is provided it shall be easily accessible and safe to operate (see 7.2.1.3 and 7.4.1 g) for instructions).

If the hand winding device is removable a safety device or function according to 5.12.2.7.16 shall be provided.

Crank handles or perforate hand wheels are not permitted.

5.4.2 Braking system

5.4.2.1 Operational brake

5.4.2.1.1 General

Escalators and moving walks shall have an operational braking system by which they:

a) can be brought to rest with an uniform deceleration;

b) can be maintained stationary.

See also 5.12.3.5.

5.4.2.1.1.1 Operational braking by electro-mechanical brake

For operational braking by electro-mechanical brake the requirements of 5.4.2.1.2 apply.

5.4.2.1.1.2 Operational braking by electrical braking

For electrical braking (e.g. electrical braking with inverter) the requirements according 5.4.2.1.1 a) shall be fulfilled.

An electro-mechanical brake according to 5.4.2.1.2 is required and also to be initiated under the conditions of 5.12.3.5.2

5.4.2.1.1.3 Operational braking by other means

Where the operational brake is effected by other means an auxiliary brake in accordance with 5.4.2.2 shall be provided;

5.4.2.1.1.4 Brakes that can be released by hand shall require continuous application of manual pressure to keep them open.

5.4.2.1.2 Electro-mechanical brake

The normal lifting of the electro-mechanical brake shall be by a continuous flow of electric current. The braking operation shall be effective immediately after the electric brake circuit is opened.

The brake force shall be generated by guided compression spring(s). Electrically generated self-excitation of the brake releasing device shall be impossible.

5.4.2.1.3 Brake load and stopping distances for operational brake

5.4.2.1.3.1 Determination of the brake load for escalators

Table 2 shall be applied for the determination of the brake load for escalators.

Table 2 — Determination of brake load for escalators

Nominal width z_1	Brake load per step
up to 0,60 m	60 kg
more than 0,60 m up to 0,80 m	90 kg
more than 0,80 m up to 1,10 m	120 kg

The number of steps to be considered is determined by "rise h_{13} divided by maximum visible height of the step riser" (see x_1 in Figure 8).

For the purpose of a test, the total brake load is permitted to be distributed over two-thirds of the number of steps thus obtained.

5.4.2.1.3.2 Stopping distances for the escalator

The stopping distances for unloaded upwards, unloaded downwards and loaded downward moving escalators (see 5.4.2.1.3.1) shall be as given in Table 3.

Table 3 — Stopping distances for escalators

Nominal speed v	Stopping distance between
0,50 m/s	0,20 m and 1,00 m
0,65 m/s	0,30 m and 1,30 m
0,75 m/s	0,40 m and 1,50 m

For intermediate nominal speeds the stopping distances shall be interpolated.

The stopping distances shall be measured from the time the electric stopping device is actuated.

The deceleration, measured on a downward moving escalator, in the direction of travel shall not exceed $1\ m/s^2$ during the operation of the braking system. For measuring purposes, the raw deceleration signal shall be band-limited using a 4,0 Hz low-pass two-pole Butterworth filter.

It is recommended to achieve the shortest possible stopping distance within the given deceleration limit.

5.4.2.1.3.3 Determination of the brake load for moving walks

Table 4 shall be applied for the determination of the brake load for moving walks.

Table 4 — Determination of brake load for moving walks

Nominal width z_1	Brake load per 0,4 m length
up to 0,60 m	50 kg
more than 0,60 m up to 0,80 m	75 kg
more than 0,80 m up to 1,10 m	100 kg
more than 1,10 m up to 1,40 m	125 kg
more than 1,40 m up to 1,65 m	150 kg

To determine the brake load for moving walks which in their length overcome several inclinations (differences in level), only the downward moving sections shall be considered.

5.4.2.1.3.4 Stopping distances for moving walks

The stopping distances for unloaded upwards, unloaded downwards and loaded downward moving inclined moving walks (see 5.4.2.1.3.3) shall be as given in Table 5. This applies also for unloaded and loaded horizontal moving walks in both directions.

Table 5 — Stopping distances for moving walks

Nominal speed *v*	Stopping distance between
0,50 m/s	0,20 m and 1,00 m
0,65 m/s	0,30 m and 1,30 m
0,75 m/s	0,40 m and 1,50 m
0,90 m/s	0,55 m and 1,70 m

For intermediate nominal speeds the stopping distances shall be interpolated.

The stopping distances shall be measured from the time the electric device for stopping is actuated.

The deceleration, measured on a downward moving or horizontal moving walk, in the direction of travel shall not exceed 1 m/s^2 during the operation of the braking system. For measuring purposes, the raw deceleration signal shall be band-limited using a 4,0 Hz low-pass two-pole Butterworth filter.

It is recommended to achieve the shortest possible stopping distance within the given deceleration limit. For moving walks a brake test under no load will be sufficient.

For loaded moving walks, the manufacturer shall prove the stopping distances by calculation (see 6.2 c)).

5.4.2.2 Auxiliary brake

5.4.2.2.1 Escalators and inclined moving walks shall be equipped with auxiliary brake(s) if:

a) the connection between the operational brake (see 5.4.2.1) and the driving sprockets of the steps/pallets or the drum of the belt is not accomplished by shafts, gear wheels, multiplex chains, or more than one single chain, or

b) the operational brake is not an electro-mechanical brake according to 5.4.2.1.2, or

c) the rise h_{13} exceeds 6 m (see also H.2).

The connection between the auxiliary brake and the driving sprockets of the steps/ pallets or the drum of the belt shall be accomplished by shafts, gear wheels, multiplex chains or more than one single chain. It is not permissible for the connection to comprise friction drives, i.e. clutches.

5.4.2.2.2 The auxiliary braking system shall be dimensioned in such a way that escalators and moving walks travelling with brake load downward are brought to rest by effective retardation and maintained stationary.

The deceleration of 1 m/s^2 downward shall not be exceeded under all operating conditions.For measuring purposes, the raw deceleration signal shall be band-limited using a 4,0 Hz low-pass two-pole Butterworth filter.

Upon operation of auxiliary brakes it is not necessary to keep the stopping distances defined for the operational brake (see 5.4.2.1.3).

5.4.2.2.3 Auxiliary brakes shall be of the mechanical (friction) type.

5.4.2.2.4 Auxiliary brakes shall stop according to 5.12.3.5.3.

The activation of the auxiliary brake shall be detected by electrical safety device or function according to 5.12.2.7.4.

5.4.2.2.5 Auxiliary brake(s) are permitted to operate together with the operational brake when in case of power failure or of an interruption of a safety circuit the stopping conditions according to 5.4.2.1.3.2 and 5.4.2.1.3.4 are kept; otherwise a simultaneous operation of the auxiliary and the operational braking system is only permitted under the conditions of 5.4.2.2.4.

5.4.2.3 Protection against risks of excessive speed and unintentional reversal of the direction of travel

A safety device or function according to 5.12.2.7.2 and 5.12.2.7.3 shall be provided.

5.4.3 Steps and pallets drive

5.4.3.1 The steps of escalators shall be driven by at least two chains of which at least one shall be located on each side of the step.

The pallets of moving walks are permitted to be driven by only one chain if the parallel movement of the pallets in the usable area is ensured by other mechanical measures.

A safety device or function according to 5.12.2.7.5 shall be provided to detect breakage or undue elongation of the step/pallet chains.

5.4.3.2 The step/pallet chain design shall be of nominal infinite fatigue life.

The safety factor against breaking of each chain shall be at least 5 (see 5.4.1.3.2) with respect to structural steel according to EN 10025-1:2004 in combination with EN 10025-2:2004, EN 10025-3:2004, EN 10025-4:2004, EN 10025-5:2004 and EN 10025-6:2004+A1:2009 and with respect to quenched and tempered steel according to EN 10083-1:2006 in combination with EN 10083-2:2006 and EN 10083-3:2006. The chain shall be subject to a tensile test.

When more than one chain is used it is assumed that the load is equally distributed over the chains.

5.4.3.3 The chains shall be tensioned continuously. A safety device or function according to 5.12.2.7.6 shall be provided to detect movement of the tensioning device. Springs working in tension are not permitted for the tensioning device. When weights are used for tensioning they shall be safely retained should their suspension break.

5.4.4 Belt drive

5.4.4.1 The factor of safety of the belt including splicing shall be at least 5 (see 5.4.1.3.2) for the dynamic forces according to 5.4.2.1.3.3 respectively 5.4.2.1.3.4. The calculation shall be carried out for the worst case.

5.4.4.2 The belt shall be driven by drums and be tensioned continuously and automatically. A safety device or function according to 5.12.2.7.6 shall be provided to detect movement of the tensioning device. Springs working in tension are not permitted for the tensioning device. When weights are used for tensioning they shall be safely retained should their suspension break.

5.5 Balustrade

5.5.1 General

Balustrades shall be installed on each side of the escalator or moving walk.

5.5.2 Dimensions of balustrade

5.5.2.1 In the inclined section the vertical height h_1 from step nose or pallet surface or belt surface to top of the handrail shall be not less than 0,90 m and not exceed 1,10 m (see Figures 5 and 6).

5.5.2.2 The balustrades shall have no parts on which a person would normally stand.

Appropriate measures shall be taken to discourage people from climbing on the outsides of the balustrade if there is a danger of people falling from them.

To ensure this, on escalators and moving walks devices (see 1 in Figure 7) shall be provided on the lower outer decking at a point (1 000 ± 50) mm above the floor level (see h_9 in Figure 7) where the bottom of the device intersects with the balustrade decking and shall extend to a length l_5 of at least 1 000 mm parallel with the balustrade decking where no stepping is possible. The device shall extend to at least a height in line with the top of the handrail not conflicting with the requirements of b_{10} and b_{12}.

Where escalators or moving walks are located adjacent to walls, devices (see 2 in Figure 7) to restrict access to the balustrade decking shall be provided at the top and bottom ends of these walls when the lower outer decking width b_{13} exceeds 125 mm. On adjacent parallel arrangements, this protection shall be provided when the combined balustrade decking width b_{14} exceeds 125 mm. The device shall extend to the height h_{10}.

All exposed fastener heads for the devices shall be of the vandal resistant type.

Where handrail level balustrade decking are provided between escalators/inclined moving walks and adjacent walls, anti-slide devices (see 3 in Figure 7) shall be provided on the balustrade decking when the distance b_{15} between the structure of the building (wall) and the centreline of the handrail is greater than 300 mm. These devices shall consist of objects fastened to the balustrade decking, no closer than 100 mm to the handrail (see b_{17}) and spaced no greater than 1 800 mm apart. The height h_{11} shall be not less than 20 mm. The devices shall have no sharp corners or edges.

The above mentioned also applies to adjacent escalators/inclined moving walks when the distance b_{16} between the centrelines of the handrails is greater than 400 mm.

5.5.2.3 Balustrades shall be designed to resist the simultaneous application of a static lateral force of 600 N and a vertical force of 730 N, both equally distributed over a length of 1 m and acting on the top of the handrail guiding system in the same place.

5.5.2.4 The parts of the balustrade facing the steps, pallets or belt shall be smooth and flush. Covers not in the direction of travel shall not project more than 3 mm. They shall be rigid and have rounded or bevelled edges. Covers of such nature are not permitted at the skirting.

Cover joints in the direction of travel (in particular between the skirting and the interior panel) shall be arranged and formed in such a manner as to eliminate any risk of harm caused by trapping.

Gaps between the interior panels of the balustrade shall be not wider than 4 mm. The edges shall be rounded off or bevelled.

When a force of 500 N is applied to the interior panel at any point of the panelling at right angles to the surface over a square or round area of 2 500 mm^2, there shall be no gap greater than 4 mm and no permanent deformation.

If glass is used for the interior panel it shall be toughened glass. The minimum thickness of 6 mm shall apply to single layer balustrades. When multi-layer glass balustrades are used, they shall be laminated toughened glass, the thickness of at least one layer shall also be not less than 6 mm.

5.5.2.5 The horizontal distance (measured at right angles to the direction of travel) between the interior panel at lower points shall be equal to or less than the horizontal distance measured at points higher up.

5.5.2.6 The lower inner decking and the interior panel shall have an angle of inclination γ of at least 25° to the horizontal (see Figure 6). This does not apply to the horizontal part of the lower inner decking that directly joins the interior panel (see b_4 in Figure 6).

5.5.2.6.1 The horizontal part b_4 up to the interior panel shall be less than 30 mm.

5.5.2.6.2 The width b_3, measured horizontally, of each lower inner decking inclined at an angle of less than 45° to the horizontal shall be less than 0,12 m (see Figure 6).

5.5.3 Skirting

5.5.3.1 The skirting shall be vertical, plain and butt-jointed.

NOTE However, special arrangements instead of butt-jointing (e.g. sliding joints) will possibly be necessary for long moving walks at the points where they pass over building expansion joints.

5.5.3.2 The perpendicular (i.e. 90°) distance h_2 between top edge of skirting or bottom edge of projecting cover joints or the lower edge of the rigid part of skirt deflectors and the line of the step nose or the tread surface of the pallets or belt shall be not less than 25 mm (see Figure 6).

5.5.3.3 The skirting including lighting and other devices shall yield not more than 4 mm under a single force of 1 500 N acting at the most unfavourable point at right angles to the surface over a square or round area of 2 500 mm^2. No permanent deformation shall result from this. This shall be met up to a height of 25 mm above the line of the step nose or the tread surface of the pallets or belt. Above the height of 25 mm the force requirements of the balustrade of 500 N (see 5.5.2.4) shall be fulfilled.

5.5.3.4 On escalators, the possibility of trapping between skirting and steps shall be minimized.

For this purpose, the following four conditions shall be fulfilled:

a) sufficient rigidity of the skirting according to 5.5.3.3;

b) clearances to be in accordance with 5.5.5.1;

c) installation of skirt deflectors which fulfil the following requirements:

- They shall consist of a rigid and a flexible part (e.g. brushes, rubber profiles).
- They shall have a minimum projection of 33 mm and a maximum of 50 mm from the vertical face of the skirt panels.
- They shall withstand a force of 900 N uniformly distributed on the projected area of the rigid part over a rectangular area of 600 mm^2 vertically to the line of attachment of the rigid part without detachment or permanent deformation.
- The rigid parts shall have a horizontal projection of between 18 mm and 25 mm and withstand the defined strength requirements. The horizontal projection of the flexible part shall have a minimum of 15 mm and a maximum of 30 mm.

— A distance of between 25 mm and 30 mm shall be provided between the lowest part of the underside of the rigid part and perpendicular to the line of the step nose, throughout the inclined portion of travel.

— The distance between the lowest part of the underside of the rigid part of the skirt deflector and the top of any step cleat in the transition and horizontal areas shall be between 25 mm and 55 mm.

— The lower surface of the rigid part shall be bevelled not less than 25° upward and the upper surface shall be bevelled not less than 25° downward from skirt panel.

— Deviating from Figure 3a, it is permitted to provide a flat surface perpendicular to the skirt with a width ≤ 5 mm that is followed by an increasing downward (on the top)/upward (on the bottom) convex slope. The shape shall reach an inclination of 25° at least in half of the horizontal projection of the rigid part (Figure 3 b)

— If there is a flat surface perpendicular to the skirt followed by straight slope (≥25°) on the top a width ≤ 10 mm and on the bottom a width ≤ 5 mm is permitted (Figure 3 c).

— The deflectors shall be designed with rounded edges. Fastening heads and joint connections shall not extend into the path of travel.

— The terminal end piece shall be tapered to give a flush interface with the skirting. The terminal end piece of any deflector device shall end not less than 50 mm and maximum 150 mm prior to the comb intersection line.

— If the skirt deflector is an extension of the lower inner decking, 5.5.2.6.2 applies. If the skirt deflector is attached or an integral part of the skirting, 5.5.3.1 apply.

d) use of suitable materials or suitable type of lining underneath the deflector device in order to achieve a coefficient of friction for rubber with a testing lubricant less than 0,45. This rubber is defined as SBR-rubber consisting of SBR caoutchouc, mineral fillings, processing additives, crosslinking agents with a density of (1,23 ± 0,2) g/cm^3, and a Shore D-hardness 50 ± 3 according EN ISO 868:2003. Testing lubricant is defined as a solution composed of sodium dodecyl sulfate (pureness ≥ 99 %) de-ionized or distilled water (for information on test methods, see Annex K).

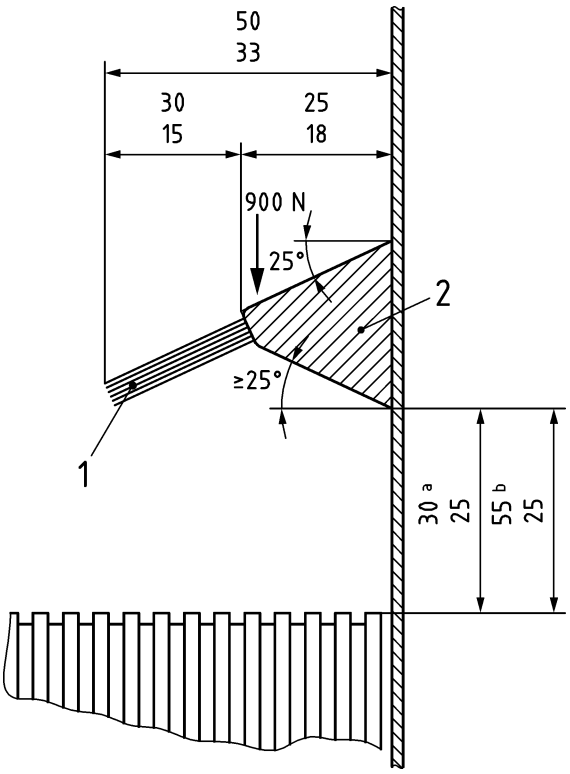


Figure 3a

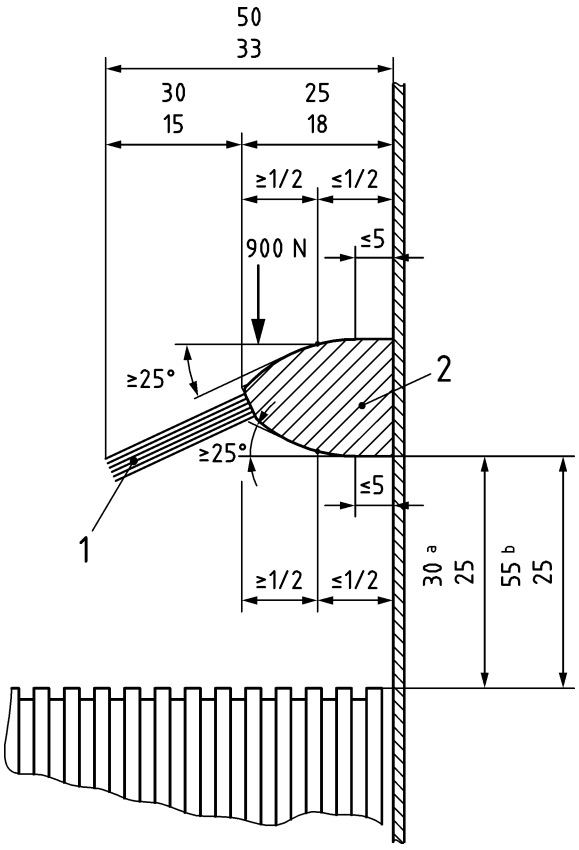


Figure 3b

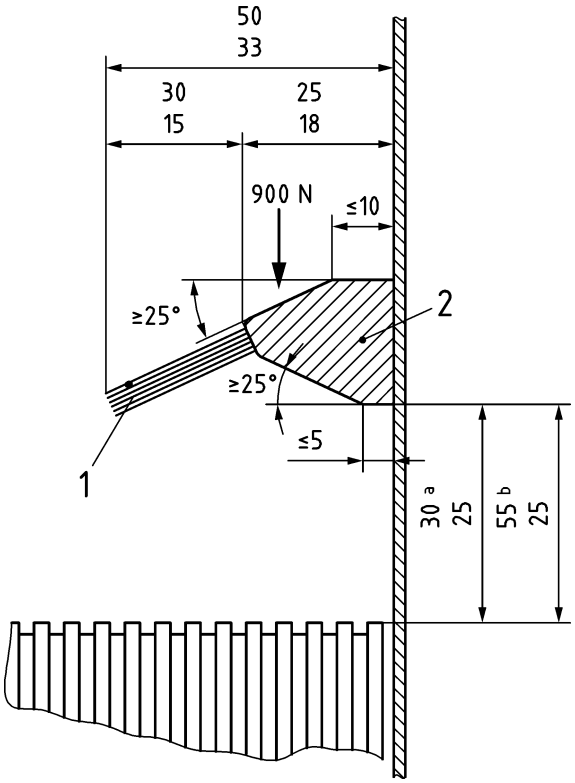


Figure 3c

Key

1 flexible part

2 rigid part

[a] in the inclined area

[b] in the transition and horizontal areas

NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure 3a-3c — Requirements on skirt deflectors

5.5.4 Newel

5.5.4.1 The newel including the handrails shall project horizontally beyond the comb intersection line by at least 0,60 m in longitudinal direction (see L_2 and l_2 in Figure 5 and detail X).

5.5.4.2 The horizontal portion of the handrail shall continue longitudinally at the landings for a distance l_3 (see Figure 5) of at least 0,30 m past the comb intersection line (see L_2 in Figure 5 and detail X).

In the case of inclined moving walks without a horizontal section at the landings, the continuation of the handrail parallel to the angle of inclination is permitted.

5.5.5 Clearance between steps, pallets or belt and skirting

5.5.5.1 Where the skirting of escalators or moving walks is placed beside the steps and pallets or the belt the horizontal clearance shall not exceed 4 mm at either side, and 7 mm for the sum of clearances measured at both sides at two directly opposite points.

5.5.5.2 Where the skirting of moving walks finishes above the pallets or the belt, the clearance shall not exceed 4 mm measured vertically from the tread surface. Motion of the pallets or the belt in lateral direction shall not cause a gap between the sides of the pallets or the belt and the vertical projection of the skirting.

5.6 Handrail system

5.6.1 General

On the top of each balustrade there shall be provided a handrail moving in the same direction and at a speed with a tolerance of – 0 % to + 2 % relative to the speed of the steps, pallets or belt under normal operating conditions.

A handrail speed monitoring device or function shall be provided according to 5.12.2.7.13.

5.6.2 Profile and position

5.6.2.1 The handrail profiles and their guides on the balustrades shall be formed or enclosed in such a way that the possibility of pinching or trapping of fingers or hands is reduced.

The handrail shall be a minimum of 80 mm horizontally (b_{10}) and 25 mm vertically (b_{12}) away from adjacent surfaces. The reduction of this area is permitted as long as b_{18} is not less than 8 mm as shown in detail W of Figure 6 (Point A on the handrail profile – Point B vertically minimum 25 mm below the lower edge of the handrail and horizontally maximum to the outer edge of the handrail). No point of the balustrade shall be above the direct line from A to B.

The distance between the handrail profile and guide or cover profiles shall under no circumstances be wider than 8 mm (see b_6' and b_6" in Figure 6, detail W).

5.6.2.2 The width b_2 of the handrail shall be between 70 mm and 100 mm (see Figure 6, detail W).

5.6.2.3 The distance b_5 between the handrail and the edge of the balustrade shall not exceed 50 mm (see Figure 6).

5.6.3 Distance between the handrail centre lines

The distance b_1 between the centre line of the handrails shall not exceed the distance between the skirting by more than 0,45 m (see b_1 and z_2 in Figure 6).

5.6.4 Handrail entry

5.6.4.1 The lowest point of entry of the handrail into the newel shall be at a distance h_3 from the finished floor level which shall be not less than 0,10 m and not exceed 0,25 m (see Figures 5 and 6).

5.6.4.2 The horizontal distance l_4 between the furthest point reached by the handrail and the point of entry into the newel shall be at least 0,30 m (see Figure 5). If l_4 is greater than (l_2 - l_3 + 50 mm) the handrail shall enter into the balustrade at an angle α of at least 20° measured to the horizontal.

5.6.4.3 At the point of entry of the handrail into the newel a guard shall be installed to protect against pinching of fingers and hands.

A safety device or function according to 5.12.2.7.9 shall be provided.

5.6.5 Guiding

The handrail shall be guided and tensioned in such a way that it will not leave its guides during normal use.

5.7 Landings

5.7.1 Surface properties

The landing area of escalators and moving walks (i.e. comb plate and floor plate) shall have a surface that provides a secure foothold for a minimum distance of 0,85 m measured from the root of the comb teeth (see L_1 in Figure 5 and detail X).

NOTE For definition of materials and test methods, see Annex J.

Exempt from this are the combs mentioned in 5.7.3.

5.7.2 Configuration of steps, pallets and belts

5.7.2.1 At the upper and lower landing, the steps of the escalator shall be guided in such a way that the front edges of the steps leaving the comb and the rear edges of the steps entering the comb are moving horizontally for a length of at least 0,80 m measured from point L_1 (see Figure 5 and detail X).

At nominal speeds above 0,50 m/s and not more than 0,65 m/s or rises h_{13} above 6 m this length shall be at least 1,20 m, measured from point L_1 (see Figure 5 and detail X).

At nominal speeds above 0,65 m/s this length shall be at least 1,60 m measured from point L_1 (see Figure 5 and detail X).

A vertical difference in level between two consecutive steps of 4 mm is permitted.

5.7.2.2 For escalators, the radius of curvature in the upper transition from incline to horizontal shall be:

at least 1,00 m for nominal speeds $v \leq 0{,}5$ m/s (inclination of max. 35°);

— at least 1,50 m for nominal speeds 0,5 m/s < $v \leq 0{,}65$ m/s (inclination of max 30°);

— at least 2,60 m for nominal speeds $v > 0{,}65$ m/s (inclination of max 30°).

The radius of curvature in the lower transition from incline to horizontal of the escalator shall be at least 1,00 m up to 0,65 m/s the nominal speed and at least 2,00 m above 0,65 m/s.

5.7.2.3 For belt moving walks, the radius of curvature in the transition from incline to horizontal shall be at least 0,40 m.

For pallet moving walks, it is not necessary to determine the radius of curvature because, on account of the maximum permissible distance between two consecutive pallets (see 5.3.5), it will always be sufficiently large.

5.7.2.4 At the upper landings of moving walks with an inclination of more than 6°, the pallets or belt shall move for a length of at least 0,40 m at a maximum angle of 6° before entering or after leaving the comb.

Analogous to 5.7.2.1, for pallet moving walks the movement is specified as follows:

The front edge of the pallet leaving the comb and the rear edge of the pallet entering the comb shall move without changing the degree of angle over at least 0,40 m.

5.7.2.5 Provisions shall be made in the area of the combs to ensure the correct meshing (see 5.7.3.3) of the comb teeth with the grooves of the tread surface.

Belts shall be supported in this area in a suitable manner, e.g. by drums, rollers, sliding plates.

A safety device or function according to 5.12.2.7.10 shall be provided.

5.7.3 Combs

5.7.3.1 General

Combs shall be fitted at both landings to facilitate the transition of users. The combs shall be easily replaceable.

5.7.3.2 Design

5.7.3.2.1 The teeth of the combs shall mesh with the grooves of the steps, pallets or belt (see 5.7.3.3). The width of the comb teeth shall be not less than 2,5 mm, measured at the tread surface (see Figure 5, detail X).

5.7.3.2.2 The ends of the combs shall be rounded off and so shaped as to minimize the risk of trapping between combs and steps, pallets or belt.

The radius of the teeth end shall be not greater than 2 mm.

5.7.3.2.3 The teeth of the comb shall have a form and inclination so that the feet of users, leaving the escalator or moving walk, should not stub against them. The design angle β shown in Figure 5, detail X shall not exceed 35°.

5.7.3.2.4 The combs or their supporting structure shall be adjustable, to ensure correct meshing (see Figure 5, detail X).

5.7.3.2.5 The combs shall have such a design that upon trapping of foreign bodies either their teeth deflect and remain in mesh with the grooves of the steps, pallets or belt, or they break.

5.7.3.2.6 A safety device or function according to 5.12.2.7.7 shall be provided.

5.7.3.3 Mesh depth of the combs into the grooves

5.7.3.3.1 The mesh depth h_8 of the combs into the grooves of the tread (see Figure 5, detail X) shall be at least 4 mm.

5.7.3.3.2 The clearance h_6 (see Figure 5, detail X) shall not exceed 4 mm.

5.8 Machinery spaces, driving station and return stations

5.8.1 General

These rooms/spaces shall be used only for accommodating the equipment necessary for the operation and maintenance and inspection of the escalator or moving walk.

Fire alarm systems, equipment for direct fire abatement and sprinkler heads, provided they are sufficiently protected against incidental damage, are permitted in these rooms provided they do not generate additional risks for maintenance operation.

NOTE See 7.4.1 d) for maintenance requirements and inspection activities.

According to Clause 5 of EN ISO 12100:2010, 6.3, effective protection and guards shall be provided for moving and rotating parts if they are accessible and dangerous, in particular for:

a) keys and screws in shafts;

b) chains, belts;

c) gears, gear wheels, sprockets;

d) projecting motor shafts;

e) speed governors not enclosed;

f) step and pallet reversal in driving stations and/or return stations if these shall be entered for maintenance purposes;

g) hand wheels and brake drums.

5.8.2 Dimensions and equipment

5.8.2.1 In machinery spaces, especially in driving and return stations inside the truss, space with a sufficiently large standing area shall be kept free from permanently installed parts of any kind. The size of the standing area shall be at least 0,30 m^2 and the smaller side shall be at least 0,50 m long. It is permitted to occupy this standing area by permanently installed parts, provided that the permanently installed parts are placed behind rounded corners of max. 0,25 m radius (see Figure 4) and at a height of at least 0,12 m above the free standing area.

Dimensions in metres

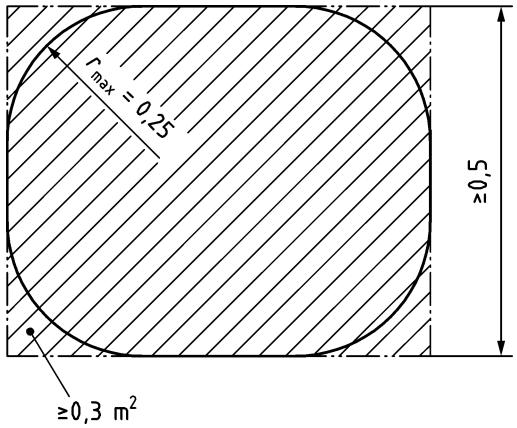


Figure 4 — Standing area

5.8.2.2 If the controller cabinet shall be moved or lifted for maintenance purposes, then suitable attachments for lifting shall be provided, e.g. eyebolts, handle.

5.8.2.3 Where the main drive or brake is arranged between the user side of the step, pallet or belt and the return line, a level standing area in the working zone of not less than 0,12 m^2 shall be provided. The minimum dimension shall be not less than 0,30 m.

This standing area is permitted to be fixed or removable.NOTE For machinery spaces, see also A.3.

5.8.3 Lighting and socket outlets

5.8.3.1 The electric lighting and the socket outlets shall be independent of the power supply to the machine being fed either by a separate cable or a branch cable which is connected before the main switch of the escalator or moving walk. It shall be possible to break the supply of all phases by means of a separate switch (see 5.11.3.1).

5.8.3.2 Electric lighting installations in driving and return stations and machinery spaces inside the truss shall be by means of a portable lamp permanently available in one of these places. One or more socket outlets shall be provided in each of these places.

The light intensity shall be at least 200 lx in working areas.

5.8.3.3 Socket outlets shall be:

a) either of type 2 P+PE (2 poles + earth conductor), 250 V, directly supplied by the mains, or

b) of a type that is supplied at a safety extra low voltage in accordance with HD 60364-4-41:2007.

5.9 Fire protection

Fire protection and building requirements differ from country to country and so far neither have been harmonized.

Therefore, this standard cannot include specific requirements for fire protection and building requirements. However, it is recommended that as far as possible, escalators and moving walks are made of materials that do not create an additional hazard in case of fire. To avoid any risk of fire, see also 5.2.1.4.

Outer and inner decking, truss, pallets/steps, track system shall be at least class C according to EN 13501-1:2007+A1:2009, 11.5.

For materials that are not generally classified a compliance test shall be undertaken according to EN 13501-1:2007+A1:2009 (SBI Test according EN 13823:2010 [2]).

For steps and pallets with plastic parts either on the tread surface or on the riser, this test shall be carried out with the step or pallet being in vertical position where the area with the plastic part are forming the test surface.

In a configuration where a continuous arrangement of plastic inserts/parts exists in the direction of travel, a test according to EN 13501-1:2007+A1:2009 (SBI Test according to EN 13823:2010) shall be done solely with plastic insert material forming the whole test surface.

NOTE A continuous arrangement is given for steps equipped with plastic inserts on the tread and on the riser and for pallets with plastic inserts in the direction of travel. Gaps between steps and pallets are not considered as an interruption of the continuous arrangement.

If sprinklers or water mist systems are used their integration and fixation into the escalator and moving walk shall be done by taking into consideration the special needs of the machine.

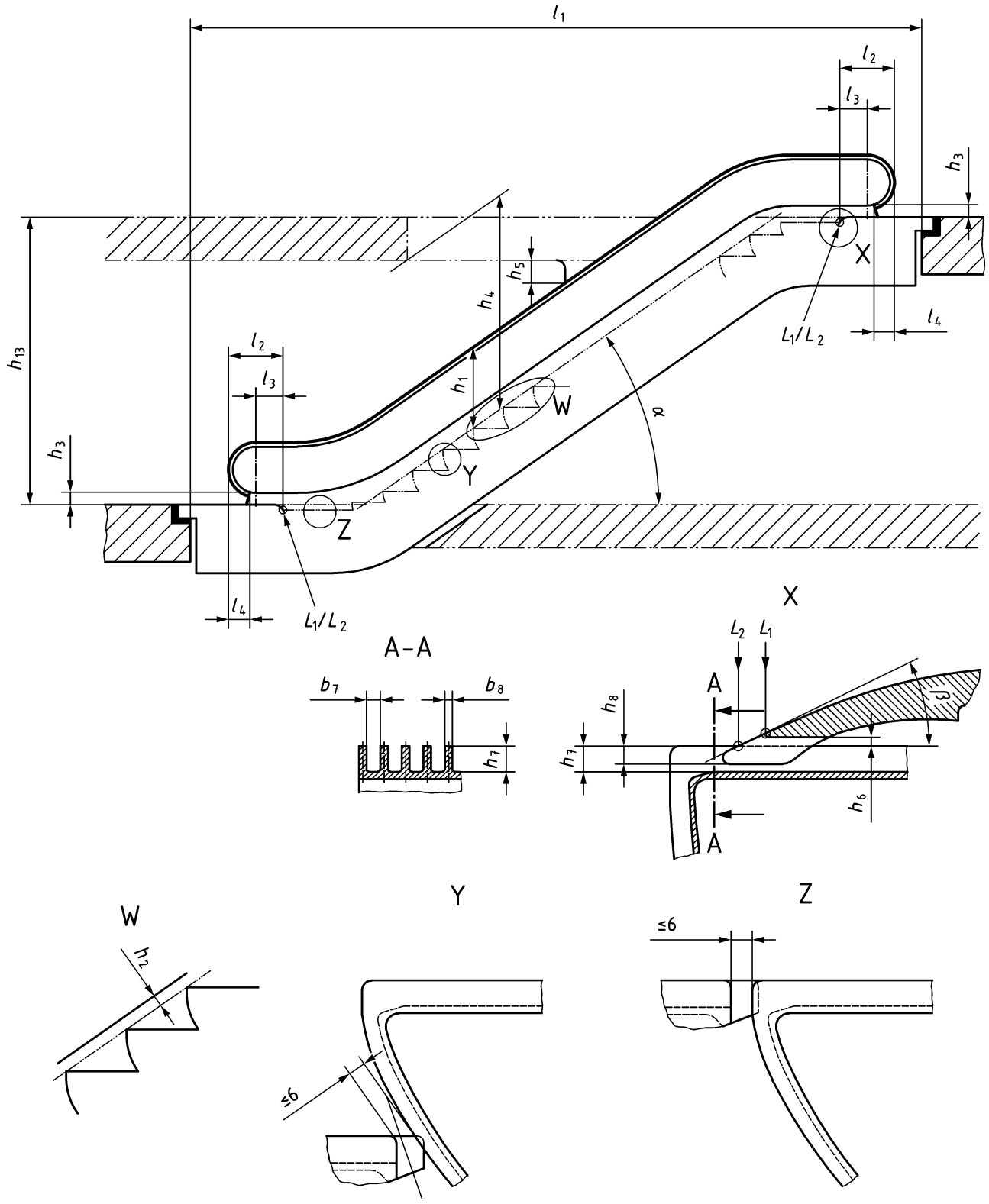
5.10 Transportation

Complete escalators/moving walks or sub-assemblies or components of escalators/moving walks which cannot be handled by hand shall:

a) either be equipped with fittings for movement by a lifting device or transportation means, or

b) be designed in a way that such fittings can be attached (e.g. threaded holes), or

c) be shaped in a way that the lifting device or transportation means can be attached easily.



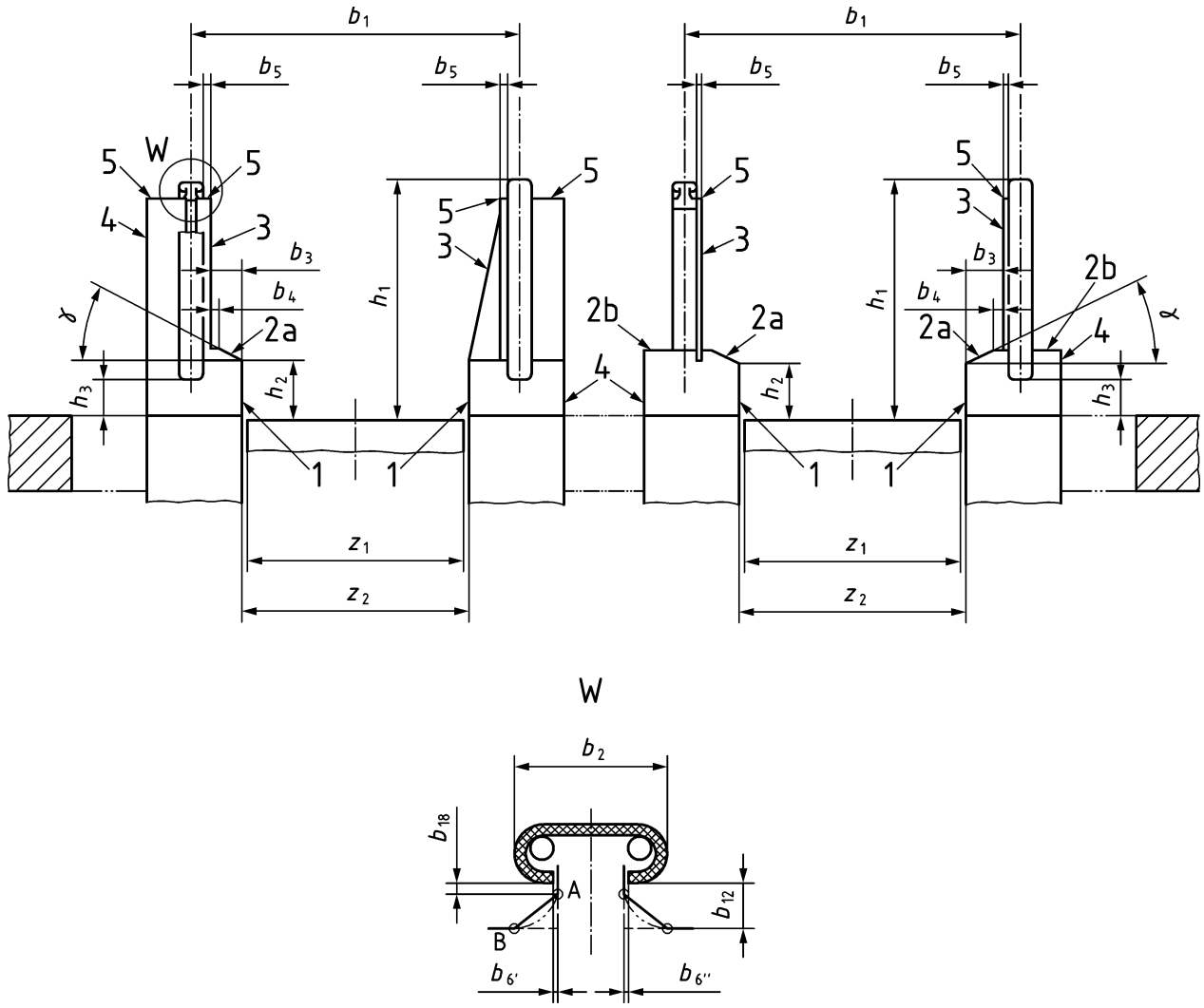
Key

Principal dimensions	Clause	Principal dimensions	Clause
b_7 5 mm to 7 mm (step treads and pallets)	5.3.2.2.5	$h_8 \geq 4$ mm	5.7.3.3.1
b_7 4,5 mm to 7 mm (belts)	5.3.2.3.2	h_{13} Rise	-

Principal dimensions	Clause	Principal dimensions	Clause
b_8 2,5 mm to 5 mm (step treads and pallets)	5.3.2.2.7	L_1 Root of the comb teeth	-
b_8 4,5 mm to 8 mm (belts)	5.3.2.3.4	L_2 Comb intersection line	-
h_1 0,90 m to 1,10 m	5.5.2.1	l_1 Distance between supports	-
h_3 0,10 m to 0,25 m	5.6.4.1	$l_2 \geq 0{,}60$ m	5.5.4.1
$h_4 \geq 2{,}30$ m	A.2.1	$l_3 \geq 0{,}30$ m	5.5.4.2
$h_5 \geq 0{,}30$ m	A.2.4	$l_4 \geq 0{,}30$ m	5.6.4.2
$h_6 \leq 4$ mm	5.7.3.3.2	α Angle of inclination	
$h_7 \geq 10$ mm (step treads and pallets)	5.3.2.2.6	$\beta \leq 35°$	5.7.3.2.3
$h_7 \geq 5$ mm (belts)	5.3.2.3.3		

NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure 5 — Escalator (elevation), principal dimensions



Key

1 skirting (5.5.3)

2a lower inner decking (5.5.2.6)

2b lower outer decking (5.5.2.2)

3 interior panel (5.5.2.4)

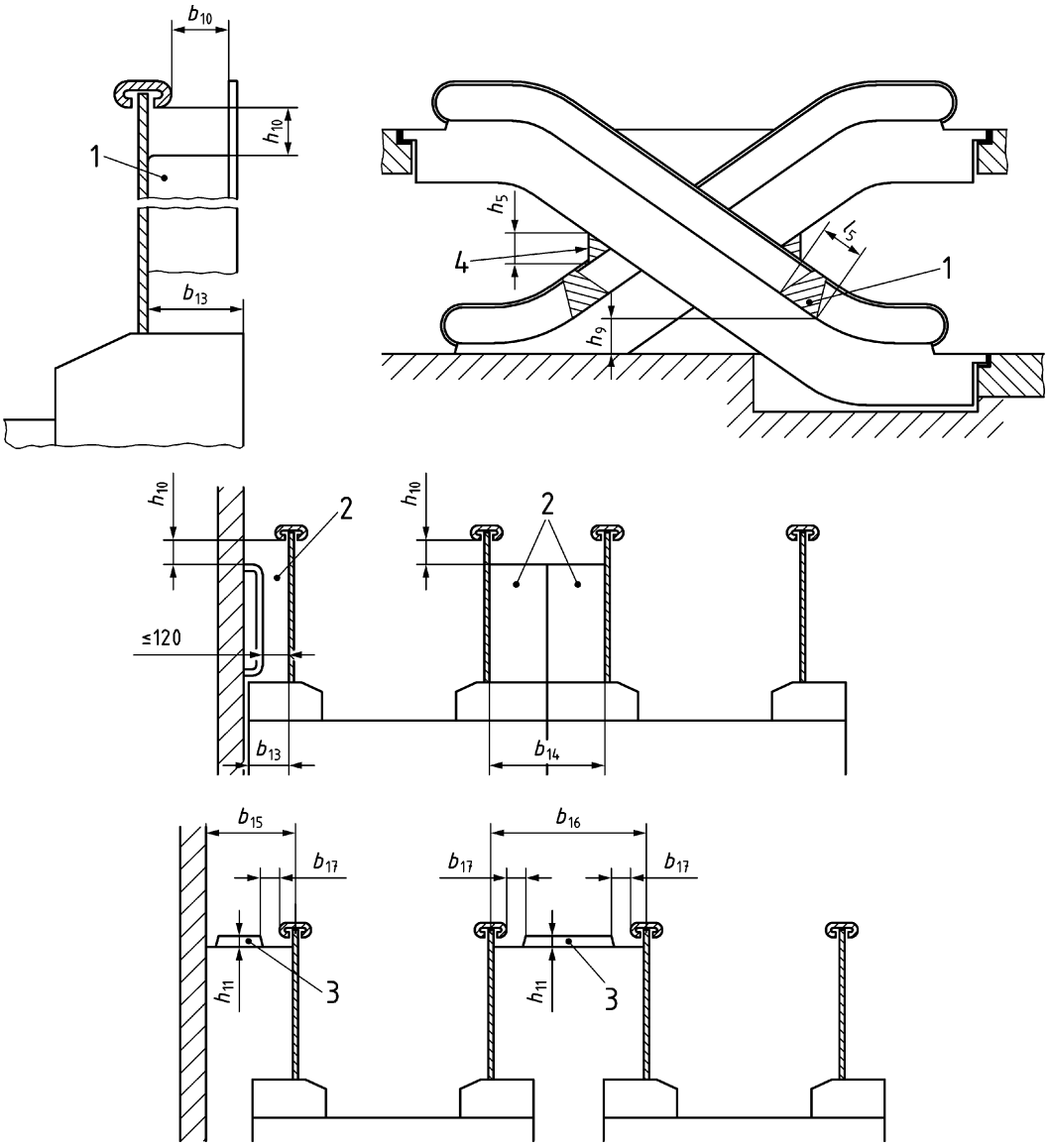
4 exterior panel (5.2.1.2)

5 balustrade decking (5.5.2.2)

Principal dimensions	Clause	Principal dimensions	Clause	Principal dimensions	Clause
$b_1 \le z_2 + 0{,}45$ m	5.6.3	$b_6' \le 8$ mm	5.6.2.1	h_3 0,10 m to 0,25 m	5.6.4.1
b_2 70 mm to 100 mm	5.6.2.2	$b_6'' \le 8$ mm	5.6.2.1	$z_2 \le z_1 + 7$ mm; distance between skirting	5.5.5.1
$b_3 < 0{,}12$ m (if γ less than 45°)	5.5.2.6.2	$b_{12} \ge 25$ mm	5.6.2.1, A.2.2		
$b_4 < 30$ mm	5.5.2.6.1	h_1 0,90 m to 1,10 m	5.5.2.1		
$b_5 \le 50$ mm	5.6.2.3	$h_2 \ge 25$ mm	5.5.3.2	$\gamma \ge 25°$	5.5.2.6
		$b_{18} \ge 8$ mm	5.6.2.1		

NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure 6 — Escalator/moving walk (sectional view), principal dimensions



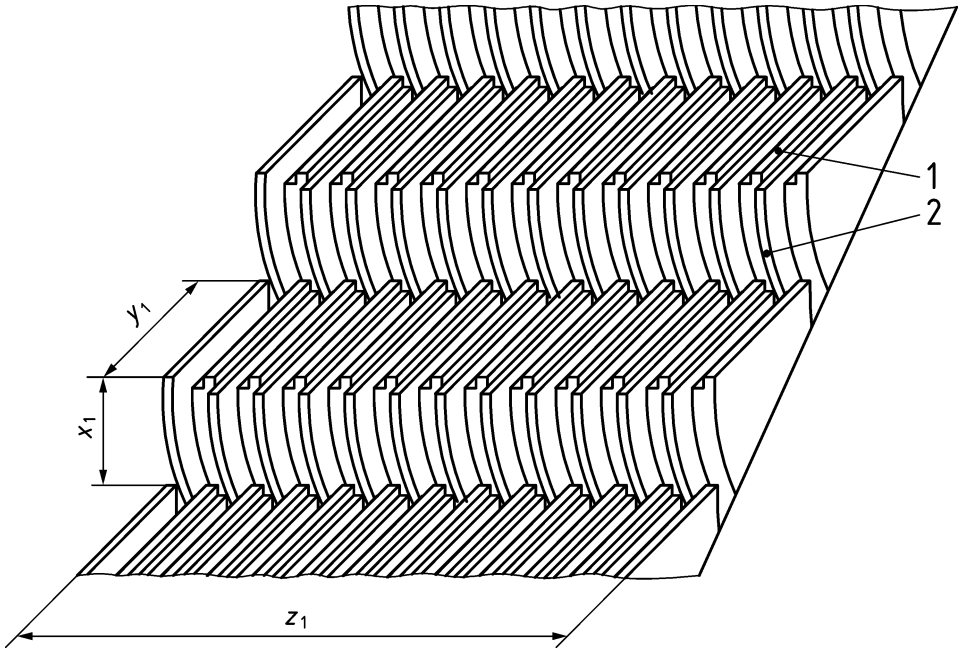
Key

1	anti-climbing device (5.5.2.2)	3	anti-slide device (5.5.2.2)
2	access restriction device (5.5.2.2)	4	vertical deflector (A.2.4)

Principal dimensions	Clause	Principal dimensions	Clause
b_{13}, b_{14}, b_{15}, b_{16}	5.5.2.2	h_{10} = 25 mm to 150 mm	5.5.2.2
b_{17} ≥ 100 mm	5.5.2.2	h_{11} ≥ 20 mm	5.5.2.2
h_5 ≥ 0,30 m	A.2.4	l_5 ≥ 1 000 mm	5.5.2.2
h_9 = (1 000 ± 50) mm	5.5.2.2	b_{10} ≥ 80 mm	A.2.2

NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure 7 — Anti-misuse devices



Key

1 step tread surface

2 step riser surface

Principal dimensions	Clause
$x_1 \leq 0{,}24$ m	5.3.2.2.1
$y_1 \geq 0{,}38$ m	5.3.2.2.2
z_1 0,58 m to 1,10 m	5.3.2.1

NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure 8 — Steps, principal dimensions

Dimensions in millimetres

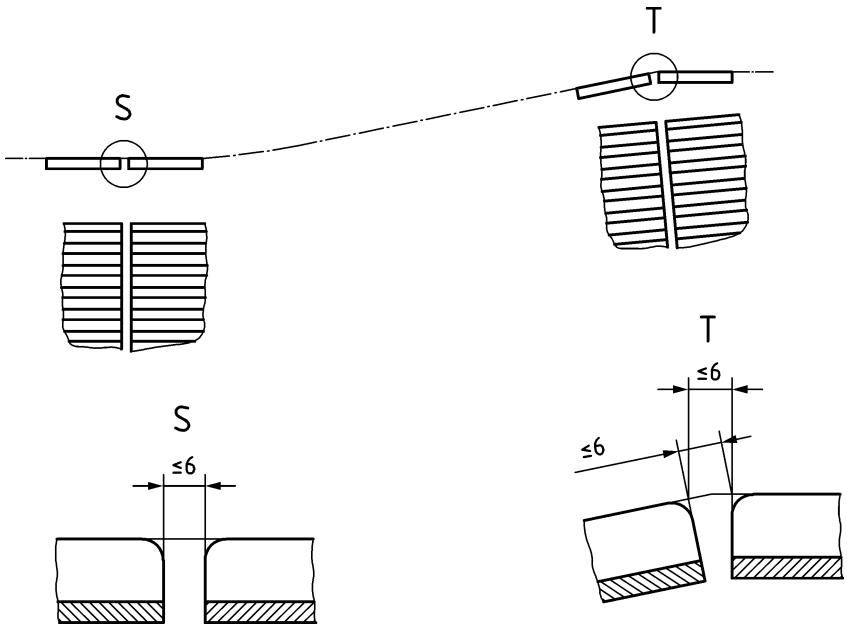


Figure 9 — Pallets, clearance and mesh depth (pallet type moving walk without meshed front and rear edges) in lower and upper landing and transition curves

Dimensions in millimetres

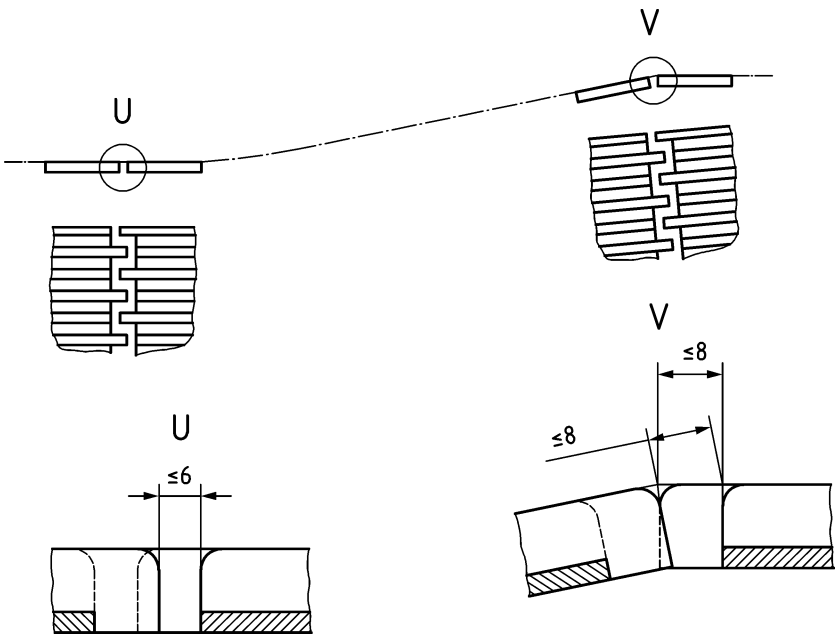
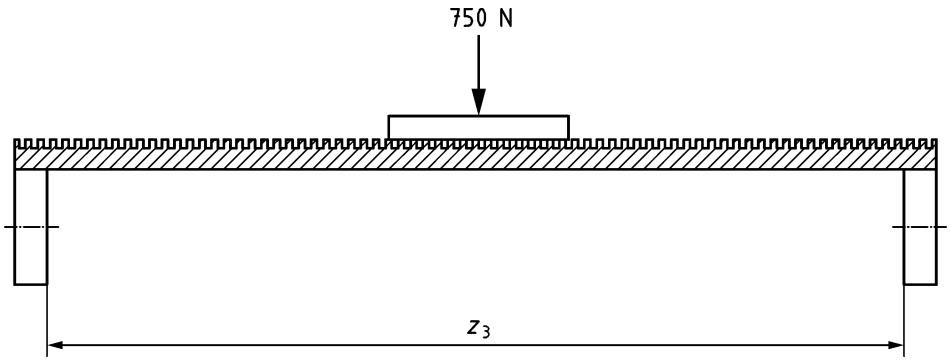


Figure 10 — Pallets, clearance and mesh depth (pallet type moving walk with meshed front and rear edges) in lower and upper landing and transition curves



Key

Symbol for quantity/Designation	Clause
z_3 Transverse distance between the supporting rollers	5.3.3.2.4

NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure 11 — Belt (sectional view), single force

5.11 Electric installations and appliances

5.11.1 General

5.11.1.1 Introduction

The electric installation of escalators or moving walks shall be so designed and manufactured as to ensure protection against hazards arising from the electric equipment or which may be caused by external influences on it, provided the equipment is used in applications for which it was made and is adequately maintained.

Therefore, the electric equipment shall:

a) comply with the requirements stated in the CENELEC harmonized standards;

b) where no harmonized standards as referred to in a) exist, comply with the requirements of the International Electrotechnical Commission (IEC) and which are stated in the CENELEC harmonized documents.

Whenever one of these standards is used, its references are given, together with the limits within which it is used.

5.11.1.2 Limits of application

5.11.1.2.1 The requirements of this standard relating to the installation and to the constituent components of the electric equipment apply:

a) to the main switch of each independent power circuit (e.g. machine, heating system) of the escalator or moving walk and dependent circuits;

b) to the switch for the lighting circuit of the escalator or moving walk and dependent circuits.

The escalator or moving walk shall be considered as a whole, in the same way as a machine with its incorporated apparatus.

5.11.1.2.2 The electricity supply to the input terminals of the switches referred to in 5.11.1.2.1 and the electricity supply to the lighting of the machinery spaces, driving and return stations are not laid down by this standard.

5.11.1.2.3 The electromagnetic compatibility shall comply with the requirements of EN 12015:2014 and EN 12016:2013.

5.11.1.3 Protection against direct contact

For protection against direct contact the requirements of EN 60204-1:2006, 6.2 shall apply.

5.11.1.4 Insulation resistance tests

For resistance of the insulation between conductors and between conductors and the earth, EN 60204-1:2006, 18.3, shall apply.

5.11.1.5 Voltage limit for control and safety circuits

For control and safety circuits, the value in direct current or the r.m.s. value in alternating current between conductors or between conductors and earth shall not exceed 250 V.

5.11.1.6 Conductor for neutral and earth-continuity

The conductor for neutral and earth continuity shall be in accordance with EN 60204-1:2006, Clause 8.

5.11.2 Contactors, relay contactors, components of failsafe circuits

5.11.2.1 Contactors and relay contactors

5.11.2.1.1 To stop the driving machine (see 5.12.3.5) the main contactors shall belong to the following categories as defined in EN 60947-4-1:2010 7):

a) AC-3 for contactors of alternating current motors;

b) DC-3 for contactors of direct current machines.

5.11.2.1.2 Relay contactors (see 5.12.3.5) shall belong to the following categories as defined in EN 60947-5-18),:

a) AC-15 for contactors in alternating current control circuits;

b) DC-13 for contactors in direct current control circuits.

5.11.2.1.3 For main contactors (see 5.11.2.1.1) it is permissible to assume, in the measures taken to comply with 5.12.1.2.2, that:

— if one of the main contacts (normally open) is closed, all the normally closed mirror contacts (EN 60947-4-1, Annex F) are open;

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7) This standard is currently impacted by the amendment EN 60947-4-1:2010/A1:2012.

8) This standard is currently impacted by the amendment EN 60947-5-1:2004/A1:2009.

5.11.2.1.4 For the relay contactors (see 5.11.2.1.2) and safety relays (see EN 50205), i. e. relays with forcibly guided (mechanically linked) contacts, it is permissible to assume, in the measures taken to comply with 5.12.1.2.2, that:

a) if one of the normally closed contact is closed, all the normally open contacts are open (EN 60947-5-1);

b) if one of the normally open contact is closed, all the normally closed contacts are open (EN 60947-5-1).

NOTE: Auxiliary contacts used as separate block added to a main contactor or relay contactor are permitted only when fulfilling the requirements of EN 60947-5-1.

5.11.2.2 Components of failsafe circuits

5.11.2.2.1 When devices according to 5.11.2.1.2 are used as relays in a failsafe circuit, the assumptions of 5.11.2.1.3 also apply.

5.11.2.2.2 If the relays used are such that the break and make contacts are never closed simultaneously for any position of the armature, the possibility of partial attraction of the armature is permitted to be disregarded (see 5.12.1.2.2 f).

5.11.2.2.3 Devices connected after safety devices shall meet the requirements of 5.12.2.6.1.3 with regard to the creep distances and air gaps (not with regard to the separation distances).

This requirement does not apply to the devices mentioned in 5.11.2.1.

5.11.3 Main switches

5.11.3.1 In the vicinity of the machine or in the return stations, or in the vicinity of the control devices, there shall be a main switch capable of breaking the supply to the motor, to the brake releasing device and to the control circuit in the live conductors.

This switch shall not cut the supply to the socket outlets or to the lighting circuits necessary for inspection and maintenance (see 5.8.3).

When separate supplies are provided for auxiliary equipment such as heating, balustrade lighting and comb lighting, it shall be possible to switch them off independently. The corresponding switches shall be located close to the main switch and be marked unambiguously.

5.11.3.2 The main switches as defined in 5.11.3.1 shall be capable of being locked or otherwise secured in the “isolated” position, with the use of a padlock or equivalent, to ensure no inadvertent operation by others (see EN 60204-1:2006, 5.3.3). The control mechanism of the main switch shall be easily and rapidly accessible after opening of the doors or trap doors.

5.11.3.3 Main switches shall be capable of interrupting the highest current involved in normal operating conditions of the escalator or moving walk. They shall comply with the requirements of EN 60204-1:2006, Clause 5.

5.11.3.4 Where the main switches of several escalators or moving walks are positioned together it shall be possible to easily identify to which escalator or moving walk they refer.

5.11.4 Electric wiring

5.11.4.1 Conductors and cables

Conductors and cables shall be selected according to EN 60204-1:2006, Clause 12.

5.11.4.2 Cross-sectional area of conductors

To ensure adequate mechanical strength the cross-sectional area of conductors shall not be less than as shown in EN 60204-1:2006, Table 5

5.11.4.3 Wiring practices

5.11.4.3.1 The general requirements of EN 60204-1:2006, 13.1.1, 13.1.2 and 13.1.3, apply.

5.11.4.3.2 Conductors and cables shall be installed in conduits or trunkings or equivalent mechanical protection. Double insulated conductors and cables can be installed without conduits or trunkings if they are located as to avoid accidental damage, e.g. by moving parts.

5.11.4.3.3 The requirement 5.11.4.3.2 needs not apply to:

a) conductors or cables not connected to safety devices provided that:

   1) they are not subject to a rated output of more than 100 VA, and;

   2) they are part of SELV or PELV circuits;

b) The wiring of operating or distribution devices in cabinets or on panels between:

   1) different pieces of electric equipment, or

   2) these pieces of equipment and the connection terminals.

5.11.4.3.4 If connections, connection terminals and connectors are not located in protective enclosure, their IP2X (EN 60529:1991) protection shall be maintained when connected and disconnected and they shall be properly fixed to prevent unintended disconnection.

5.11.4.3.5 If, after opening of the main switch or switches of an escalator/moving walk, some connection terminals remain live and if the voltage exceeds 25 VAC or 60 VDC, a permanent warning label according to EN 60204-1:2006, Clause 16, shall be appropriately placed in proximity to the main switch or switches and a corresponding statement shall be included in the maintenance manual.

Furthermore, for circuits connected to such live terminals, the requirements of labelling, separation or identification by colour shall be fulfilled as given in EN 60204-1:2006, 5.3.5.

5.11.4.3.6 Connection terminals whose accidental interconnection could lead to a dangerous malfunction of the escalator/moving walk shall be clearly separated unless their method of construction obviates this risk.

5.11.4.3.7 In order to ensure continuity of mechanical protection, the protective sheathing of conductors and cables shall fully enter the casings of switches and appliances, or shall terminate in a suitably constructed gland.

However, if there is a risk of mechanical damage due to movement of parts or sharp edges of the frame itself, the conductors connected to the safety device shall be protected mechanically.

5.11.4.4 Connectors

Plug socket combinations shall comply with the requirements of EN 60204-1:2006, 13.4.5 except c), d) and i).

Connectors and devices of the plug-in type placed in the circuits of electrical safety devices shall be so designed that it shall not be possible to insert them in a position which leads to a dangerous situation.

5.12 Electric control system

5.12.1 Protective devices and functions

5.12.1.1 Overview

Table 6 provides an overview of protective devices and functions to be regarded with reference to the corresponding clauses.

Table 6 — Protective devices and functions

#	Description	Reference	General requirement	Failure lock
A	Protection against electric faults	5.12.1.2	Annex B	Yes[a]
B	Protection of motors	5.12.1.3	EN 60947–4-1	Yes[b]
C	Protection of safety devices	5.12.1.4	-	Yes
D	Protection against electrostatic loading	5.12.1.5	-	No

[a] Failure lock (see 5.12.2.8) is not required for 5.12.1.2.2 a) and b)

[b] Failure lock is not applicable for 5.12.1.3.3

5.12.1.2 Protection against electric faults

5.12.1.2.1 Any single fault listed in 5.12.1.2.2 in the electric equipment of an escalator or moving walk, if it cannot be excluded under conditions described in 5.12.1.2.3 and/or Annex B, shall not, on its own, be the cause of a dangerous situation of the escalator or moving walk.

5.12.1.2.2 The following faults shall be envisaged:

a) absence of voltage;

b) voltage drop;

c) loss of continuity of a conductor;

d) fault to earth of a circuit;

e) short circuit or open circuit, change of value or function in an electric component such as resistor, capacitor, transistor, lamp;

f) non-attraction or incomplete attraction of the moving armature of a contactor or relay;

g) non-separation of the moving armature of a contactor or relay;

h) non-opening of a contact;

i) non-closing of a contact;

j) phase reversal.

5.12.1.2.3 The non-opening of a contact need not be considered in the case of safety switches conforming to 5.12.2.6.1.

5.12.1.3 Protection of motors

5.12.1.3.1 Motors directly connected to the mains shall be protected against short-circuiting.

5.12.1.3.2 Motors directly connected to the mains shall be protected against overload by means of automatic circuit breakers with manual reset (except as provided for in 5.12.1.3.3) which shall cut off the supply to the motor in all live conductors (see EN 60947-4-1:20109)).

5.12.1.3.3 When the detection of overload operates on the basis of temperature increase in the windings of the motor, the protection device is permitted to close its contact automatically after sufficient cooling down has taken place. However, it shall only be possible to restart the escalator or moving walk under the conditions of 5.12.3.2.

5.12.1.3.4 The provisions of 5.12.1.3.2 and 5.12.1.3.3 apply to each winding if the motor has windings supplied by different circuits.

5.12.1.3.5 When the escalator or moving walk driving motors are supplied by DC generators driven by motors, the generator driving motors shall also be protected against overload.

5.12.1.4 Protection of safety devices

The fault to earth of a circuit[10)] in which there is a safety device shall cause the immediate stopping of the driving machine.

5.12.1.5 Protection against electrostatic loading

Means to discharge electrostatic loading shall be provided (e.g. anti-static-brushes).

5.12.2 Safety devices and functions

5.12.2.1 Overview

Table 7 provides an overview of requirements for the implementation of the safety circuit.

NOTE The term device in the context with 5.12.2 represents both device and function.

Table 7 — Requirements for the implementation of the safety control system

#	Description	Reference
A	Function of safety devices	5.12.2.2
B	Monitoring of safety devices	5.12.2.3
C	Power supply for safety devices	5.12.2.4
D	Actuation of safety devices	5.12.2.5
E	Means of safety devices	5.12.2.6
F	Events to be detected by safety devices	5.12.2.7 (Table 8)
G	Function of failure lock	5.12.2.8
H	Function for detecting deviations of the electrical braking sequence	5.12.2.9 (Table 9)

9) This standard is currently impacted by the amendment EN 60947-4-1:2010/A1:2012.

10) "fault to earth of a circuit" equals "Masse- oder Erdschluss in einem Schaltkreis" in German and "défaut d´isolement par rapport à la masse ou à la terre dans un circuit" in French.

5.12.2.2 Function of safety devices

The safety devices listed in Table 8 shall initiate a stop and prevent restarting according to 5.12.3.9. They shall consist of:

a) either one or more safety switches satisfying 5.12.2.6.1, and/or

b) failsafe circuits satisfying 5.12.2.6.2 considering failure exclusion of electronic components according to Annex B, and/or

c) Safety related electrical, electronic and programmable electronic devices (E/E/PE) in accordance with 5.12.2.6.3.

5.12.2.3 Monitoring of safety devices

No electric equipment shall be connected in parallel with a safety device with the exception of:

a) safety devices in case of inspection control (5.12.3.13);

b) connections to different points of the safety circuit for information about the status of safety devices; the devices used for that purpose shall fulfil the requirements of Annex B.

5.12.2.4 Power supply of safety devices

The construction and arrangement of the internal power supply units shall be such as to prevent the appearance of false signals at the outputs of safety devices due to the effects of switching. In particular, voltage peaks arising from the operation of the escalator or moving walk or other equipment on the network shall not create inadmissible disturbances in electronic components (noise, immunity) in compliance with EN 12015:2014 and EN 12016:2013.

5.12.2.5 Actuation of safety devices

The components actuating the safety devices shall be selected and assembled so that they are able to function properly even under the mechanical stresses resulting from its continuous operation.

Fixing elements for safety devices shall ensure the operation of the function by mechanical or geometric arrangements.

In the case of redundancy type failsafe circuit, it shall be ensured by mechanical or geometric arrangements of the detecting elements that a mechanical fault cannot cause unnoticed loss of redundancy.

Detecting elements of failsafe circuits shall fulfil the requirements of D.4.2 and D.4.3 if its malfunction is not detected.

5.12.2.6 Means of safety devices

5.12.2.6.1 Safety switches

5.12.2.6.1.1 The operation of a safety switch shall be by positive mechanical separation of the contacts. This positive mechanical separation shall even occur if the contacts are welded together.

Positive mechanical separation is achieved, when all contacts are brought to their open position in such a way that for a significant part of the travel there are no resilient elements (e.g. springs) between the moving contacts and the part of the actuator to which the actuating force is applied.

The design shall be such as to minimize the risk of a short-circuit resulting from a faulty component.

5.12.2.6.1.2 The safety switch shall be provided for a rated insulation voltage of 250 V if the enclosure provides a degree of protection of at least IP 4X (in accordance with EN 60529:1991), or 500 V if the degree of protection of the enclosure is less than IP 4X.

Safety switches shall belong to the following categories as defined in EN 60947-5-1:200411),:

a) AC-15 for safety switches in alternating current circuits;

b) DC-13 for safety switches in direct current circuits.

5.12.2.6.1.3 If the protective enclosure is not at least of type IP 4X the air gaps shall be at least 3 mm and creep distances at least 4 mm.

After separation the distance for contacts shall be at least 4 mm.

5.12.2.6.1.4 In the case of multiple breaks, the individual distances for breaking contacts shall be at least 2 mm after separation.

5.12.2.6.1.5 Debris from the conductive material shall not lead to short-circuiting of contacts.

5.12.2.6.2 Failsafe circuits

5.12.2.6.2.1 Anyone of the faults envisaged in 5.12.1.2 shall not be on its own the cause of a dangerous situation.

5.12.2.6.2.2 Furthermore, the following conditions apply for the faults envisaged in 5.12.1.2.2:

If one fault combined with a second fault can lead to a dangerous situation, the escalator or moving walk shall be stopped by the time the next operating sequence takes place in which the faulty element should participate.

The possibility of the second fault leading to a dangerous situation before the escalator or moving walk has been stopped by the sequence mentioned, is not considered.

If the malfunction of the component which has caused the first fault cannot be detected by a change of state, appropriate measures shall ensure that the fault is detected and movement prevented at the latest when the escalator or moving walk is restarted according to 5.12.3.2.

The MTBF (mean time between failures) of the failsafe circuit shall be at least 2,5 years. This time was determined under the assumption that within a period of three months each escalator or each moving walk is restarted according to 5.12.3.2 at least once and, thus, is subject to a change of state.

5.12.2.6.2.3 If two faults combined with a third fault can lead to a dangerous situation, the escalator or moving walk shall be stopped by the time the next operating sequence takes place in which one of the faulty elements should participate.

The possibility of the third fault leading to a dangerous situation before the escalator or moving walk has been stopped by the sequence mentioned, is not considered.

If the malfunction of the components which have caused the two faults cannot be detected by a change of state, appropriate measures shall ensure that the faults are detected and movement is prevented at the latest when the escalator or moving walk is restarted according to 5.12.3.2.

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11) This standard is currently impacted by the amendment EN 60947-5-1:2004/A1:2009.

The MTBF (mean time between failures) of the failsafe circuit shall be at least 2,5 years. This time was determined under the assumption that within a period of three months each escalator or each moving walk is restarted according to 5.12.3.2 at least once and, thus, is subject to a change of state.

5.12.2.6.2.4 A combination of more than three faults can be disregarded if:

a) the failsafe circuit is built up of at least two channels, and their equal status is monitored by a control circuit. The control circuit shall be checked prior to a restart of the escalator or moving walk according to 5.12.3.2 (see also Annex C), or

b) the failsafe circuit is built-up of at least three channels, and their equal status is monitored by a control circuit.

If the requirements of a) or b) are not fulfilled, it is not permitted to interrupt the failure analysis but it shall be continued analogous to 5.12.2.6.2.3.

For the implementation 5.11.2.2 shall be applied.

5.12.2.6.2.5 Drafting and assessing failsafe circuits shall be as shown in Figure C.1.

5.12.2.6.3 Safety related electrical, electronic and programmable electronic devices (E/E/PE)

Safety related electrical, electronic and programmable electronic devices (E/E/PE) shall be designed in accordance with the requirements of EN 62061:200512),

If a E/E/PE and a non-safety related system share the same hardware, the requirements for E/E/PE shall be met.

5.12.2.7 Events to be detected by safety devices

5.12.2.7.1 Overview

Table 8 provides an overview of events to be detected by safety devices.

12) This standard is currently impacted by the amendment EN 62061:2005/A1:2013.

Table 8 — Safety devices

#	Description	Reference	Means of safety device	Failure lock	Enabled in inspection mode
A	Detection of excessive speed	5.12.2.7.2	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 2)	Yes	Yes
B	Detection of unintentional reversal of the direction of travel	5.12.2.7.3	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 2)	Yes	Yes
C	Detection of non-lifting of the auxiliary brake	5.12.2.7.4	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 1)	Yes	No
D	Detection of breakage or undue elongation of parts immediately driving the steps, pallets or the belt	5.12.2.7.5	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 1)	Yes	Yes
E	Detection of movement of tensioning device	5.12.2.7.6	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 1)	Yes	Yes
F	Detection of entrapment at comb	5.12.2.7.7	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 1)	No	Yes
G	Detection of the stopping of a succeeding escalator or moving walk or detection of structural measures blocking the exit of the escalator or moving walk	5.12.2.7.8	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 2)	No	No
H	Detection of entrapment at hand rail entry	5.12.2.7.9	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 1)	No	Yes
I	Detection of sagging of step or pallet	5.12.2.7.10	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 2)	Yes	No
J	Detection of missing of step or pallet	5.12.2.7.11	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 2)	Yes	No
K	Detection of non-lifting of the brake	5.12.2.7.12	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 1)	Yes	No
L	Detection of speed deviation of the hand rail	5.12.2.7.13	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 1)	No	No
M	Detection of opened floor plate	5.12.2.7.14	5.12.2.6.1 or 5.12.2.6.2 or	No	No

#	Description	Reference	Means of safety device	Failure lock	Enabled in inspection mode
			5.12.2.6.3 (SIL 1)		
N	Detection of the actuation of the stop device for emergency situations	5.12.2.7.15	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 1)	No	Yes
O	Detection of installed hand winding device	5.12.2.7.16	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 1)	Yes	Yes
P	Detection of the maintenance and repair stop switch	5.12.2.7.17	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 2)	No	Yes
Q	Detection of the actuation of the stop device on the inspection control device	5.12.2.7.18	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 2)	No	Yes
R	Detection of the absence/presence of a removable barrier intended to prevent access of shopping trolleys and baggage carts	5.12.2.7.19	5.12.2.6.1 or 5.12.2.6.2 or 5.12.2.6.3 (SIL 2)	No	No

5.12.2.7.2 Detection of excessive speed

A device shall be provided to detect excessive speed before the speed exceeds a value of 1,2 times the nominal speed.

It is permissible to disregard this requirement if the design prevents excessive speed.

5.12.2.7.3 Detection of unintentional reversal of the direction of travel

A device shall be provided for escalators and inclined ($\alpha \geq 6°$) moving walks to detect immediately the unintentional reversal of direction of travel.

5.12.2.7.4 Detection of non-lifting of the auxiliary brake

A device shall be provided to detect the non-lifting of the auxiliary brake after starting the escalator/moving walk (see 5.4.2.2).

5.12.2.7.5 Detection of breakage or undue elongation of parts immediately driving the steps, pallets or the belt

A device shall be provided to detect the breakage or undue elongation of parts immediately driving the steps, pallets or the belt, e.g. chains or racks.

5.12.2.7.6 Detection of movement of tensioning device

A device shall be provided to detect an unintended extension or reduction of the distance between the driving and tensioning devices of more than 20 mm (see 5.4.3.3 and 5.4.4.2).

5.12.2.7.7 Detection of entrapment at comb

A device shall be provided to detect objects being trapped which are not dealt with by the means described in 5.7.3.2.5.

5.12.2.7.8 Detection of the stopping of a succeeding escalator or moving walk or detection of structural measures blocking the exit of the escalator or moving walk

Stopping of a succeeding escalator or moving walk where an intermediate exit does not exist (see A.2.6) or the exit of the escalator or moving walk by structural measures is blocked (e.g. shutters, fire protection gates). See A.2.5 for additional stop device for emergency situation and definition of the exit area.

5.12.2.7.9 Detection of entrapment at hand rail entry

A device shall be provided to detect foreign bodies being trapped in the handrail entry (see 5.6.4.3).

5.12.2.7.10 Detection of sagging of step or pallet

If any part of the step or pallet is sagging so that meshing of the combs is no longer ensured a safety device shall be provided. This safety device shall be arranged before each transition curve at a sufficient distance before the comb intersection line to ensure that the step or pallet which has sagged does not reach the comb intersection line (see stopping distances defined in 5.4.2.1.3.2 and 5.4.2.1.3.4). The safety device may be applied at any point of the step or pallet (see 5.7.2.5).

This does not apply to belt moving walks.

5.12.2.7.11 Detection of missing of step or pallet

A missing step/pallet shall be detected and the escalator/moving walk stopped before the gap (resulting from the missing step/pallet) emerges from the comb. This shall be ensured by a safety device or function provided at each driving and return station in the return run of the steps/pallets. The installation of the detection means for this device is not permitted in the straight part between the transition curves as this is not part of driving or return station.

5.12.2.7.12 Detection of non-lifting of the operational brake

A device shall be provided to detect the non-lifting of the operational brake after starting the escalator/moving walk (see 5.4.2.1).

5.12.2.7.13 Detection of speed deviation of the hand rail

A handrail speed monitoring device shall be provided and shall initiate the stopping of the escalator or moving walk in the event of a hand rail speed deviation of more than + 15 %/-15 % to the step/pallet speed within a time frame of 5 s to 15 s (see 5.6.1).

It is permissible to disregard the requirement of + 15 % if the design prevents this situation condition.

5.12.2.7.14 Detection of opened inspection cover

A device shall be provided to detect opened inspection cover (see 5.2.4).

5.12.2.7.15 Detection of the actuation of the stop device for emergency situations

A device shall be provided to detect the actuation of a stop device for emergency.

NOTE Devices according to EN ISO 13850:2008 do not support the functional requirement for stop devices according to 5.12.2.7.15. For the specific purpose of safety for escalators and moving walks the stop device for emergency situations is defined different to EN ISO 13850:2008.

5.12.2.7.16 Detection of installed hand winding device

A device shall be provided to detect the installation of a removable hand winding device (see 5.4.1.4).

5.12.2.7.17 Detection of the maintenance and repair stop device

There shall be a stop device in the driving and return station.

Escalators and moving walks with the driving unit arranged between the user side of the step, pallet or belt and the return line, or outside the return stations, shall have additional stop devices in the area of the driving unit.

The stop devices shall be functionally in accordance with EN ISO 13850:2008. The position of the actuator of the stop device shall be marked clearly and permanently or the status of the safety contact shall be displayed clearly on the safety device

SPECIFIC CASE A stop device need not be provided in a machinery space if a main switch according to 5.11.3 is located therein.

NOTE A stop device in accordance with emergency stop device defined in EN ISO 13850:2008 will comply to the requirement above

5.12.2.7.18 Detection of the actuation of the stop device on the inspection control device

A device shall be provided to detect the actuation of the stop device on the inspection control device. The stop device shall:

a) be operated manually;

b) have the switching positions marked clearly and permanently;

NOTE A stop device in accordance with emergency stop device defined in EN ISO 13850:2008 will comply to the requirement above

This device is only active when the inspection control device is plugged in.

5.12.2.7.19 Detection of the absence/presence of a removable barrier intended to prevent access of shopping trolleys and baggage carts

If the escalator/moving walk is required to operate in both directions and has facility for removable barriers in unrestricted area the absence/presence of these barriers shall be detected to prevent wrong positioning of the barrier resulting in operation towards the barrier (see also A.4).

A device shall be provided to detect the removal of the barrier when the escalator/moving walk is running and the absence/presence of a removable barrier intended to prevent access of shopping trolleys and baggage carts and shall permit starting away from the inserted barrier.

See A.2.5 for additional stop device for emergency situation and definition of the exit area.

5.12.2.8 Function of failure lock

When a failure is locked, starting shall be prevented for the electric control devices and functions mentioned in Table 8 and Table 9.

NOTE Failure lock prevents from starting. Manual reset releases the failure lock

Safety devices (see Table 8 and Table 9), protective devices (see Table 6) and control devices (see Table 10) shall be provided with a failure lock where mentioned.

Making available according Table 10, item A, shall be possible only after manual reset of the failure lock.

It is not permitted to carry out a manual reset of the failure lock remotely.

The manual reset of the failure lock shall be performed only by an authorized person.

Before manual reset of the failure lock, the root cause for stopping shall be investigated, the stopping device shall be checked and corrective action shall be taken if necessary.

The failure lock shall remain active in case of:

a) even another following event of Table 6, Table 8 or Table 9 occurs;

b) the reinstatement of the power supply or

c) the change to or the return from inspection control.

In inspection control it is permissible to enable/disable the safety devices according Table 8 and Table 9.

5.12.2.9 Function for detecting deviations of the electrical braking sequence

Table 9 — Requirements for detecting deviations of the electrical braking sequence

#	Description	Reference	Means of safety device	Failure lock	Enabled in inspection mode
A	Detection of time deviations for the braking sequence for electrical braking	5.12.2.9.1	5.12.2.6.2 or 5.12.2.6.3 (SIL 2)	Yes	No

5.12.2.9.1 Detection of time deviations for the braking sequence for electrical braking

A device shall be provided to detect the exceeding of the requirements of 5.12.3.5.2.2

5.12.3 Control devices and functions

5.12.3.1 Overview

Table 10 provides an overview of control devices and functions.

Table 10 — Control devices and functions

#	Description	Reference	General requirement
A	Making available for use and starting – manually operated	5.12.3.2	5.12.1.1 (Table 6, item A)
B	Automatic operation – Starting in predetermined direction	5.12.3.3	5.12.1.1 (Table 6, item A)
C	Automatic operation – Starting in 2-Direction-Mode	5.12.3.4	5.12.1.1 (Table 6, item A)
D	Stopping the escalator or moving walk	5.12.3.5	5.12.1.1 (Table 6, item A)
E	Making unavailable and stopping by operator – manually operated	5.12.3.6	5.12.1.1 (Table 6, item A), 5.12.3.5
F	Stopping – automatically operated	5.12.3.7	5.12.1.1 (Table 6, item A), 5.12.3.5
G	Stopping by stop device for emergency situations, manually operated	5.12.3.8	5.12.3.5
H	Stopping initiated by protective and safety devices and functions	5.12.3.9	5.12.3.5
I	Preventing from starting when permitted stopping distance exceeded	5.12.3.10	5.4.2.1.3.1, 5.4.2.1.3.4, 5.12.2.8
J	Intended reversal of direction of travel	5.12.3.11	-
K	Reactivation for automatic restart	5.12.3.12	5.12.1.1 (Table 6, item A)
L	Inspection control	5.12.3.13	5.12.2.7.20, 5.12.3.5

5.12.3.2 Making available for use and starting – manually operated

Making available for use and starting of the escalator/moving walk shall only be possible without users and be effected by one or more switches available to authorized persons only (e.g. key-operated switches, switches with detachable lever, switches under lockable protective caps, remote start devices) and be reachable from an area outside the comb intersection line. Such switches shall not function concurrently as main switches described in 5.11.3. The person who operates the switch shall be able to verify the step/pallet band is free of users and objects by visual or other means before making this operation. The direction of travel shall be distinctly recognizable from the indication on the switch.

The starting switch(es) shall be located within reach of the stop device according to 5.12.3.8.

For remote starting devices the requirements above shall apply.

NOTE See 7.4.1 d) for manual starting and 7.4.1 e) for the obligation to observe a complete revolution of the step/pallet band before making the escalator/moving walk available to the public after maintenance.

5.12.3.3 Automatic operation – Starting in predetermined direction

5.12.3.3.1 Automatic operation shall only be possible after 5.12.3.2 applied.

Escalators or moving walks which start or accelerate automatically by detecting the entering of a user shall move with at least 0,2 times the nominal speed when the user reaches the comb intersection line and then accelerate less than 0,5 m/s^2.

The means for detecting the entering of a user shall take into account an average walking speed of 1 m/s.

Constructional measures may be necessary to prevent circumvention of the detecting means.

For the implementation of starting automatically (5.12.1.2 applies), the consequence of failures of the detection means actuating the automatic start at the entries (e.g. no or partly no detection of users) shall be prevented.

NOTE The intention of the above requirements is to detect a user entering the landings. Depending on the location of the detecting means the area to be regarded for detection may extend the landings (e.g. provision of traffic columns) or is smaller than the landings.

5.12.3.3.2 On escalators/moving walks which start automatically by the entering of a user, the direction of travel shall be predetermined, clearly visible to the user and marked distinctly on the escalator/moving walk (see 7.2.2).

In such cases where escalators or moving walks which start automatically by the entering of a user can be entered in the direction opposite its predetermined direction of travel, they shall start in the predetermined direction and conform to the requirements of 5.12.3.3.1. The moving time shall be not less than 10 s.

5.12.3.3.3 Following control requirements for users waiting on any of the landings apply

— for the moving step/pallet band; or

— in case the step/pallet band is stopped according to 5.12.3.7;

5.12.3.3.3.1 Requirement where the step/pallet band is moving

Means shall be provided to detect any user on the landing. It shall provide a signal to the control system to keep the escalator/moving walk moving until the last user has left the landing or entered the moving step/pallet band. For stopping the requirements of 5.12.3.7 apply.

5.12.3.3.3.2 Requirements where the step/pallet band is stopped according to 5.12.3.7:

When a user is about to enter the step/pallet band, detecting means shall be provided not more than 0.3 m before the comb intersection line providing control signal to the control system causing

a) the termination of the automatic operation (5.12.3.3) and making the escalator/moving walk unavailable. Starting shall only apply according to 5.12.3.2; or

b) the reactivation for automatic start according to 5.12.3.12; or

c) to initiate the start of the step band/pallet band with an acceleration of not more than 0,3 m/s^2

5.12.3.4 Automatic operation - Starting in 2-Direction-Mode

5.12.3.4.1 Automatic operation shall only be possible after 5.12.3.2 applied.

Escalators which start automatically by detecting the entering of a user shall move with at least 0,2 times the nominal speed when the user reaches the comb intersection line and then accelerate less than 0,5 m/s^2.

The means for detecting the entering of a user shall take into account an average walking speed for a walking person of 1 m/s.

Constructional measures may be necessary to prevent circumvention of the detecting means.

For the implementation of starting automatically (5.12.1.2 applies), the consequence of failures of the detection means actuating the automatic start at the entries (e.g. no or partly no detection of users) shall be prevented.

2-Direction-Mode is not permitted on moving walks.

Note 1: The intention of above requirements is to detect a user is entering the landings. Depending on the location of the detecting means the area to be regarded for detection may extend the landings (e.g. provision of traffic columns) or is smaller than the landings

Note 2: For escalators a traffic flow analysis has to be undertaken by the owner to establish this functionality can accommodate passenger volumes in both directions

5.12.3.4.2 On escalators which can start automatically in either direction (2-Direction-Mode) by the entering of a user, the operating mode shall be clearly visible to the user and marked distinctly on the escalator (see also 7.2.2). They shall start in the direction determined by the user entering first. When the escalator was started by a user from either direction, the indicator opposite from the initiated starting side shall automatically indicate “no entry” (see 7.2.1.2.3).

5.12.3.4.3

Following control requirements for users waiting on any of the landings apply:

— for the moving step/pallet band; or

— in case the step/pallet band is stopped according to 5.12.3.7.

5.12.3.4.3.1 Requirement where the step/pallet band is moving

Means shall be provided to detect any user on the landing. It shall provide a signal to the control system to keep the escalator/moving walk moving until the last user has left the landing or entered the moving step/pallet band. For stopping the requirements of 5.12.3.7 apply.

5.12.3.4.3.2 Requirements where the step/pallet band is stopped according to 5.12.3.7:

When a user is about to enter the step/pallet band, detecting means shall be provided not more than 0.3m before the comb intersection line providing control signal to the control system causing

a) the termination of the automatic operation (5.12.3.3) and making the escalator/moving walk unavailable. Starting shall only apply according to 5.12.3.2; or

b) the reactivation for automatic start according to 5.12.3.12; or

c) the start of the step/pallet band with an acceleration of not more than 0.3 m/s.

5.12.3.5 Stopping the escalator or moving walk

5.12.3.5.1 General

Stopping is regarded as the initiation of a braking sequence caused by protective, safety and control devices and functions.

The stopping shall operate automatically:

a) in the event of loss of the voltage supply;

b) in the event of loss of the voltage supply to the control circuits.

NOTE The interruption of a safety circuit is not considered as loss of voltage supply.

The supply to the motor(s) shall be interrupted by at least two independent contactors, the contacts of which shall be in series in the supply circuit of the motor(s). If, when the escalator or moving walk is stopped, one of the main contacts of one of the contactors has not opened, restarting shall be prevented.

The interruption of the electricity supply to the operational brake shall be effected by at least two independent electric devices. They can be those which break the supply to the motor(s). If after the stop of the escalator or moving walk one of these electric devices has not opened, restarting shall be prevented.

5.12.3.5.2 Initiation of the braking sequence of the operational brake

5.12.3.5.2.1 There shall be no intentional delay in the application of the operational braking system. If the control system starts a braking sequence immediately to bring the escalator/moving walk to a stop, this is not considered as an intentional delay.

5.12.3.5.2.2. Where electrical braking according to 5.4.2.1.1.2 is provided the interruption of the electricity supply of the electro-mechanical brake shall occur no later than 1 s after the specified electrical braking time is achieved after the initiation of the electrical braking sequence. The total time for the defined electrical braking sequence until the actuation of the electro-mechanical brake shall not exceed 4 s.

In case of the events 5.12.2.7.2, 5.12.2.7.3 and 5.12.2.9.1 the electrical braking sequence shall be terminated and the electro-mechanical brake shall be applied immediately**.**

5.12.3.5.3 Initiation of the braking sequence by the auxiliary brake

Auxiliary brakes shall become effective in either of the following conditions:

a) before the speed exceeds a value of 1,4 times the nominal speed;

b) by the time the steps and pallets or the belt change from the present direction of motion.(See also 5.4.2.2.5).

5.12.3.6 Stopping and making unavailable by operator - manually operated

Before stopping, the person shall have means of ensuring that nobody is using the escalator or moving walk, before making this operation. For remote stopping devices the same requirements apply.

5.12.3.7 Stopping - automatically operated

It is permitted to design the control in such a way that the escalator or moving walk is stopped automatically after a sufficient time (at least the anticipated user transfer time plus 10 s) after the user has actuated a detection means described in 5.12.3.2.

5.12.3.8 Stopping by stop device for emergency situations, manually operated

5.12.3.8.1 Stop device for emergency situations shall be provided to stop the escalator or moving walks in the event of an emergency according to 5.12.2.7.15 when the actuator of the stop device has been activated. The actuator of the stop device shall be placed in conspicuous and easily reachable positions at least at or near each landing of the escalator or moving walk (see 7.2.1.2.2 for optical design). At the landings, the stop switches shall be reachable from an area outside the step/pallet band.

If the stop switch is located below half the balustrade height h_1, in addition an indicator according to Figure 12 shall be placed on the inner side of the balustrade with the following characteristics:

— a minimum diameter of 80 mm;

— coloured red;

— marked with “STOP” in white letters;

— located above half the balustrade height h_1;

— an arrow - which also may be located below half the balustrade height h_1.- pointing from the sign towards the stop device.

The distances between stop devices for emergency situations shall not exceed:

— 30 m on escalators;

— 40 m on moving walks.

If necessary, additional stop switches shall be provided to maintain the distance.

For moving walks intended to transport shopping trolleys and baggage carts, see I.2.

Dimensions in millimetres

NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure 12 — Stop device indicator

Stop devices for emergency situations shall be safety devices according to 5.12.2.6.1.

NOTE Devices according to EN ISO 13850:2008 do not support the functional requirement for stop devices according to 5.12.3.8. For the specific purpose of safety for escalators and moving walks the stop switch for emergency situations is defined different to EN ISO 13850:2008.

5.12.3.9 Stopping initiated by protective and safety devices and functions

All protection means in Table 6, items A, B, C and all detections means in Table 8 and Table 9 shall cause the stopping by operational brake according to 5.12.3.5.

5.12.3.10 Preventing from starting when permitted stopping distance exceeded

A device shall be provided to prevent from starting in case the maximum permitted stopping distances (5.4.2.1.3.2 and 5.4.2.1.3.4) are exceeded by more than 20 %.

Failure lock function according to 5.12.2.8 shall be provided.

5.12.3.11 Intended reversal of direction of travel

An intended reversal of the direction of travel shall be possible only if the escalator or moving walk stands still and 5.12.3.2 applies.

5.12.3.12 Reactivation for automatic restart

Where stopping is effected by a stop switch for emergency situation according to 5.12.3.8, reactivation of the escalator or moving walk for automatic restart without the switches mentioned in 5.12.3.2 is permitted under the following conditions:

a) The steps, pallets or the belt shall be supervised between the comb intersection lines and additional 0,30 m beyond each comb so that reactivation for automatic restart is effected only when there is no person or object within this zone.

   The device shall be able to detect an opaque upright standing cylinder with a diameter of 0,30 m and a height of 0,30 m at any place within this zone.

b) The escalator or moving walk shall start by the entering of a user according to 5.12.3.3 and 5.12.3.4.

   Starting shall be effected only if, for a period of at least 10 s, the control device has not detected any persons or objects within the defined zone.

c) The reactivation control initiated by the control device for automatic restart shall be a safety device according to 5.12.2. Self-controlling transmitter elements are permitted in single-channel design.

5.12.3.13 Inspection control

5.12.3.13.1 Escalators or moving walks shall be equipped with inspection controls to permit operation during maintenance or repair or inspection by means of portable and manually operated control devices. At least one portable control device shall be provided for each escalator or moving walk.

This device shall require at least continuous activation by the use of both hands in order to initiate and to maintain any operation of the escalator/moving walk. It shall be designed so that the operator must use both hands during the same time period, one hand on each control actuation device, to operate the inspection control.

5.12.3.13.2 For this purpose, one inspection outlet for the connection of the flexible cable of the portable manually operated control device shall be provided at least at each landing, e.g. in the driving station and the return station in the truss. The length of the cable shall be at least 3,00 m. Inspection outlets shall be located in such a way that any point of the escalator or moving walk can be reached with the cable.

5.12.3.13.3 The operating elements of this control device shall be protected against accidental operation. The escalator or moving walk is permitted to run only as long as the operating elements are switched on by permanent application of manual pressure. The direction of travel shall be distinctly recognizable from the indication on the switch. Each control device shall have a stop device according to 5.12.2.7.18.

When the inspection control device is plugged in, the operation of the stop switch shall cause the disconnection of the power supply from the driving machine and the operational brake shall be activated.

5.12.3.13.4 When in inspection control, the inspection control device shall be the only means for starting the escalator or moving walk. All other starting devices shall be rendered inoperative.

All inspection outlets shall be arranged in such a way that when more than one control device is connected, they all become inoperative for the starting of the escalator/moving walks (see Table 8 and Table 9 for safety devices remaining active in inspection control).

6 Verification of the safety requirements and/or protective measures

6.1 General

Table 11 indicates the methods by which the safety requirements and measures described in Clause 5 shall be verified by the manufacturer for each new model of escalator/moving walk, together with a reference to the corresponding sub-clauses in this standard. Secondary sub-clauses, which are not listed in the table, are verified as part of the quoted sub-clause. All verification records shall be kept by the manufacturer.

Where mechanical testing is required in accordance with this standard, setting tolerances are permitted.

Table 11 — Methods to be used to verify conformity to the requirements

Clause	Testing[a]	Measurement[b]	Calculation[c]	Visual inspection[d]
5.2.1.1				**x**
5.2.1.2	**x**[e]		**x**[e]	
5.2.1.3				**x**
5.2.1.4				**x**
5.2.1.5				**x**
5.2.2		**x**		
5.2.3				**x**
5.2.4			**x**	**x**
5.2.5			**x**	
5.3.1		**x**		
5.3.2		**x**		
5.3.3	**x**		**x**	

Clause	Testing[a]	Measurement[b]	Calculation[c]	Visual inspection[d]
5.3.4		x		
5.3.5		x		
5.4.1.2		x		
5.4.1.3.1				x
5.4.1.3.2			x	
5.4.1.4				x
5.4.2.1.1	x			
5.4.2.1.2	x			
5.4.2.1.3.1			x	
5.4.2.1.3.2		x		
5.4.2.1.3.3			x	
5.4.2.1.3.4		x		
5.4.2.2.1				x
5.4.2.2.2			x	
5.4.2.2.3				x
5.4.2.2.5	x			
5.4.3.1				x
5.4.3.2	x		x	
5.4.3.3				x
5.4.4.1			x	
5.4.4.2				x
5.5.1				x
5.5.2.1		x		
5.5.2.2		x		x
5.5.2.3			x	
5.5.2.4		x		x
5.5.2.5		x		
5.5.2.6		x		
5.5.3.1		x		
5.5.3.2		x		-
5.5.3.3	x			
5.5.3.4	x	x		x
5.5.4		x		
5.5.5.1		x		x
5.5.5.2		x		x
5.6.1	x	x		
5.6.2.1		x		x

Clause	Testing[a]	Measurement[b]	Calculation[c]	Visual inspection[d]
5.6.2.2		x		
5.6.2.3		x		
5.6.3		x		
5.6.4.1		x		
5.6.4.2		x		
5.6.4.3				x
5.6.5				x
5.7.1	x	x		
5.7.2.1		x		
5.7.2.2		x		
5.7.2.3		x		
5.7.2.4		x		
5.7.2.5				x
5.7.3.1				x
5.7.3.2.1		x		x
5.7.3.2.2		x		x
5.7.3.2.3		x		x
5.7.3.2.4				x
5.7.3.2.5				x
5.7.3.2.6	x			
5.7.3.3.1		x		
5.7.3.3.2		x		
5.8.1				x
5.8.2.1		x		
5.8.2.2				x
5.8.2.3		x		
5.8.3		x		x
5.9	x			
5.10				x
5.11.3.1	x			x
5.11.3.2				x
5.11.3.3				x
5.11.4.1				x
5.11.4.2				x
5.11.4.3.1				x
5.11.4.3.2				x
5.11.4.3.4				x

Clause	Testing[a]	Measurement[b]	Calculation[c]	Visual inspection[d]
5.11.4.3.5				x
5.11.4.3.6				x
5.11.4.3.7				x
5.11.4.4				x
5.12.1.2				x
5.12.1.3				x
5.12.1.4	x			
5.12.1.5				x
5.12.2.2	x			
5.12.2.3				x
5.12.2.4				x
5.12.2.5				x
5.12.2.6.1.2				x
5.12.2.6.1.3		x		
5.12.2.6.1.4				x
5.12.2.6.2	x			
5.12.2.6.3	x			
5.12.2.7	x			
5.12.2.8	x			
5.12.2.9	x			
5.12.3.2	x			
5.12.3.3	x			
5.12.3.4	x			
5.12.3.5	x			
5.12.3.6	x			
5.12.3.7	x			
5.12.3.8	x			x
5.12.3.9	x			
5.12.3.10	x			
5.12.3.11	x			
5.12.3.12	x			x

Clause	Testing[a]	Measurement[b]	Calculation[c]	Visual inspection[d]
5.12.3.13.1				**x**
5.12.3.13.2		**x**		**x**
5.12.3.13.3				**x**
5.12.3.13.4	**X**			
Clause 7				**x**
Annex A		**x**		**x**
Annex B	**x**			**x**
Annex G		**x**		**x**
M.2		**x**	**x**	
M.3			**x**	

[a] The result of the test is to show that the escalator/moving walk works as intended, including the electric safety devices.

[b] The result of the measurement is to show that the stated measurable parameters have been met.

[c] Calculations will verify that the design characteristics of the provided components meet the requirements.

[d] The results of the visual inspections is only to show that something is present (e.g. a marking, a control panel, an instruction handbook), that the marking required satisfies the requirement and that the content of the documents delivered to the owner is in accordance with the requirements.

[e] Alternatively.

6.2 Specific data, test reports and certificates

The following documentation should be held by the manufacturer:

a) stress analysis of the truss or equivalent certificate by a stress analyst;

b) proof by calculation of sufficient breakage resistance of the parts directly driving the steps, pallets or the belt, e.g. step chains, racks;

c) calculation of the stopping distances for loaded moving walks (see 5.4.2.1.3.4) together with adjustment data;

d) proof testing of steps or pallets;

e) proof of the breaking strength of the step chain/pallet chain/belt;

f) proof of sliding coefficients for skirting;

g) proof of anti-slip properties of tread surfaces (steps, pallets, floor and comb plates without combs);

h) proof of stopping distances and deceleration values;

i) proof of electromagnetic compatibility.

7 Information for use

7.1 General

All escalators and moving walks are required to be provided with documentation that shall include an instruction handbook relating to use, maintenance, inspection, periodic checks and rescue operations. All information for use shall be in accordance with EN ISO 12100:2010, 6.4, and also contain additional provisions for the use of machines within the scope of the standard.

Information for use shall cover, separately or in combination, transport, assembly and installation, commissioning, use (setting, teaching/programming, operation, cleaning, fault finding and maintenance) of the escalator and moving walk, and, if necessary, de-commissioning, dismantling and disposal.

7.2 Signals and warning devices

7.2.1 Plates, inscriptions and notices for use

7.2.1.1 General

All signs, inscriptions and notices for use shall be of durable material, placed in a conspicuous position and written in clearly legible characters in the language of the country where the escalator or moving walk is in operation.

7.2.1.2 Safety signs near the entrances of escalators or moving walks

7.2.1.2.1 The following mandatory action signs and prohibition signs for the user shall be fixed in the vicinity of the entrances:

d) “Small children shall be held firmly” (see Figure G.1);

e) “Dogs shall be carried” (see Figure G.2);

f) “Use the handrail” (see Figure G.3, Reg. Nr. ISO 7010-M012);

g) “Push chairs not permitted” (see Figure G.4).

When required by local conditions, prohibition signs, e.g. "Transportation of bulky and heavy loads not permitted" and mandatory action signs like "use permitted only with footwear" or "for safety reasons, wheelchair users are advised to use the lift" will possibly be necessary.

7.2.1.2.2 Stop devices referred to in 5.12.3.8 shall be coloured red and either on the device itself or in its immediate vicinity be marked with the inscription “STOP”. The indicator mentioned in 5.12.3.8.1 is not considered to fulfill this requirement.

7.2.1.2.3 During maintenance, repair, inspection or similar work, the access to the escalator or moving walk shall be barred to unauthorized persons by devices:

— which shall bear the notice “No Access”, or

— the “No Entry” indicator (prohibition sign C,1a as described in the “Convention on Road Signs and Signals” (Vienna, 8.11.1968) [3])

and be available in immediate area.

7.2.1.3 Instructions for hand winding devices

If a hand winding device is provided, operating instructions for use shall be available in the vicinity. The direction of travel of the escalator or moving walk shall be indicated clearly.

7.2.1.4 Notices on the access doors to machinery spaces outside the truss, driving and return stations

On access doors to machinery spaces outside the truss, driving and return stations, a notice shall be fixed with the inscription:

“Machinery space - danger, access prohibited to unauthorized persons”.

7.2.2 Special indicators for escalators and moving walks starting automatically

In the case of escalators or moving walks starting automatically (see 5.12.3.3 and 5.12.3.4), a clearly visible signal system, e.g. road traffic signals, shall be provided indicating to the user whether the escalator or moving walk is available for use, and its direction of travel. The automatic operation in 2-Direction-Mode (5.12.3.4) requires an additional indication for this operation (e.g. sign for two-way-traffic).

7.3 Inspection and test

7.3.1 General

Escalators and moving walks shall be inspected before their first use.

7.3.2 Constructional inspection and acceptance inspection and test

The constructional inspection and acceptance inspection and test shall be carried out at the job-site on completion of the escalator or moving walk.

For the constructional inspection and acceptance inspection and test, the data specified in 6.2 should form part of a pre-completed test sheet. Furthermore, layout drawings, description of the equipment and wiring diagrams (current flow chart with legend or explanations, and a terminal connection chart) which permit a check of compliance with the safety requirements specified in this standard, shall be provided.

The constructional inspection comprises the examination of the completed installation for conformity with the required data and with regard to proper workmanship as specified in this standard.

The acceptance inspection and test comprises:

a) overall visual inspection;

b) functional test;

c) test of electric safety devices with regard to their effective operation;

d) test of the brake(s) of the escalator or moving walk under no load, for compliance with the prescribed stopping distances (see 5.4.2.1.3.2 and 5.4.2.1.3.4). An examination of the brake adjustment according to the calculation required in 6.2 c) is also necessary.

   Additionally, for escalators, a test of the stopping distances under brake load (see 5.4.2.1.3.2) is required unless the stopping distances can be verified by other methods;

e) measurement of the insulation resistance of the different circuits between conductors and earth (see 5.11.1.4). For this measurement, the electronic components shall be disconnected.

This needs to include a test of the electric continuity of the connection between the earth terminal(s) in the driving station and the different parts of the escalator or moving walk liable to be live accidentally.

7.4 Accompanying documents (in particular, instruction handbook)

7.4.1 Contents

The instruction handbook (e.g. in accordance with EN 13015:2001) or other written instructions shall contain among others:

a) information relating to transport, handling and storage of the escalator or moving walk, e.g.:

   — storage conditions;

   — dimensions, mass value(s), position of the centre(s) of gravity;

   — indications for handling (e.g. drawings indicating application points for lifting equipment);

b) information relating to installation and commissioning of the escalator or moving walk, e.g.:

   — building interfaces (see Annex A);

   — fixing / anchoring and vibration dampening requirements;

   — assembly and mounting conditions;

   — space needed for use and maintenance;

   — permissible environmental conditions (e.g. temperature, moisture, vibration, electromagnetic radiation, earthquake and civil defence);

   — instructions for connecting to the power supply (particularly about protection against electric overloading);

   — advice about waste removal/disposal;

— if necessary, recommendations about protective measures which shall be taken by the owner; e.g. additional safeguards (see EN ISO 12100:2010, Figure 2, Footnote d)), safety distances, safety signs and signals;

c) information relating to the escalator or moving walk itself, e.g.:

— detailed description of the escalator or moving walk, its fittings, its guards and/or protective devices;

— comprehensive range of applications for which the escalator or moving walk is intended, including prohibited usages, if any, taking into account variations of the original machine if appropriate;

— diagrams (especially schematic representation of safety functions and layout details);

— technical documentation about electric equipment (see EN 60204 series [4]);

— documents attesting that the escalator or moving walk complies with the relevant directives;

— documents specifying the grade of the slip resistance;

d) information relating to the use of the escalator or moving walk, e.g. about:

— manual starting (e.g. necessity to check of step, pallet, landings for absence of persons and goods);

— intended use;

— description of manual controls (actuators);

— setting and adjustment;

— risks which could not be eliminated by the protective measures taken by the designer;

— interdiction to place merchandise between adjacent balustrades or between a balustrade and adjacent building structures;

— preventing arrangements in the vicinity of the escalator/moving walk which encourages misuse;

— keeping free of unrestricted areas (see A.2.5);

— particular risks which may be generated by certain applications (including the use of shopping trolleys and/or baggage carts on escalators and moving walks, see Annex I), and about specific safe measures which are necessary for such applications;

— reasonably foreseeable misuse and prohibited usages;

— recommendation to not use escalators as regular staircases or emergency exits;

— recommendation that, for escalators and moving walks which otherwise would be exposed to weather conditions, the customer provides a roof or enclosure;

— fault identification and location, repair, and restarting after an intervention;

— investigations and necessary corrective actions in case of faults requiring manual reset, to be taken before reset and restart;

e) information for maintenance, e.g.:

- necessity to follow the maintenance instructions given in the instruction handbook;
- personal protective equipment which need to be used and training required;
- nature and frequency of inspections;
- instructions relating to maintenance operations which require a definite technical knowledge or particular skills and hence should be carried out exclusively by skilled persons (e.g. maintenance staff, specialists);
- instructions relating to maintenance actions (e.g. replacement of parts) which do not require specific skills and hence may be carried out by the owner;
- drawings and diagrams (e.g. wiring and schematic diagrams) enabling maintenance personnel to carry out their task rationally (especially fault-finding tasks);
- instructions relating to cleaning and refurbishment;
- necessity to observe a complete revolution of the step/pallet band before making the escalator/moving walk available to the public after maintenance;
- instructions on the necessary use of inspection controls during maintenance and repair work;

f) information about periodic inspection and tests to ascertain whether the escalator or moving walk is safe in operation, including:

- electric safety devices with regard to their effective operation;
- brake(s) according to 7.3.2 d);
- driving elements for visible signs of wear and tear and for insufficient tension of belts and chains;
- steps, pallets or the belt for defects, true run and guidance;
- dimensions and tolerances specified in this standard;
- combs for proper condition and adjustment;
- interior panel and the skirting;
- handrails;
- test of the electric continuity of the connection between the earth terminal(s) in the driving station and the different parts of the escalator or moving walk liable to be live accidentally;

g) information for emergency situations, e.g.:

- the operating method to be followed in the event of accident or breakdown;
- use of hand winding device, if any (see 5.4.1.4 and 7.2.1.3);
- warning about possible emission or leakage of harmful substance(s), and if possible indication of means to fight their effects;

— for escalators and moving walks subject to seismic conditions, instructions describing the behaviour of the unit in the event of earthquake and the need to maintain and to periodically test that the seismic equipment is in working order, and instructions that after seismic event the safe operating ability of the escalator or moving walk shall be checked;

h) a declaration that the emission sound pressure level measured under free field conditions at a distance of 1,00 m from the surface of the machinery and at a height of 1,60 m from the floor plate is expected not to exceed 70 dB(A).

7.4.2 Presentation of the instruction handbook

a) Type and size of print shall ensure the best possible legibility. Warning signs and/or cautions should be emphasized by the use of colours, symbols and/or large print.

b) Information for use shall be given in the language(s) of the country in which the escalator or moving walk will be used for the first time and in the original version. If more than one language shall be used, each language should be readily distinguished from the other(s), and efforts should be made to keep the translated text and the relevant illustration together.

c) Whenever helpful to the understanding, text should be supported by illustrations. Illustrations should be supplemented with written details enabling, for instance, manual controls (actuators) to be located and identified; they should not be separated from the accompanying text and should follow sequential operations.

d) Consideration should be given to presenting information in tabular form where this will aid understanding. Tables should be adjacent to the relevant text.

e) The use of colours should be considered, particularly in relation to components requiring quick identification.

f) When information for use is lengthy, a table of contents and/or an index should be given.

g) Safety-relevant instructions which involve immediate action should be provided in a form readily available to the operator.

7.4.3 Advice for drafting and editing information for use

a) The information shall clearly relate to the specific model of escalator or moving walk.

b) When information for use is being prepared, the communication process “see – think – use” should be followed in order to achieve the maximum effect and should follow sequential operations. The questions “how?” and “why?” should be anticipated and the answers provided.

c) Information for use shall be as simple and as brief as possible, and should be expressed in consistent terms and units with a clear explanation of unusual technical terms.

d) Documents giving instructions for use should be produced in durable form (i.e. they should be able to survive frequent handling). It may be useful to mark them “keep for future reference”. Where information for use is kept in electronic form (e.g. CD, DVD, tape) information on safety-related issues that need immediate action shall always be backed up with a hard copy that is readily available.

7.5 Marking

At least at one landing, the

— name and full address of the manufacturer and, where applicable, his authorized representative;

— designation of series or type of the machinery;

— serial number;

— year of construction (year in which the manufacturing process is completed)shall be indicated, visible from the outside.

Annex A
(normative)

Building interfaces

A.1 General

The requirements in in the following chapters are important for the safety of users and maintenance personal.

If it is not possible for the manufacturers of the escalator or moving walk to fulfill these requirements (or some of them) due to the fact that e.g. they are not installing the escalator or moving walk, those requirements that are not fulfilled shall be part of the instruction handbook as an obligation for the owner (see 7.4).

A.2 Free space for users

A.2.1 The clear height above the steps of the escalator or pallets or belt of the moving walk including the area to the end of the newel and the unrestricted area at all points shall be not less than 2,30 m (see h_4 in Figures 5 and A.1).

A.2.2 To prevent collision, a minimum free area around the escalator or moving walk is defined as per Figure A.1. The clear height h_4 can be reduced outside of the handrail to the height h_{12}, which measured from the steps of the escalator or the pallets or the belt of the moving walk shall be at least 2,10 m. The distance between the outer edge of the handrail and walls or other obstacles (see b_{10} in Figure A.1) shall under no circumstances be less than 80 mm horizontally and 25 mm vertically below the lower edge of the handrail (see b_{12} in Figure 6). The area is permitted to be smaller, if by appropriate measures, the risk of injury is minimized.

A.2.3 For escalators and moving walks arranged adjacent to one another either parallel or criss-cross, the distance between the handrails shall be not less than 160 mm (see b_{11} in Figure A.1).

A.2.4 Where building obstacles can cause injuries, appropriate preventive measures shall be taken.

In particular, at floor intersections and on criss-cross escalators or moving walks, a vertical deflector of not less than 0,30 m in height, not presenting any sharp cutting edges, shall be mounted rigidly above the handrail level and extend at least 25 mm below the lower edge of the handrail, e.g. as an imperforate triangle (see h_5 in Figures 5 and 7).

It is not necessary to comply with these requirements when the distance b_9 between the outer edge of the handrail and any obstacle is equal to or greater than 400 mm (see Figure A.1).

A.2.5 At the exit(s) of each individual escalator or moving walk a sufficient unrestricted area shall be available to accommodate persons. The width of the unrestricted area shall at least correspond to the distance between the outer edges of the handrails plus 80 mm on each side. The depth shall be at least 2,50 m measured from the end of the balustrade. It shall be permissible to reduce it to 2,00 m if the width of the unrestricted area is increased to at least double the distance between the outer edges of the handrails plus 80 mm on each side. These are the minimum permitted dimensions that shall be applied in all conditions assuming that this unrestricted area is not affected by e.g. other passenger flows within the building.

NOTE For guiding barriers and traffic columns, see A.5.

An overlapping of unrestricted areas is not permitted. A lateral shift of the unrestricted area is permitted. The floor of the unrestricted area shall be flat. A maximum inclination of 6° is permissible. Fixed stairs inside the unrestricted areas are not permitted.

Where the exit of the escalator or moving walk is blocked by structural measures (e.g. shutters, fire protection gates, removable barriers) or in the case that there is no sufficient exit between succeeding escalators/moving walks, an additional stop switch for emergency situations shall be provided:

a) within reach from inside the escalator/moving walk.

b) within a distance between 2,00 m and 3,00 m before the step/pallet/belt reaches the comb intersection line;

c) within a vertical range of 200 mm below and 400 mm above the handrails measured from the top of the handrail to the middle of the actuator (e.g. push button or handle).

Assemblies in the inside or outside of the balustrade are permitted when they are arranged and formed in such a manner as to eliminate any risk of harm caused by trapping (taking into account 5.5.2.4, A.2.2 and A.5).

A.2.6 In the case of successive escalators and moving walks without intermediate exits, they shall have the same capacity. A safety device according to 5.12.2.7.8 shall be provided.

A.2.7 Where it is possible for people to come into contact with the outer edge of a handrail at a landing and can be drawn into a hazardous situation, such as toppling over a balustrade, appropriate preventative measures shall be taken (for an example, see Figure A.2).

Some examples are:

— prevention of entry into the space by the placement of permanent barriers;

— increasing the height of the building structure of the fixed balustrade in the hazard area by at least 100 mm above the handrail level and positioned between 80 mm and 120 mm from the outer edge of the handrail.

A.2.8 The surrounds of the escalator or moving walk shall be illuminated, especially in the vicinity of the combs.

Information should be exchanged between the manufacturer and the customer.

A.2.9 It is permissible to arrange the lighting in the surrounding space and/or at the installation itself. The intensity of illumination at the landings including the combs shall be related to the intensity of illumination of the general lighting in the area. The intensity of illumination shall be not less than 50 lx at the comb intersection line measured at floor level.

A.3 Machinery spaces outside the truss

A.3.1 A safe access for persons to machinery spaces shall be provided.

A.3.2 Machinery spaces shall be lockable and only accessible to authorized persons

A.3.3 Machinery spaces shall be provided with permanently installed electric lighting on the following basis:

a) a minimum of 200 lx at floor level in working areas;

b) a minimum of 50 lx at floor level in access routes leading to these working areas.

Emergency lighting shall be installed to allow the safe evacuation of all personnel working in any machinery space.

NOTE Emergency lighting is not intended for continuation of maintenance or other activities.

A.3.5 The dimensions of machinery spaces shall be sufficient to permit easy and safe working on equipment, especially the electrical equipment.

In particular there shall be provided at least a clear height of 2,00 m at working areas, and:

a) a clear horizontal area in front of the control panels and the cabinets. This area is defined as follows:

   1) depth, measured from the external surface of the enclosures: at least 0,70 m;

   2) width, the greater of the following values: 0,50 m or the full width of the cabinet or panel;

a) a clear horizontal area of at least 0,50 m x 0,60 m for maintenance and inspection of moving parts at points where this is necessary.

A.3.6 The clear height for movement shall not be less than 1,80 m.

The access ways to the clear spaces mentioned in A.3.6 shall have a width of at least 0,50 m. This value may be reduced to 0,40 m where there are no moving parts.

This full height for movement is taken to the underside of the structural roof beams and measured from both:

a) the floor of the access area;

b) the floor of the working area.

A.3.7 In machinery spaces the clear height shall under no circumstances be less than 2,00 m.

A.4 Measures to prevent access of shopping trolleys and baggage carts

A.4.1 General

If there is a reasonable foreseeable risk that shopping trolleys and/or baggage carts can be taken onto escalators or moving walks, adequate measures shall be taken to eliminate risks and access shall be prevented if the following conditions are given:

a) for escalators: where shopping trolleys or baggage carts are available in the area around.

b) for escalators: where shopping trolleys or baggage carts are in an area not close to the escalator where it is reasonably foreseeable that they are taken onto the escalator.

c) for moving walks: where shopping trolleys or baggage carts are not intended to be used on a moving walk

NOTE It´s in the responsibility of the owner to define the width of the trolleys, that it´s ensured that the trolleys can´t fit through between balustrade and barrier.

A.4.2 Barriers

If barriers are used, the following requirements shall be fulfilled:

a) The barrier shall be installed at the entrance only. An installation at the exit is not permitted in the unrestricted area.

b) The design of the barrier shall not create another risk.

c) The free entrance width between ends of the newels and barriers – and between barriers itself - shall be at least 500 mm and less than the width of the type of shopping trolley or baggage cart which will be used.

d) The height of the barrier shall be between 900 mm and 1 100 mm.

e) The barrier and its fixation shall withstand the following load: At a height of 200 mm a horizontal force of 3 000 N applies.

NOTE: This force results from an impact of a chassis of a shopping trolley (according to EN 1929-1 [5]) /baggage cart loaded with 160 kg moving with a speed of 1,00 m/s.

f) The barrier shall be fixed preferably at the building structures. It is also permitted to fix it at the floor plate. In that case, when the defined forces apply, there shall be no permanent deformation and increased/additional gaps.

A.5 Fixed guiding barriers and traffic columns

Where fixed guiding barriers and/or traffic columns (including e.g. control devices and stop devices for emergency situations) are necessary in the unrestricted area, their design shall not create another risk. The following requirements shall be met:

a) The guiding barriers or traffic columns shall have a minimum horizontal distance (radius) of 500 mm to any point of the handrail and shall be positioned outside of the centre line of the handrail (see placement A in Figure A.3).

b) The minimum horizontal distance (radius) to any point of the handrail may be reduced to 300 mm, provided that the guiding barriers or traffic columns are positioned outside of the centre lines of the handrails and an additional barrier is installed between the guiding barriers or traffic columns and the vertical centre line of the balustrade newel (see placement B in Figure A.3).

   The additional barrier shall have a lateral distance between 80 mm to 120 mm of the handrail outer edge and shall close at least the area between the actual lowest point of the handrail entry into the newel and the balustrade decking profile and shall have filled inlets with gaps < 25 mm (see Figure A.3).

c) The minimum horizontal distance (radius) to any point of the handrail may be reduced to 180 mm, provided that the guiding barrier or traffic column is positioned outside of the outer edge of the handrail and an additional barrier is installed between the guiding barrier or traffic column and the vertical centre line of the balustrade newel (see placement C in Figure A.3).

   The additional barrier shall have a lateral distance between 80 mm to 120 mm of the handrail outer edge and shall close at least the area between the actual lowest point of the handrail entry into the newel and the balustrade decking profile and shall have filled inlets with gaps < 25 mm (see Figure A.3).

d) The minimum horizontal distance (radius) to any point of the handrail may be reduced to 100 mm, provided that the guiding barrier or traffic column is of a round shape and is positioned outside of

the outer edge of the handrail and an additional barrier is installed between the guiding barrier or traffic column and the vertical centre line of the balustrade newel (see placement D in Figure A.3).

The additional barrier shall have a lateral distance between 80 mm to 120 mm of the handrail outer edge and shall close at least the area between the actual lowest point of the handrail entry into the newel and the balustrade decking profile and shall have filled inlets with gaps < 25 mm (see Figure A.3)

In addition, the following specific requirements apply:

a) The guiding barriers and traffic columns and their fixation shall withstand a horizontal force of 1 kN/m applied to the top of the device.

b) The guiding barriers and traffic columns shall be fixed preferably at the building structures. It is also permitted to fix it at the floor plate. In that case, when the defined forces apply, there shall be no permanent deformation and increased/additional gaps.

c) The height of traffic columns shall be at least the height of the handrail level.

d) The height of guiding barriers shall be at least the height of the balustrade decking.

e) If guiding barriers and traffic columns are placed inside the unrestricted area, the size of the unrestricted area shall remain the same and in this case be extended in the length.

f) Guiding barriers and traffic columns are not considered as structural measures that block the exit.

For guiding barriers and traffic columns in the immediate environment of the unrestricted area these requirements also apply. For other devices/installations outside the unrestricted area in the immediate environment requirements a), b), c) and d) apply.

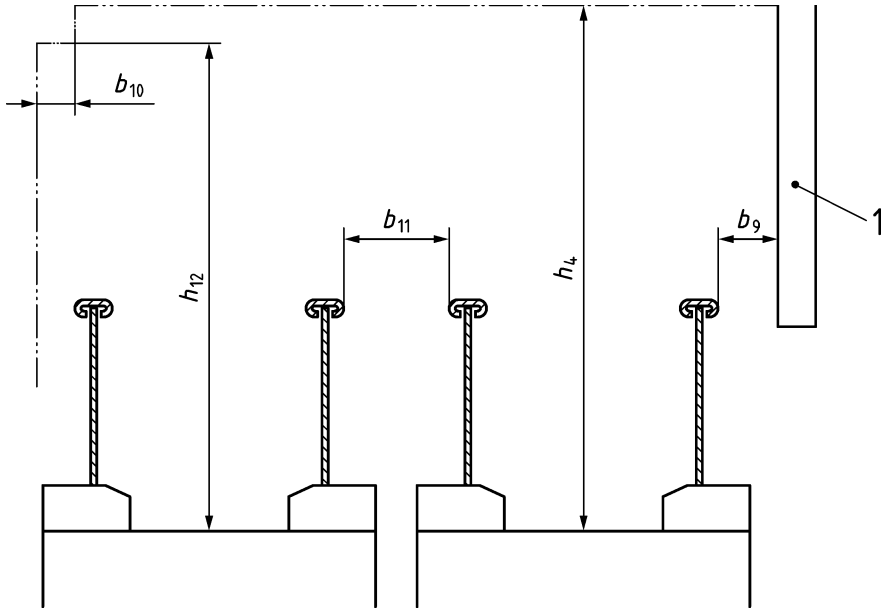
A.6 Electric power supply

Agreements shall be made between the owner and the manufacturer about electric supply and electric protection requirements (e.g. electric shock, short circuit; overload).

The installation shall comply with

a) EN 60204-1:2006, or

b) with the requirements of the national rules of the country where it is installed.



Key

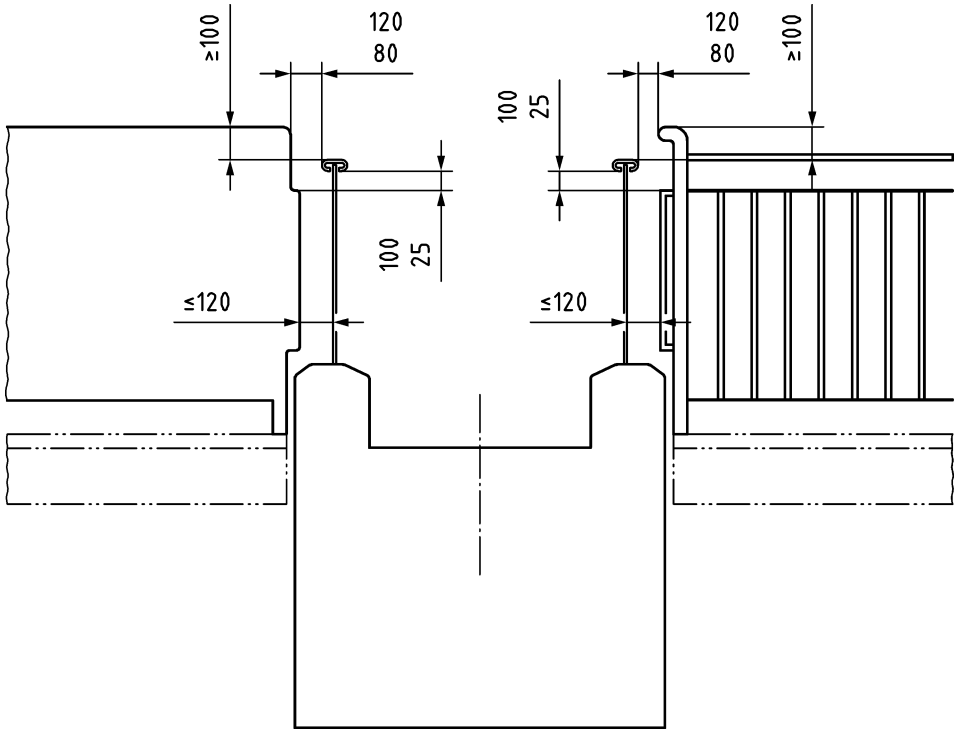
1 obstacle (e.g. column)

Principal dimensions	Clause	Principal dimensions	Clause
$b_9 \geq 400$ mm	A.2.4	$h_4 \geq 2\,300$ mm	A.2.1
$b_{10} \geq 80$ mm	A.2.2	$h_{12} \geq 2\,100$ mm	A.2.2
$b_{11} \geq 160$ mm	A.2.3		

NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure A.1 — Clearances between building structure and escalator/moving

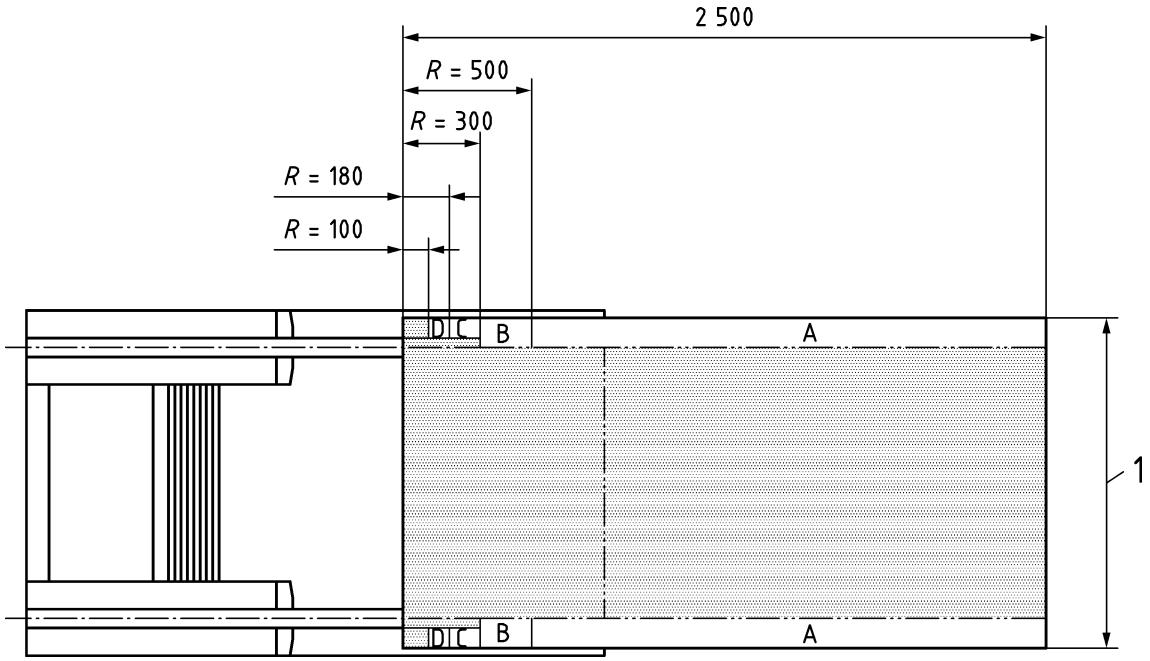
Dimensions in millimetres



NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure A.2 — Example of barriers at landings

Dimensions in millimetres



Key

1 distance between the outer edge of the handrails plus 80 mm on each side

A position: outside of the handrail centre lines;
additional barrier: not needed

B position: outside of the handrail centre lines;
additional barrier: between the column/guiding barrier and the vertical centre line of the handrail

C position: outside of the outer edge of the handrail;
additional barrier: between the column/guiding barrier and the vertical centre line of the handrail

D round column/guiding barrier, position: outside of the outer edge of the handrail;
additional barrier: between the column/guiding barrier and the vertical centre line of the handrail

R horizontal distance (radius) between any point of the handrail and the traffic column/guiding barrier

Figure A.3 — Possible placements of fixed guiding barriers and traffic columns in unrestricted areas

Annex B
(normative)

Electronic components - Failure exclusion

B.1 Scope

5.12.1 envisages a number of faults of the electric equipment of the escalator and moving walk.

During the failure analysis, some faults can be excluded under certain conditions.

This annex describes these conditions and gives the requirements for fulfilling them.

B.2 Failure exclusions - conditions

Table B.1 shows:

a) a list of the major and most usual components used in present electronic technology; the components have been grouped by "families":

   1) passive components 1;

   2) semiconductors 2;

   3) miscellaneous 3;

   4) assembled printed circuits 4;

b) a number of identified failures:

   1) interruption I;

   2) short-circuit II;

   3) change value to higher value III;

   4) change value to lower value IV;

   5) change of function V;

c) the possibility and conditions of failure exclusion:

   The first condition for failure exclusion is that components shall always be used within their own worst case limits, even in the worst case conditions specified by the standards, in the field of temperature, humidity, voltage and vibrations.

d) some remarks.

In the table:

— the "NO" in the cell means: failure not excluded, i.e. shall be considered;

— the unmarked cell means: the identified fault type is not relevant.

A design guide line for safety circuits is given in Annex E.

Table B.1 — Exclusions of failures

Component	Possible failure exclusion					Conditions for the exclusion of faults Remarks
	I	II	III	IV	V	
1 Passive components						
1.1 Resistor fixed	No	(1)	No	(1)		(1) Only for film resistors with varnished or sealed resistance film and axial connection according to applicable IEC standards, and for wire wound resistors if they are made by a single layer winding protected by enamel or sealed.
1.2 Resistor variable	No	No	No	No		
1.3 Resistor, non linear 1.3.1 NTC 1.3.2 PTC 1.3.3 VDR 1.3.4 IDR	No No No No	No No No No	No No No No	No No No No		
1.4 Capacitor	No	No	-	No		
1.5 Inductive components - coil - choke	No	No		No		
2 Semiconductors						
2.1 Diode, LED	No	No			No	Change of function refers to change in reverse current value.
2.2 Zener Diode	No	No		No	No	Change to lower value refers to change in Zener voltage. Change of function refers to change in reverse current value.
2.3 Thyristor, Triac, GTO	No	No			No	Change of function refers to self triggering or latching of components.

<table>
<tr><td>2.4 Optocoupler</td><td>No</td><td>(2)</td><td></td><td></td><td>No</td><td>'I' means open circuit in one of the two basic components (LED and photo transistor); 'II' means short circuit between them.
(2) Can be excluded under condition that the optocoupler is according to EN 60747–5-5:2011, and the isolation voltage is at least according to table below (taken from EN 60664–1:2007, Table F.1).
<table>
<tr><th>Voltage phase-to-earth derived from rated system voltage up to and including V_{rms} and d.c.</th><th>Preferred series of impulse withstand voltages in volts for installation (category III)</th></tr>
<tr><td>50</td><td>800</td></tr>
<tr><td>100</td><td>1 500</td></tr>
<tr><td>150</td><td>2 500</td></tr>
<tr><td>300</td><td>4 000</td></tr>
<tr><td>600</td><td>6 000</td></tr>
<tr><td>1 000</td><td>8 000</td></tr>
</table></td></tr>
<tr><td>2.5 Hybrid circuits</td><td>No</td><td>No</td><td>No</td><td>No</td><td>No</td><td></td></tr>
<tr><td>2.6 Integrated circuits</td><td>No</td><td>No</td><td>No</td><td>No</td><td>No</td><td>Change in function to oscillation; 'and' gates becoming 'or' gates, etc.</td></tr>
<tr><td colspan="7">3 Miscellaneous</td></tr>
<tr><td>3.1 Connectors
Terminals
Plugs</td><td>No</td><td>(3)</td><td></td><td></td><td></td><td>(3) EN 60664–1:2007 applies with the conditions of pollution degree of 3;
- material group III and
- presence of an inhomogeneous field.
If the protection of the connector is better than IP 4X (in accordance with EN 60529), the creepage distances can be reduced to the clearance values given by EN 60664-1.</td></tr>
<tr><td>3.2 Neon bulb</td><td>No</td><td>No</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.3 Transformer</td><td>No</td><td>(4)</td><td>(5)</td><td>(5)</td><td></td><td>(4) Short-circuits include short-circuits of primary or secondary windings, or between primary and secondary coils.
(5) Change in value refers to change of ratio by partial short-circuit in a winding.
(4) and (5) Can be excluded under condition that isolation resistance and voltage are in line with EN 61558–1:2005, 18.2 and 18.3.</td></tr>
<tr><td>3.4 Fuse</td><td></td><td>(6)</td><td></td><td></td><td></td><td>'II' means short circuit of the blown fuse.
(6) Can be excluded if the fuse is correctly rated, and constructed according to EN 60269–1:200713).</td></tr>
</table>

13) This standard is currently impacted by the amendment EN 60269-1:2007/A1:2009 and EN 60269-1:2007/A2:2014.

3.5 Relay	No	(7) (8)				(7) Short-circuits between contacts, and between contacts and coil can be excluded if the relay fulfils the requirements of 5.11.2.2.3 (5.12.1.2.2). (8) Welding of contacts cannot be excluded. However, if the relay is constructed to have mechanically forced interlocked contacts, and made according to EN 60947–5-1:200414), the assumptions of 5.11.2.1.3 apply.
3.6 Printed circuit board (PCB)	No	(9)				The general specifications of the PCB are in accordance with EN 62326–1:2002. The base material shall be according to the specifications of the EN 61249 series. (9) EN 60664–1:2007 applies with the conditions of: - pollution degree of 3; - material group III; - and presence of an inhomogeneous field. If the protection of the PCB is better than IP 4X (in accordance with EN 60529), the creepage distances can be reduced to the clearance values given by EN 60664-1.
4 Assembly of components on printed circuit board	No	(10)				(10) Short circuit can be excluded under circumstances where the component itself can be excluded and is mounted in a way that the creeping distances and clearances are not reduced below the minimum acceptable values as listed in 3.1 and 3.6 of this table, not by the mounting technique, nor by the PCB itself.

Key

I interruption
II short-circuit
III change value to higher value
IV change value to lower value
V change of function

14) This standard is currently impacted by the amendment EN 60947-5-1:2004/A1:2009.

Annex C
(normative)

Drafting and assessing failsafe circuits

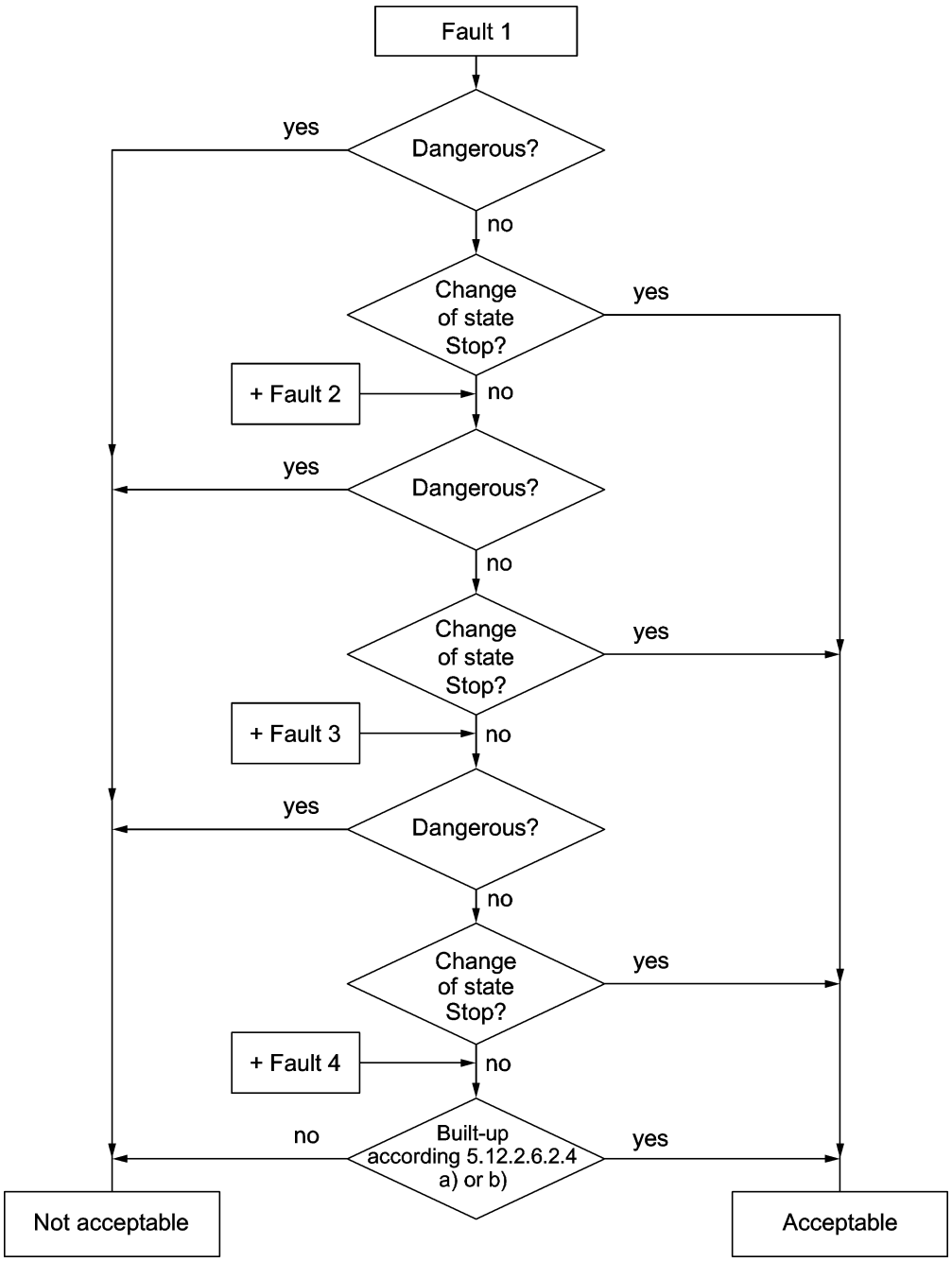


Figure C.1 — Flow chart for drafting and assessing failsafe circuits

Annex D
(normative)

Testing of failsafe circuits containing electronic components and/or safety related electrical, electronic and programmable electronic devices (E/E/PE)

D.1 General

For failsafe circuits containing electronic components, laboratory tests are necessary because practical checks on site, by inspectors, are impossible.

In the following, mention is made to printed circuit board. If a failsafe circuit is not assembled in such a manner, then the equivalent assembly shall be assumed.

D.2 General provisions

D.2.1 Failsafe circuits containing electronic components

The applicant shall indicate to the laboratory:

a) the identification on the board;

b) working conditions;

c) listing of used components;

d) layout of the printed circuit board;

e) layout of the hybrids and marks of the tracks used in failsafe circuits;

f) function description;

g) electric data inclusive wiring diagram, if applicable, including input and output definitions of the board.

D.2.2 Safety related electrical, electronic and programmable electronic devices (E/E/PE)

In addition to D.2.1 the following documentation shall be provided:

a) documents and descriptions relating to the common measures for the design and implementation process;

b) general description of the software used (e.g. programming rules, language, compiler, modules);

c) function description including software architecture and hardware/software interaction;

d) description of blocks, modules, data, variables and interfaces;

e) software listings.

D.3 Test samples

There shall be submitted to the laboratory:

a) one printed circuit board and

b) one printed circuit board bare (without components).

D.4 Mechanical tests

D.4.1 General

During the tests, the tested object (printed circuit) shall be kept under operation. During and after the tests, no unsafe operation and condition shall appear within the failsafe circuit.

D.4.2 Vibrations

Transmitter elements of failsafe circuits shall withstand the requirements of:

a) EN 60068-2-6:1995, A.6.1, Table C.2 (Endurance by sweeping):

20 sweep cycles in each axis:

1) at amplitude 0,35 mm or 5 g_n ; and

2) in the frequency range 10 Hz to 55 Hz;

and also of:

b) EN 60068-2-27:1993, 4.1, Table 1 (acceleration and duration of pulse) in the combination of:

1) 1 pulse in each axis with a peak acceleration 294 m/s^2 or 30 g_n;

2) corresponding duration of pulse 11 ms; and

3) corresponding velocity change 2,1 m/s half sine.

NOTE Where shock absorbers for transmitter elements are fitted, they are considered as part of the transmitter elements.

After tests, clearances and creeping distances shall not become smaller than the minimum accepted.

D.4.3 Bumping

D.4.3.1 General

Bumping tests shall simulate the cases when printed circuits fall, introducing the risk of rupture of components and unsafe situation. These tests shall be carried out according to EN 60068-2-27:2009.

Tests are divided into the partial test shocking, and continuous shocking. During the tests, the operation of the circuit is not required.

D.4.3.2 Partial test shocking

The test object shall satisfy the following minimum requirements:

a) Shocking shapes 1 pulse in each axis (half-sinus);

b) Amplitude of acceleration 15 g_n;

c) Duration of shock 11 ms.

D.4.3.3 Continuous shocking

The test object shall satisfy the following minimum requirements:

a) Amplitude of acceleration 10 g_n;

b) Duration of shock 16 ms;

c)

1) Number of shocks 1 000 ± 10;

2) Shock frequency 2/s.

D.5 Climatic stress testing

D.5.1 Temperature tests

Temperature tests shall be carried out according to EN 60068-2-14:2009 as follows:

a) Operating ambient limits: 0 °C, + 65 °C (ambient temperature of the electric safety device in the control panel);

b) Test conditions:

1) The printed circuit board shall be in operational position.

2) The printed circuit board shall be supplied with normally rated voltage.

3) The electric safety device shall operate during and after the test. If the printed circuit board includes components other than failsafe circuits, they also shall operate during the test (their failure is not considered).

4) Tests will be carried out for minimum and maximum temperature (0 °C, + 65 °C); tests will last a minimum of 4 h.

5) If the printed circuit board shall be used to operate within wider temperature limits, it shall be tested for these values.

D.5.2 Humidity tests

Humidity tests are not necessary for failsafe circuits as the pollution degree for escalators/moving walks is supposed to be class 3 according to EN 60664-1:2007, and the relative creeping distances and clearances are specified in this standard.

D.6 Functional and safety test of PESSRA

Functional and safety tests for E/E/PE shall be performed according to EN 62061:2005 15),.

15) This standard is currently impacted by the amendment EN 62061:2005/A1:2013.

Annex E
(informative)

Design guideline for safety circuits

This design guide-line gives recommendations to avoid dangerous situations in the case when information is collected from the safety circuit for control purposes, for remote control, alarm control, etc.

Some dangerous situations are recognized coming from the possibility of bridging one or several electric safety devices by short circuiting or by local interruption of common lead (earth) combined with one or several other failures. It is good practice to follow the recommendations given below:

— Design the board and circuits with distances in accordance with specifications 3.1 and 3.6 of Table B.1.

— Organize common lead so that the common lead for the control of the escalator/moving walk comes behind the electronic components. Any rupture will cause a non-operation of the control (danger exists that changes in wiring occur during the life of the escalator/moving walk).

— Make always calculations about the “worst case” condition.

— Always use outside (out of element) resistors as protective devices of input elements; internal resistor of the device should not be considered as safe.

— Use only components according to listed specifications.

— Consider backwards voltage coming from electronics. Using galvanically separated circuits can solve the problems in some cases.

— Design electric installations in accordance with HD 60364-5-54:2011 [6].

— The “worst case” calculation cannot be avoided, whatever the design. If modifications or add-ons are made after the installation of the escalator/moving walk, the “worst case” calculation, involving new and existing equipment, shall be carried out again

— Some failure exclusions can be accepted, according to Table B.1.

— Failures outside the environment of the escalator/moving walk need not be taken into consideration.

— “An interruption of the earth from the main supply of the building to the controller collection earth bar (rail) can be excluded, providing the installation is made in accordance with HD 60364-5-54:2011.”

Annex F
(informative)

Examples of possible dynamic torsional tests for steps and pallets

F.1 General

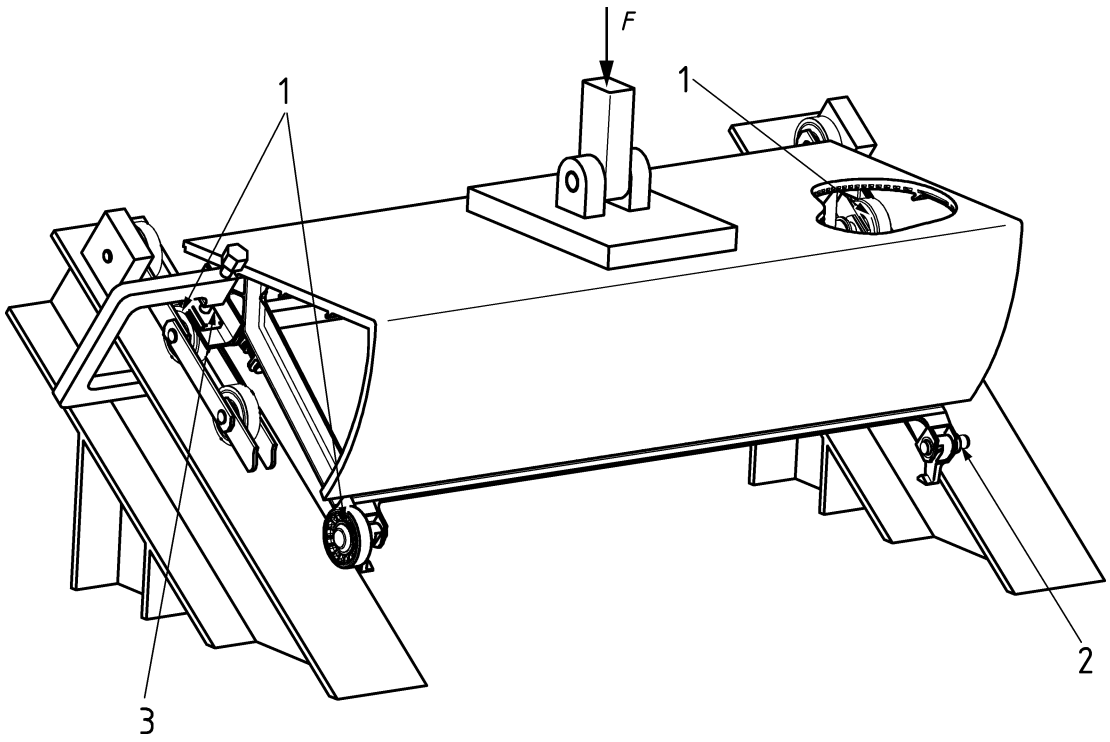
The following examples illustrate practical methods for carrying out dynamic torsional tests as required by 5.3.3.3.1.2 and 5.3.2.3.2.

F.2 Torsional test 1

The step/pallet is tested at the maximum inclination (inclined support) for which it shall be applied, together with rollers (not rotating), axles or stub shafts (if existing). It is supported and fixed via the step/pallet chains. In order to minimize the influence of the rollers on the deformation, all rollers supporting the step are replaced by steel rollers with the same main dimensions. Furthermore the supporting trailer roller is able to move with low friction on the supporting plane to allow also transverse movement. To avoid the lift off of the step/pallet roller opposite to the unsupported free trailer roller mentioned below, it has a locking clamp parallel to the supporting area with a clearance less than 0,2 mm (see Figure F.1 for test equipment).

In order to enable the torsioning of the step/pallet, one trailer roller is not supported or is left out. In addition the centre of this trailer roller is able to move downward from 0 to – 4 mm, moving in an arc whose centre is the step/pallet chain roller centre. This 4 mm displacement is related to a trailer roller to step/pallet chain roller centre distance of 400 mm. This ratio is also maintained, when the 400 mm dimension is varied.

A dynamic load is applied perpendicular to the tread surface on a steel plate arranged as specified in 5.3.3.2.1 and 5.3.3.2.3 respectively, in the centre of the tread surface, which leads to the deflection at the unsupported or left out trailer roller.



Key

1 with steel rollers

2 without roller

3 locking clamp parallel to the supporting area

F dynamic load

NOTE The construction of the test equipment does not have to correspond to the drawing. It only serves to illustrate the requirements.

Figure F.1 — Torsional test for step and pallet (1) – Test equipment

F.3 Torsional test 2

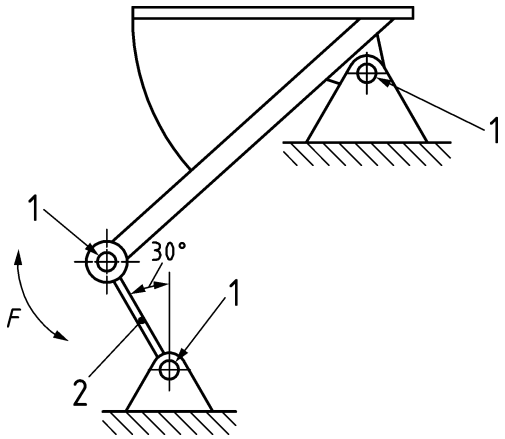
The step/pallet assembly is mounted by its chain axle and by one end of the trailer wheel axle, as shown in Figure F.2, below (no wheels are fitted for this test). The chain axle is supported at the position normally occupied by the step/pallet chain. The step/pallet is free to rotate about, but not to slide along, the chain axle. The 'fixed' end of the trailer wheel axle is held at the journal by a ball-jointed arm, to allow free movement in all directions. The lower end of the arm is ball-jointed to a fixed support.

The 'free' end of the trailer wheel axle is connected by a ball joint to the actuating device. The lower end of the actuating device is ball-jointed to a fixed support so that the 'free' end of the trailer wheel axle is able to move in any direction. The axis of the actuating device is perpendicular to the plane encompassing the axes of both trailer and chain wheel axles.

The restraining and actuating linkages make use of a ball bearing of identical design to the bearing fitted to the trailer wheels. The normal trailer wheel fixings are used, and the prescribed torque values applied, for the test assembly.

The actuating device is applied and released in each direction so as to cause a cyclic linear displacement. The peak displacement is 2 mm, above and below the nominal 'zero' position of the step/pallet (i.e. from the point with the axles chain and trailer wheel axles in the same plane).

This ± 2 mm displacement is related to a trailer roller to step/pallet chain roller centre distance of 400 mm. This ratio is also maintained, when the 400 mm dimension is varied.



Key

1 pivot

2 link (one side of step only)

F dynamic load

Figure F.2 — Torsional test for step and pallet (2) – Test principle

Annex G
(normative)

Safety signs for the user of escalators and moving walks

The design of safety signs shall be in accordance with ISO 3864-1:2011 and ISO 3864-3:2012. The minimum diameter of the signs shall be 80 mm.

Figure G.1 — Mandatory action sign "Small children shall be held firmly"

Figure G.2 — Mandatory action sign "Dogs shall be carried"

Figure G.3 — Mandatory action sign “Use the handrail”

Figure G.4 — Prohibition sign “Push chairs not permitted”

Annex H
(informative)

Guidelines for selection and planning of escalators and moving walks

H.1 Maximum capacity

For traffic flow planning, the maximum number of persons that can be carried by an escalator or moving walk in 1 h is given in Table H.1:

Table H.1 — Maximum capacity

Step/pallet width z1 m	Nominal Speed v m/s		
	0,50	0,65	0,75
0,60	3 600 persons/h	4 400 persons/h	4 900 persons/h
0,80	4 800 persons/h	5 900 persons/h	6 600 persons/h
1,00	6 000 persons/h	7 300 persons/h	8 200 persons/h
NOTE 1 Use of shopping trolleys and baggage carts (see Annex I) will reduce the capacity by approx. 80 %. NOTE 2 For moving walks with a pallet width in excess of 1,00 m the capacity is not increased as users need to hold the handrail, the additional width is to principally enable the use of shopping trolleys and baggage carts.			

H.2 Escalators or moving walks for public transport

For escalators or moving walks which:

— are part of a public transport system including entrance and exit points, or

— are suitable for intensive use, regularly operating for approximately 140 h/week with a load reaching 100 % of the brake load (see 5.4.2.1.3.1 and 5.4.2.1.3.3) for a total duration of at least 0,5 h during any time interval of 3 h,

it is recommended to install auxiliary brakes also for rises h_{13} less than 6 m.

The load conditions and additional safety features should be agreed between the manufacturer and the owner reflecting the traffic levels which exist.

Annex I
(normative)

Requirements on escalators and moving walks intended to transport shopping trolleys and baggage carts

I.1 Escalators

The use of both shopping trolleys and baggage carts on escalators is unsafe and shall not be permitted.

The principle reasons why the use of these products is considered to be unsafe are foreseeable misuse, overloading and width restriction.

Where shopping trolleys and/or baggage carts are available in the area around escalator installations and if it is reasonably foreseeable that trolleys and/or baggage carts can be taken onto the escalator, suitable barriers shall be provided to prevent access (see A.4).

NOTE: If safe means of transportation, i.e. shopping trolleys or baggage carts, become available for use on escalators, then special measures should be defined between the manufacturer of the escalator, the manufacturer of the means of transportation and the customer based on risk assessment in accordance with EN ISO 14798:2012 [7].

Outline guidance is given as follows:

Shopping trolleys or baggage carts which are chosen for use on an escalator shall be specified between the shopping trolley or baggage cart manufacturer and the escalator manufacturer. If non-specified shopping trolleys or baggage carts are available in the escalator area, there is a serious risk of misuse. It is necessary to prevent access to the escalator entrance.

The width of the shopping trolley or baggage cart and its contents shall be at least 400 mm less than the nominal step width. Passengers shall be able to leave the escalator, even if shopping trolleys or baggage carts are on the escalator.

The escalators shall be supplied with a horizontal step run of 1,6 m at both landing areas, minimum transition radia of 2,6 m at the upper landing and 2,0 m at the lower landing, and limiting the nominal speed to 0,5 m/s and the inclination to 30°.

Combs shall be designed with an angle β of max. 19° combined with a diameter of the shopping trolley or baggage cart roller of at least 120 mm diameter.

Additional stops for emergency situations according to A.2.5 shall be provided. The stop for emergency situations near the transition curve shall be reachable from inside the escalator and the stops for emergency situations at exit(s) shall be reachable from outside of the escalator.

Shopping trolleys or baggage carts shall conform to the escalator design:

— The shopping trolley or baggage cart design shall ensure a safe and correct loading.

— The maximum weight for a shopping trolley or baggage cart shall be 160 kg when loaded.

— Shopping trolley or baggage cart should automatically lock themselves on the inclined part of escalators.

— Shopping trolley or baggage cart shall be fitted with a braking or blocking system.

Shopping trolley or baggage cart shall have deflectors (bumpers) to reduce the risk of clamping.

— For safe exit from the escalator, it is necessary that the rear rollers of the shopping trolley or baggage cart are able to push the front rollers over the comb. The front rollers and/or blocking system shall easily release from the steps.

— Deflectors and guiding devices shall be added to the surrounding area to ensure correct alignment of shopping trolley or baggage cart when entering the escalator.

— Safety signs about safe and correct use of the shopping trolley or baggage cart shall be added.

I.2 Moving walks

The use of suitably designed shopping trolleys (according to EN 1929-2:2004 and EN 1929-4:2005) and baggage carts on moving walks is permitted.

Shopping trolleys or baggage carts which are chosen for use on a moving walk shall be specified between the baggage cart manufacturer and the moving walk manufacturer. If non-specified shopping trolleys or baggage carts are available in the moving walk area, there is a serious risk of misuse. It is necessary to prevent access to the moving walk entrance (see A.4).

The width of the shopping trolley or baggage cart and its contents shall be at least 400 mm less than the nominal pallet/belt width. Passengers shall be able to leave the moving walk, even if shopping trolleys or baggage carts are on the moving walk.

For moving walks with an inclination greater than 6°, the nominal speed shall be limited to 0,5 m/s.

Combs shall be designed with an angle β of max. 19° combined with a diameter of the shopping trolley or baggage cart roller of at least 120 mm diameter.

Additional stops for emergency situations according to A.2.5 shall be provided. The stop for emergency situations near the transition curve shall be reachable from inside the moving walk and the stops for emergency situations at exit(s) shall be reachable from outside of the moving walk.

Shopping trolleys or baggage carts shall conform to the moving walk design:

— The shopping trolley or baggage cart design shall ensure a safe and correct loading.

— The maximum weight for a shopping trolley or baggage cart shall be 160 kg when loaded.

— Shopping trolley or baggage cart shall automatically lock themselves on the inclined part of moving walks.

— Shopping trolley or baggage cart shall be fitted with a braking or blocking system.

— Shopping trolley or baggage cart shall have deflectors (bumpers) to reduce the risk of clamping.

— For safe exit from the moving walk, it is necessary that the rear rollers of the shopping trolley or baggage cart are able to push the front rollers over the comb. The front rollers and/or blocking system shall easily release from the pallet.

— Deflectors and guiding devices shall be added to the surrounding area to ensure correct alignment of shopping trolley or baggage cart when entering the moving walk

— Safety signs about safe and correct use of the shopping trolley or baggage cart should be added

Annex J
(informative)

Determination of anti-slip properties of the tread surfaces of steps and pallets, of comb plates and floor plates

J.1 Introduction

The generally held requirement for anti-slip designs of tread surfaces for steps and pallets and of comb plates and floor plates formerly in EN 115:1995 needs to be made more precise for safe use in practice.

Procedures for determining and assessing the anti-slip properties of coverings have not been standardized before either internationally or on a European level.

However, in the Federal Republic of Germany, there have been tried and tested procedures for determining the anti-slip properties of floor coverings for many years - DIN 51130:2014 [8] or Employers' Liability Insurance Association rules for health and safety at work: DGUV Regel 108-003 [9].

The manufacturers of escalators and moving walks working together in the CEN/TC 10/WG 2 have checked this suitability procedure to see whether it can be applied to the corresponding components for escalators and moving walks. The results obtained show that the DIN 51130 procedure for determining the anti-slip properties of step and pallet coverings and comb plates and floor plates is suitable.

The decision on the DIN 51130 procedure does not exclude other, at least just as safe solutions, which could have been set out too in the technical rules of other member states of the European Union or other states contracted to the Agreement on the European Economic Area.

Test certificates from test centres that are registered in other member states of the European Union or in other states contracted to the Agreement on the European Economic Area are taken into consideration in the same way as DIN 51130 test certificates if the tests, test procedures and construction requirements on which the test certificates of these centres are based are equivalent to the DIN 51130 ones. These centres are mainly those that meet the requirements set out in EN ISO/IEC 17025:2005 [10] or EN 45011:1998 [11].

Test certificates issued under this standard contain the results of the DIN 51130 test and the resulting assessment in accordance with J.2.

J.2 Testing and assessing anti-slip properties

The procedure for testing anti-slip properties is governed by DIN 51130.

Your attention is drawn to the fact that the intermediary medium of oil in the DIN 51130 test procedure is not used to give the test a particularly adverse operating condition. The use of a specific, defined oil is used as a constant test parameter with which, as has been proved, better differentiation of the test results is achieved.

NOTE This procedure is based on the people carrying out the test treading on the covering to be tested on an inclined plane. It is used as an aid to deciding whether the respective covering is suitable for use on escalators and moving walks.

The average inclination angle determined from a range of measurements is critical for classifying the covering in one of five assessment groups. The assessment group is used as a benchmark for the level of

anti-slip properties where coverings in assessment group R 9 meet the lowest anti-slip requirements and those in assessment group R 13 the highest. The allocation of assessment groups to the angle ranges is shown in Table J.1.

Table J.1 — Allocating the overall average values of the inclination angles to the anti-slip assessment groups

Overall average value	Assessment group
from 6° to 10°	R 9
over 10° to 19°	R 10
over 19° to 27°	R 11
over 27° to 35°	R 12
greater than 35°	R 13

The assessment of the anti-slip properties of coverings with surface profiles shall take into account all directions. The lowest assessment group is the one relevant for safety purposes.

Coverings that meet at least assessment group R 9 are considered anti-slip for installations in general. When impacted by water and snow the assessment group R 10 for escalators and moving walks and R 11 for pallets of inclined moving walks shall be considered.

If, at the landings of escalators and moving walks and their allocated floors, there are different assessment groups, it should be taken care that neighbouring floors shall only differ by one in their assessment groups.

The part of the test related to the area below the surface of cleated profiles is not used to assess the anti-slip properties of coverings on escalators and moving walks.

Annex K
(informative)

Determination of sliding properties of footwear on balustrade skirting

K.1 Introduction

On escalators there is the danger of being entrapped between the moving step band and the stationary balustrade skirting. To reduce the risk several requirements are defined in 5.5.3.4. One of these is that suitable measures are necessary to be taken to reduce the sliding friction of skirting panels. This general requirement shall be made more specific for safe use in practice.

Procedures for determining and assessing the sliding properties of coverings have not be standardized before either internationally or on a European level.

But there is a German standard, DIN 51131:2014 [12], that shall be submitted to the CEN as the German proposal for a European Standard. This standard sets out parameters for measuring the kinetic friction coefficients μ on surfaces that are normally trodden on with footwear. Using this procedure the conditions to be taken into consideration on escalators can largely be reproduced.

The manufacturers of escalators and moving walks working together on the CEN/TC 10/WG 2 have checked this suitability procedure to see whether it can be applied. The results obtained show that the procedure as per DIN 51131 for determining the sliding properties of balustrade skirting is suitable. In addition an upper limit for the kinetic friction coefficient μ of skirting panels was determined from the test results that, together with the other requirements in EN 115-1, sufficiently reduces the risk of being entrapped.

The decision on the DIN 51131 procedure does not exclude other, at least just as safe solutions, which could also have been set out in technical rules of other member states of the European Union or other states contracted to the Agreement on the European Economic Area.

Test certificates from test centres that are registered in other member states of the European Union or in other states contracted to the Agreement on the European Economic Area are taken into consideration in the same way as DIN 51131 test certificates if the tests, test procedures and construction requirements on which the test certificates of these centres are based are equivalent to the DIN 51131 ones. These centres are mainly those that meet the requirements set out in EN ISO/IEC 17025:2005 or EN 45011:1998.

Test certificates issued under this standard contain the results of the DIN 51131 test and the resulting assessment in accordance with K.2.

K.2 Testing and assessing sliding properties

The procedure for testing sliding properties is governed by DIN 51131.

In order to reproduce conditions on escalators as realistic as possible, tests should be carried out according to DIN 51131 with rubber only.

For the slider material and skirting panel used for testing, the average of the kinetic friction coefficient μ is calculated from the third to the fifth individual measurements.

Annex L
(informative)

Major modification

A major modification is a change of the location, a change of the nominal speed, of the electric safety devices, of the braking system, of the drive, of the control, of the step band, of the truss and of the balustrades. Wherever applicable, the principles set forth for the constructional inspection and acceptance inspection and test (7.3.2) should apply to the new environmental conditions, modified components and other components which are affected.

The replacement of parts by parts of same design is not considered to be a major modification. Modifications according EN115-2 are not considered as major modifications.

Escalators and moving walks should be inspected after major modifications and at regular intervals.

Such inspections and tests should be made by a competent person.

Annex M
(normative)

Escalators and moving walks subject to seismic conditions

M.1 Introduction

This annex specifies the special provisions and safety rules for escalators and moving walks permanently installed in buildings that are in compliance with EN 1998-1:2004 (Eurocode 8).

M.2 Structural requirements

M.2.1 General

Escalators and moving walks within the scope of this standard shall comply with the relevant safety requirements and/or protective measures of this annex when they are subject to seismic conditions.

M.2.2 Supports

The support conditions of the escalators and moving walks in combination with the building shall be secured so that the escalators and moving walks under seismic conditions are not subjected to constraint. One support shall be designed as fixed support the other supports shall be designed as movable in horizontal direction. The supporting conditions shall be simple statically determined.

Escalators and moving walks shall be retained on the supports in vertical direction by adequate measures so that they cannot be displaced from the supports under seismic conditions.

M.2.3 Arrangement

The length and the movability of the escalators and moving walks shall be chosen in accordance with the building movement between two storeys of the building. The supports shall be designed so that they overlap the building interface. For the determination of the overlap the theoretical maximum "storey drift" of the building shall be used.

M.2.4 Mechanical safety devices for escalators and moving walks

If the design of the escalators and moving walks in combination with the building does not ensure that the escalator or moving walk remains in safe position on the supports, then an additional mechanical safety device shall be applied, so that the escalator and moving walk cannot fall off the supports.

M.3 Design requirements

M.3.1 General

It is assumed that negotiations have been made for each contract between the customer and the supplier/installer about the peak ground acceleration a_{gR} to be considered (see also Introduction). The building designer or owner shall provide the design acceleration which will be documented in the information. The owner shall agree on one common acceleration value a_{gR}. The acceleration value a_{gR} need to be communicated between all participants of the contract.

M.3.2 Truss

Based on the requirements of EN 1998-1:2004 the design of the truss for the escalators and moving walks shall be sufficiently executed for the ambient seismic condition. The structural design shall provide a dissipation capacity to withstand a design-relevant earthquake of the region where it is located.

M.3.3 Mass for the truss of escalators and moving walks

For design calculations of escalators and moving walks the forces shall be determined with the agreed ground acceleration (a_{gR}).

For the determination of horizontal and vertical forces on escalators and moving walks the dead weight plus the step load, given in Table M.1, shall be used.

The step load is determined by the maximum capacity of the escalator according to H.1 with an average weight of 75 kg per person.

Table M.1 — Step load determination

Nominal speed m/s	**Step width** m	**Step depth** m	**Max capacity** Pers./h	**Max capacity** Pers./s	**Travel time /step** s	**Person/ step**	**Person weight** kg	**Step load** kg/step
0,50	1,00	0,40	6 000	1,67	0,80	1,33	75	100

With a factor ψ of 0,6 (taken from EN 1990:2013, Table A.1, category C/D) this leads to a seismic step load Q_{SE} of 60 kg per step.

M.3.4 Condition of loading and deformation during a seismic event

For calculation the seismic condition shall be classified as an exceptional load case. In in areas of regular seismic activity the load case shall be classified as standard variable load.

Superposition rules and safety factors shall be chosen in accordance with EN 1990:200216), EN 1993-1-1:2007 and EN 1998-1:2013.

Plastic deformation is permitted as long as it does not influence the structural integrity of the truss and supports. The structural integrity of the truss with supports and the safe operability (function) of the escalator or moving walk must be inspected by experts after the seismic event before the escalator or moving walk can be put back to operation.

The importance factor γ_I shall be chosen as 0,85.

Friction for supports does not need to be considered in support reaction calculations.

M.3.5 Calculation procedure according to EN 1998-1:2013

The calculation procedure shall be undertaken in accordance with Figure M.1.

M.4 Machinery

Machinery shall be designed and anchored to prevent displacement as a result of the forces imposed on them including forces generated by the design acceleration (a_{gR}).

16) This standard is currently impacted by the amendment EN 1990:2002/A1:2005.

M.5 Electrical installation and other equipment

In case the building is equipped with a seismic detector/sensor the electrical system of the escalator or moving walk shall provide an interface for the connection to this detector/sensor and shall stop the escalator or moving walk in case of seismic activity. This function shall be of manual reset type.

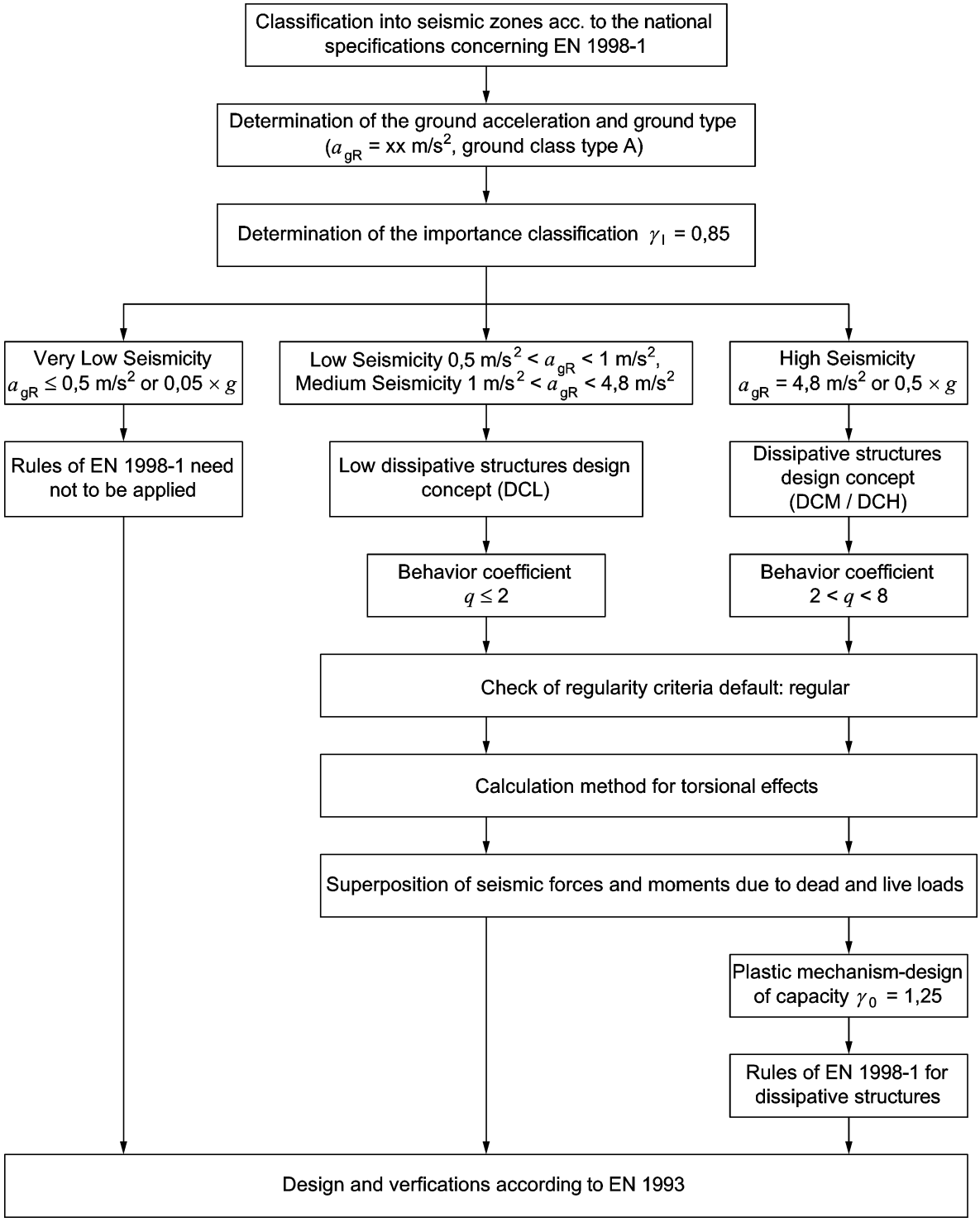


Figure M.1 — Calculation procedure according to EN 1998-1:2004

Annex N
(normative)

Interpretations of EN 115-1

N.1 Format of an interpretation request

CEN	INTERPRETATION REQUEST		EN 115–1 Page 1 of 1
EN 115–1	**Edition:**	**Clause(s):**	
Key-word(s):			
QUESTION			
PROPOSED ANSWER			
COMMENTS OF THE CONVENOR			
Date of request: Date of answer in CEN/TC 10/WG 2……:		Source:	

N.2 Format of an interpretation

<table>
<tr><td>CEN</td><td colspan="2">INTERPRETATION
related to</td><td>[Nr.]
Page 1 of 1</td></tr>
<tr><td rowspan="2">EN 115–1</td><td rowspan="2">Edition:</td><td rowspan="2">Clause(s):</td><td>Valid from:</td></tr>
<tr><td>Date of modification:</td></tr>
<tr><td colspan="3">Key-word(s):</td><td>Replacing interpretation Nr.:</td></tr>
<tr><td colspan="4">QUESTION</td></tr>
<tr><td colspan="4">INTERPRETATION</td></tr>
<tr><td colspan="4">Date of answer in CEN/TC 10/WG 2:
Date of approval by CEN /TC 10 members:</td></tr>
</table>

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission to provide a means of conforming to Essential Requirements of the New Approach Directive for Machinery 2006/42/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] CEN/TS 115-4, Safety of escalators and moving walks — Part 4: Interpretations related to EN 115 family of standards

[2] EN 13823:2010, Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item

[3] Convention on Road Signs and Signals. Vienna, 8.11.1968

[4] EN 60204 (all parts), Safety of machinery — Electrical equipment of machines (IEC 60204, all parts)

[5] EN 1929-1:1998, Basket trolleys — Part 1: Requirements and tests for basket trolleys with or without a child carrying facility

[6] HD 60364-5-54:2011, Low-voltage electrical installations — Part 5-54: Selection and erection of electrical equipment — Earthing arrangements and protective bonding conductors (IEC 60364-5-54:2011)

[7] EN ISO 14798:2012, Lifts (elevators), escalators and moving walks — Risk assessment and reduction methodology

[8] DIN 51130:2014, Prüfung von Bodenbelägen — Bestimmung der rutschhemmenden Eigenschaft — Arbeitsräume und Arbeitsbereiche mit Rutschgefahr, Begehungsverfahren — Schiefe Ebene (EN: Testing of floor coverings — Determination of the anti-slip properties — Workrooms and fields of activities with slip danger, walking method - Ramp test; FR: Essais des révêtements de sol — Détermination de la résistance au glissement — Pièces et zones de travail exposées aux risques de glissement — Méthode de marche sur plan incliné)

[9] DGUV Regel 108-003, Fußböden in Arbeitsräumen und Arbeitsbereichen mit Rutschgefahr

[10] EN ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)

[11] EN 45011:1998, General requirements for bodies operating product certification systems (ISO/IEC Guide 65:1996

[12] DIN 51131:2014, Prüfung von Bodenbelägen — Bestimmung der rutschhemmenden Eigenschaft — Verfahren zur Messung des Gleitreibungskoeffizienten (EN: Testing of floor coverings — Determination of the anti-slip property — Measurement of sliding friction coefficient. FR: Essais des revêtements de sol — Détermination de la résistance au glissement — Mesurage du coefficient de la friction de glissement)</std>

[13] ASME A17.2-2004, Guide for Inspection of Elevators, Escalators, and Moving Walks</std>

[14] Japan Guide for Earthquake Resistant Design & Construction of Vertical Transportation (Edition 1998)

[15] NZS 4332:1997, Non-domestic passenger and good conveyors