



**International  
Standard**

**ISO 8103-1**

**Escalators and moving walks —  
Part 1:  
Safety requirements**

*Escaliers mécaniques et trottoirs roulants —  
Partie 1: Exigences de sécurité*

**First edition  
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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by the European Committee for Standardization (CEN) (as EN 115-1:2017) and was adopted, without modification other than those given below by Technical Committee ISO/TC 178, *Lifts, escalators and moving walks*

- change "this European Standard" or "this standard" to "this document";
- change any "EN ISO xxxx" references to "ISO xxxx" references.

A list of all parts in the ISO 8103 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

### 0.1 General

The content of this document was already published in EN 115-1:2017. This document contains only editorial changes and update of references.

This document is a type-C standard as stated in ISO 12100.

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 type-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.

### 0.2 General remarks

The contents of this document 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 ISO/TC 178. The formats of an interpretation request and the interpretation are given in the Information Note – System of ISO/TC 178 series of standards, Interpretations and Frequently Asked Questions (FAQ) procedures.

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# Escalators and moving walks —

## Part 1: Safety requirements

### 1 Scope

This document is applicable for new escalators and moving walks (pallet or belt type) as defined in [Clause 3](#).

This document 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](#)).

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 document.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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<sup>1)</sup>, *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, *Eurocode 8: 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+AMD1:2009, *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 — Amendment 1*

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

1) 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 13501-1:2007+AMD1:2009, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests — Amendment 1*
- 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 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 60947-4-1:2010<sup>2)</sup>, *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<sup>3)</sup>, *Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices (IEC 60947-5-1:2004)*
- EN 61249 (all parts), *Materials for printed boards and other interconnecting structures (IEC 61249, all parts)*
- EN 62061:2005<sup>4)</sup>, *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)*
- ISO 868:2003, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)*
- ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*
- ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*
- ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*
- 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*

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

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

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

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

### 3 Terms, definitions, symbols and abbreviations

#### 3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

##### 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 1 to entry: Authorized persons should be competent for the tasks they have been authorized for (see also [3.1.8](#)).

##### 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**

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

Note 1 to entry: 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 1 to entry: 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 1 to entry: 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 and/or E/E/PE, used to carry out safety functions

**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 1 to entry: In this document, 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

**3.1.28**

**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 document.

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

Symbol	Designation	Unit	Figures
$a_{gR}$	Peak ground acceleration (reference peak ground acceleration on type A ground)	m/s <sup>2</sup>	—
$b_1$	Distance between the handrail centre lines	m	<a href="#">Figure 6</a>
$b_2$	Width of the handrail	mm	<a href="#">Figure 6</a>
$b_3$	Horizontal distance between skirting and interior panel	mm	<a href="#">Figure 6</a>
$b_4$	Width of the horizontal part of the lower inner decking that directly joins the interior panel	mm	<a href="#">Figure 6</a>
$b_5$	Horizontal distance between the inner edge of the handrail and the top edge of the interior panel	mm	<a href="#">Figure 6</a>
$b_6', b_6''$	Horizontal distance between the handrail profile and guide or cover profiles	mm	<a href="#">Figure 6</a>
$b_7$	Width of the grooves	mm	<a href="#">Figure 5</a>
$b_8$	Web width	mm	<a href="#">Figure 5</a>
$b_9$	Horizontal distance between the outer edge of the handrail and a non-continuous obstruction, e.g. roof intersection, column	mm	<a href="#">Figure A.1</a>
$b_{10}$	Horizontal distance between the outer edge of the handrail and a continuous obstruction, e.g. wall	mm	<a href="#">Clause 5, Figure A.1</a>
$b_{11}$	Horizontal distance between the handrails of adjacent escalators/moving walks	mm	<a href="#">Figure A.1</a>
$b_{12}$	Perpendicular distance between the lower edge of the handrail and the balustrade decking	mm	<a href="#">Figure 6</a>
$b_{13}$	Width of the lower outer decking	mm	<a href="#">Figure 7</a>
$b_{14}$	Horizontal distance between the outer edges of interior panels on adjacent escalators or moving walks	mm	<a href="#">Figure 7</a>
$b_{15}$	Horizontal distance between the building structure (wall) and the centreline of the handrail	mm	<a href="#">Figure 7</a>
$b_{16}$	Horizontal distance between the centrelines of the handrails of adjacent escalators/moving walks	mm	<a href="#">Figure 7</a>
$b_{17}$	Horizontal distance of the anti-slide device to the outer edge of the handrail	mm	<a href="#">Figure 7</a>
$b_{18}$	Perpendicular distance between the lower edge of the handrail and the point where the handrail stand is connected to the balustrade	mm	<a href="#">Figure 6</a>
$h_1$	Vertical distance between the top of the handrail and step nose or pallet surface or belt surface	m	<a href="#">Figures 5, 6</a>
$h_2$	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	<a href="#">Figure 6</a>
$h_3$	Distance between the entry of handrail into the newel and the floor	m	<a href="#">Figures 5, 6</a>
$h_4$	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	<a href="#">Figures 5, A.1</a>
$h_5$	Height of the deflector	m	<a href="#">Figures 5, 7</a>
$h_6$	Clearance between the upper edge of the tread surface and the root of the comb teeth	mm	<a href="#">Figure 5</a>
$h_7$	Depth of the grooves	mm	<a href="#">Figure 5</a>
$h_8$	Mesh depth of the comb into the grooves of the tread	mm	<a href="#">Figure 5</a>
$h_9$	Vertical distance between floor and lower end of the anti-climbing device	mm	<a href="#">Figure 7</a>
$h_{10}$	Vertical distance between lower edge of the handrail and upper end of the access restriction device	mm	<a href="#">Figure 7</a>



Table 1 (continued)

Symbol	Designation	Unit	Figures
$h_{11}$	Height of the anti-slide device	mm	<a href="#">Figure 7</a>
$h_{12}$	Height of the upper edge of the free space outside the handrail	mm	<a href="#">Figure A.1</a>
$h_{13}$	Vertical distance between the upper and lower finished floor levels	m	<a href="#">Figure 5</a>
$L_1$	Root of the comb teeth	—	<a href="#">Figure 5</a>
$l_1$	Horizontal distance between supports	m	<a href="#">Figure 5</a>
$L_2$	Comb intersection line	—	<a href="#">Figure 5</a>
$l_2$	Distance between the furthest point reached by the handrail and the comb intersection line measured parallel to the tread surface	m	<a href="#">Figure 5</a>
$l_3$	Length of the straight portion of the handrail in the direction of landing measured from the comb intersection line	m	<a href="#">Figure 5</a>
$l_4$	Distance between the furthest point reached by the handrail and the point of entry into the newel measured parallel to the tread surface	m	<a href="#">Figure 5</a>
$l_5$	Length of anti-climbing device on the lower outer decking	mm	<a href="#">Figure 7</a>
$Q_{SE}$	Seismic step load	kg/step	—
$v$	Nominal speed	m/s	—
$x_1$	Step height	m	<a href="#">Figure 8</a>
$y_1$	Step depth	m	<a href="#">Figure 8</a>
$z_1$	Nominal width for the load carrying area (step, pallet or belt)	m	<a href="#">Figures 6, 8</a>
$z_2$	Horizontal distance between skirting	m	<a href="#">Figure 6</a>
$z_3$	Transverse distance between the supporting rollers	mm	<a href="#">Figure 11</a>
$\alpha$	Angle of inclination of the escalator or moving walk	°(degree)	<a href="#">Figure 5</a>
$\beta$	Design angle of the teeth of the comb	°(degree)	<a href="#">Figure 5</a>
$\gamma$	Cross-sectional angle of inclination of the lower inner decking	°(degree)	<a href="#">Figure 6</a>
$\mu$	Friction coefficient	—	—
$\psi$	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 document, 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 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](#), [5.12.3.13](#), [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.1](#));
- 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](#)).

### 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

Electromagnetic radiation, like low frequency radiation, radio frequency radiation and microwaves, can be received by the escalator or moving walk during normal operation (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](#), [5.12.3.5.1](#));
- 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](#), [Figure G.2](#));
- 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 other items than persons (e.g. shopping or luggage trolleys, push chairs) (see [7.4.1 d](#)), [A.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 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 ISO 12100:2010, 6.2, for relevant but not significant hazards, which are not dealt with by this document.

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<sup>2</sup> 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 ISO 13857:2019, 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  $\alpha$  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  $\alpha$  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<sup>2</sup>. 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  $\pm 1^\circ$  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<sup>2</sup>.

NOTE 6 000 N/ m<sup>2</sup> is derived from a structural rated load of 5 000 N/m<sup>2</sup> (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).

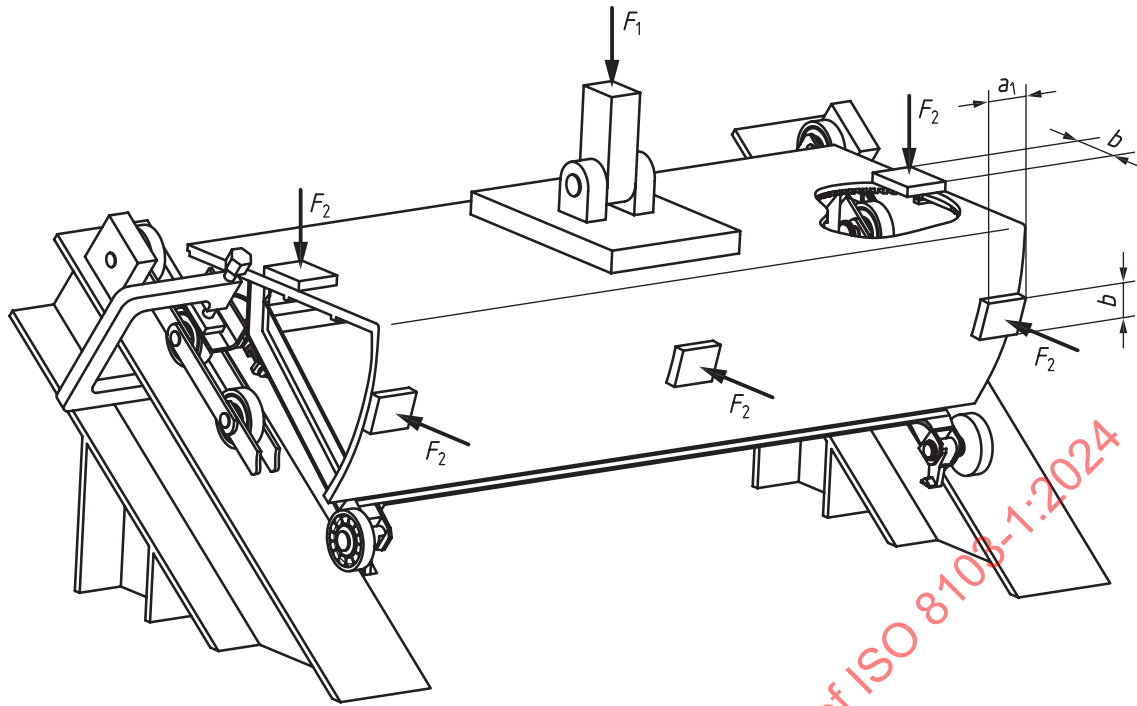
The step shall be tested as a whole together with rollers (not rotating), axles or stub shafts (if existing) in a horizontal position (horizontal support) and at the maximum inclination (inclined support) for which the step shall be applied.

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<sup>2</sup>, 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. See [Figure 2](#). 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.

#### 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<sup>2</sup>, 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 (initial setting tolerances are permitted).

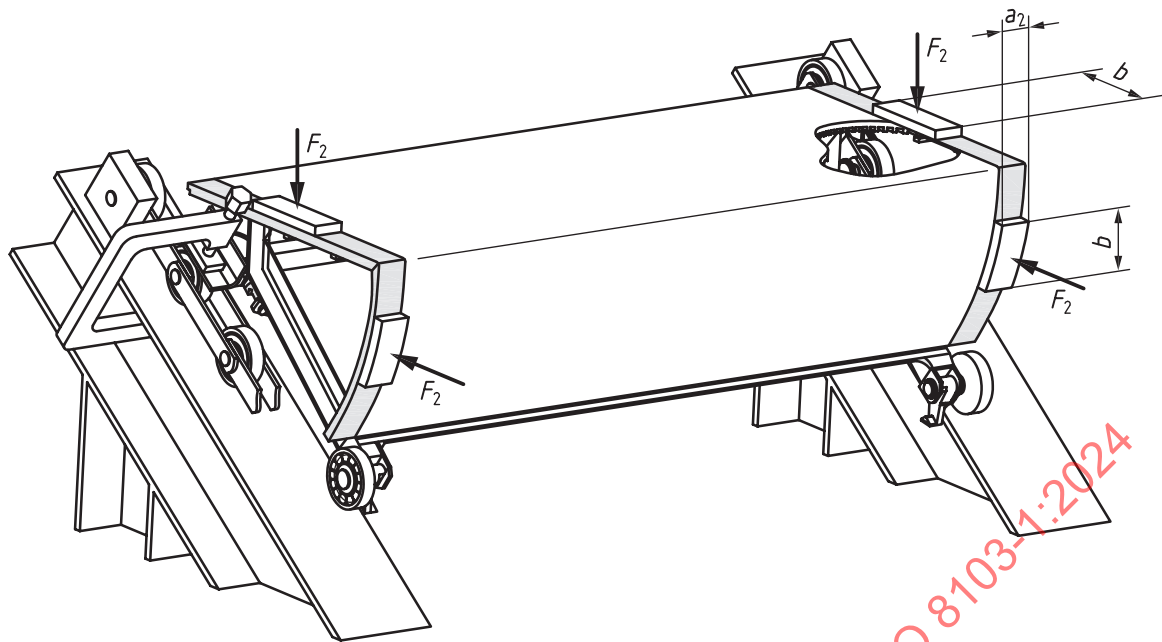


**Key**

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

**Figure 1 — Step test**

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:



**Key**

$F_1$  3 000 N

$F_2$  1 500 N

$a_2$  width of the inserts/fixings

$b$  50 mm

**Figure 2 — Step test with inserts/fixings**

### 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<sup>2</sup>, 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 not be below 3 000 N (including weight of the plate), the size of the plate not smaller than 0,20 m x 0,30 m and its thickness not less than 25 mm.

For pallets with a depth smaller than 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  $5 \times 10^6$  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  $\pm 2$  mm displacement of the trailer wheel centre, moving in an arc whose centre is the chain wheel centre. The  $\pm 2$  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  $5 \times 10^6$  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.

#### 5.3.3.3.2 Pallets

##### 5.3.3.3.2.1 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  $5 \times 10^6$  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 than 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.

##### 5.3.3.3.2.2 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  $\pm 2$  mm displacement of the trailer wheel centre, moving in an arc whose centre is the chain wheel centre. The  $\pm 2$  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  $5 \times 10^6$  cycles whereby an undisturbed sinusoidal force flow shall be achieved.

For pallets with a smaller length than 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). For steps 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  $\pm 5$  % 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  $\alpha$  up to 30°;
- 0,50 m/s for an escalator with an angle of inclination  $\alpha$  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 according 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**

**5.4.2.1.1.1** 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](#).

#### 5.4.2.1.1.2 Operational braking by electro-mechanical brake.

For operational braking by electro-mechanical brake the requirements of [5.4.2.1.2](#) apply.

#### 5.4.2.1.1.3 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](#)

#### 5.4.2.1.1.4 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.

**5.4.2.1.1.5** 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  $1 \text{ m/s}^2$  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  $1 \text{ m/s}^2$  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 has 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  $1 \text{ m/s}^2$  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  $(1\ 000 \pm 50)$  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<sup>2</sup>, 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  $\gamma$  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](#)).

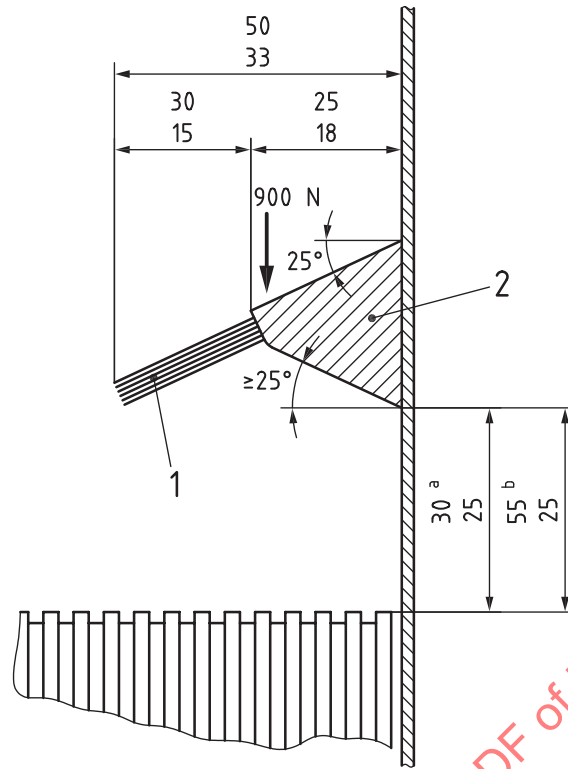
**5.5.3.3** The skirting including lighting and other devices shall yield not more than 4 mm under a single force of 1 500 N acting at the most unfavourable point at right angles to the surface over a square or round area of 2 500 mm<sup>2</sup>. No permanent deformation shall result from this. This 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. See [Figure 5](#) detail R.

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

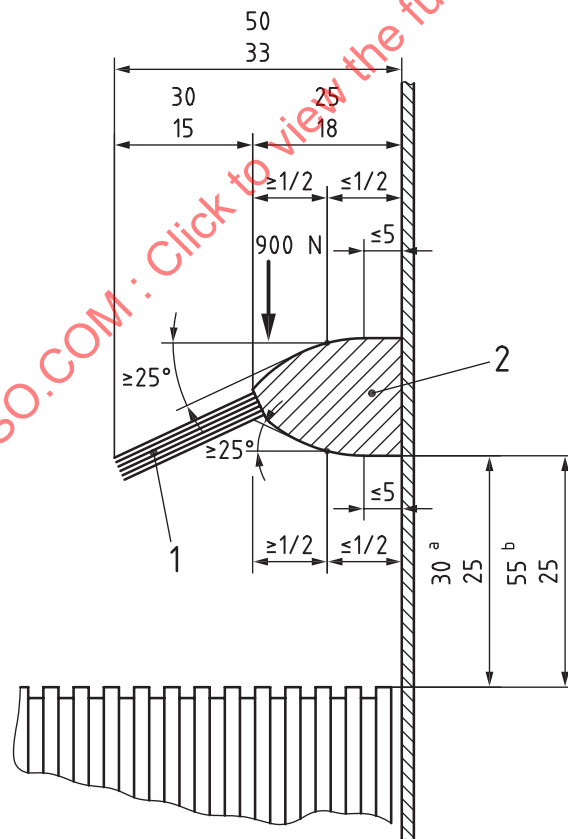
For this purpose, the following four conditions shall be fulfilled:

- 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<sup>2</sup> 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 3 a\)](#), 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](#) applies.
- 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<sup>3</sup>, and a Shore D-hardness 50 ± 3 according to ISO 868:2003. Testing lubricant is defined as a solution composed of sodium dodecyl sulfate (purity ≥ 99 %) de-ionized or distilled water (for information on test methods, see [Annex K](#)).

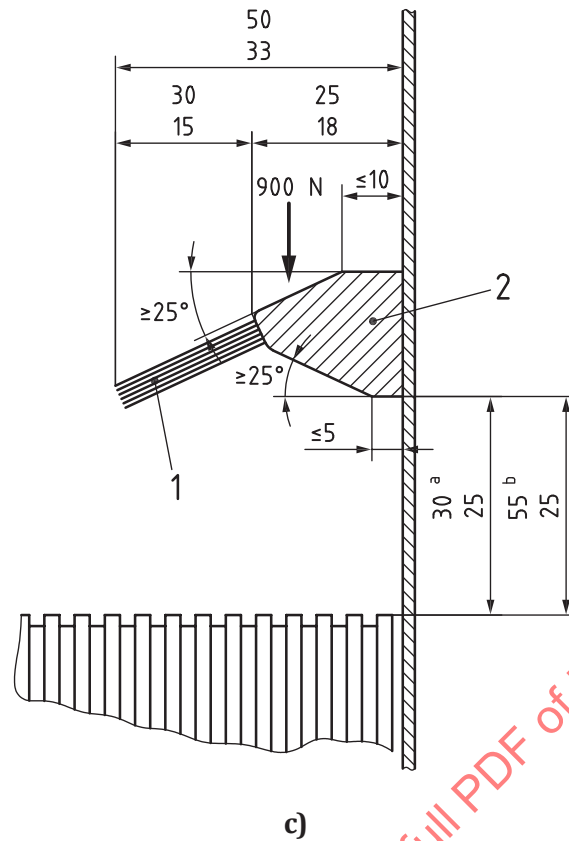




a)



b)



**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 3 — 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  $(l_2 - l_3 + 50\text{ mm})$  the handrail shall enter into the balustrade at an angle  $\alpha$  of at least  $20^\circ$  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  $0,5 \text{ m/s} < v \leq 0,65$  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  $\beta$  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](#)), [7.4.1 e](#)) and [7.4.1 f](#)) for maintenance requirements and inspection activities.

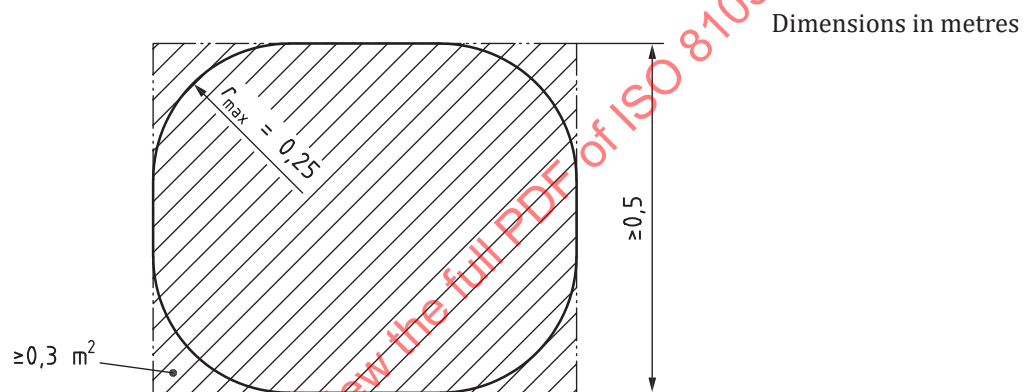
According to ISO 12100:2010, 6.3, effective protection and guards shall be provided for moving and rotating parts if they are accessible and dangerous, in particular for:

- 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  $0,30 \text{ m}^2$  and the smaller side shall be at least  $0,50 \text{ m}$  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.  $0,25 \text{ m}$  radius (see [Figure 4](#)) and at a height of at least  $0,12 \text{ m}$  above the free-standing area.



**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  $0,12 \text{ m}^2$  shall be provided. The minimum dimension shall be not less than  $0,30 \text{ m}$ .

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  $200 \text{ lx}$  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 document 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 to EN 13823:2010+A1:2014<sup>[2]</sup>).

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+A1:2014) shall be done solely with plastic insert material forming the whole test surface.

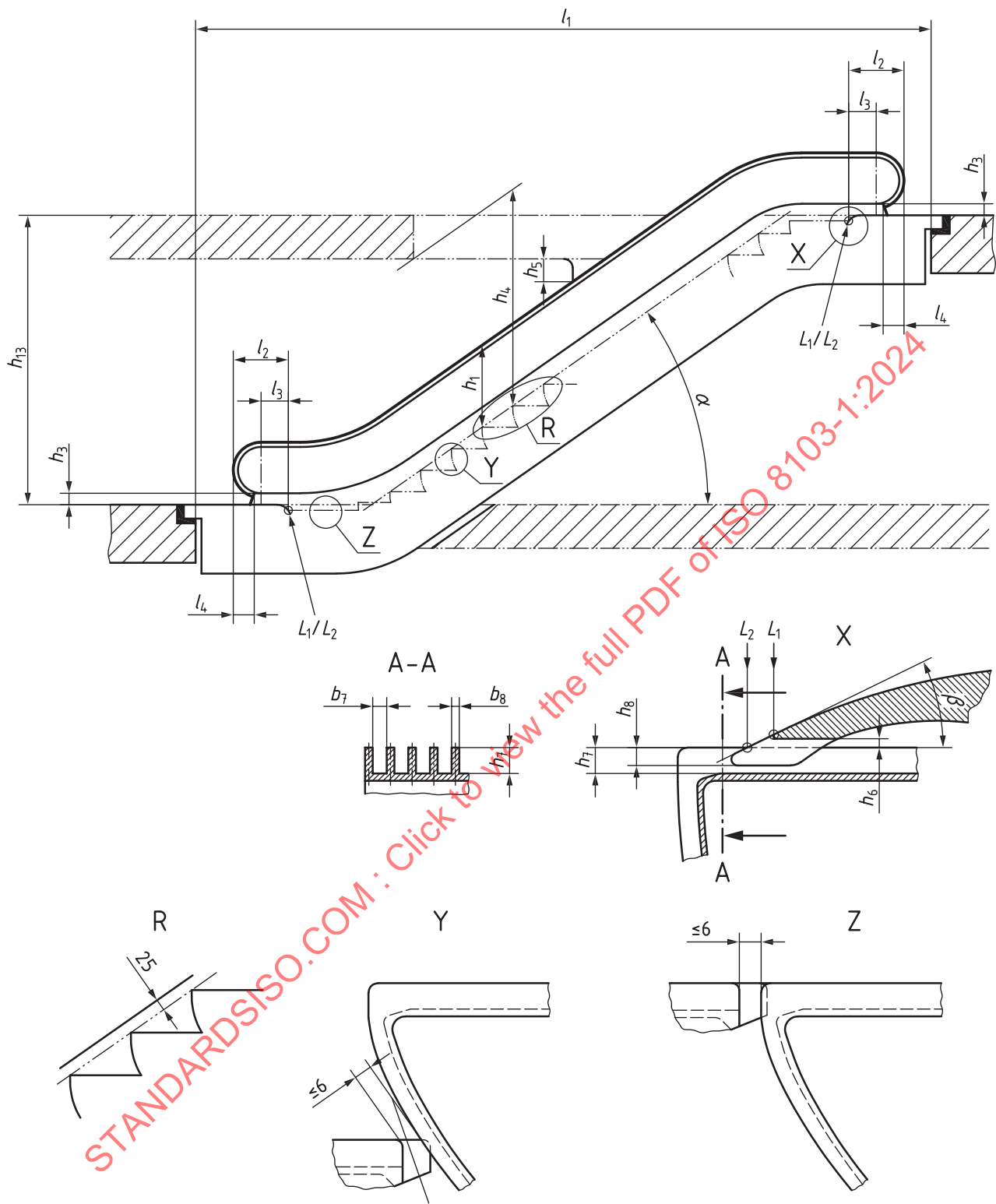
**NOTE** A continuous arrangement is given for steps equipped with plastic inserts on the tread and on the riser and for pallets with plastic inserts in the direction of travel. Gaps between steps and pallets are not considered as an interruption of the continuous arrangement.

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
b7 5 mm to 7 mm (step treads and pallets)	<a href="#">5.3.2.2.5</a>	h8 ≥ 4 mm	<a href="#">5.7.3.3.1</a>
b7 4,5 mm to 7 mm (belts)	<a href="#">5.3.2.3.2</a>	h13 Rise	-
b8 2,5 mm to 5 mm (step treads and pallets)	<a href="#">5.3.2.2.7</a>	L1 Root of the comb teeth	-
b8 4,5 mm to 8 mm (belts)	<a href="#">5.3.2.3.4</a>	L2 Comb intersection line	-

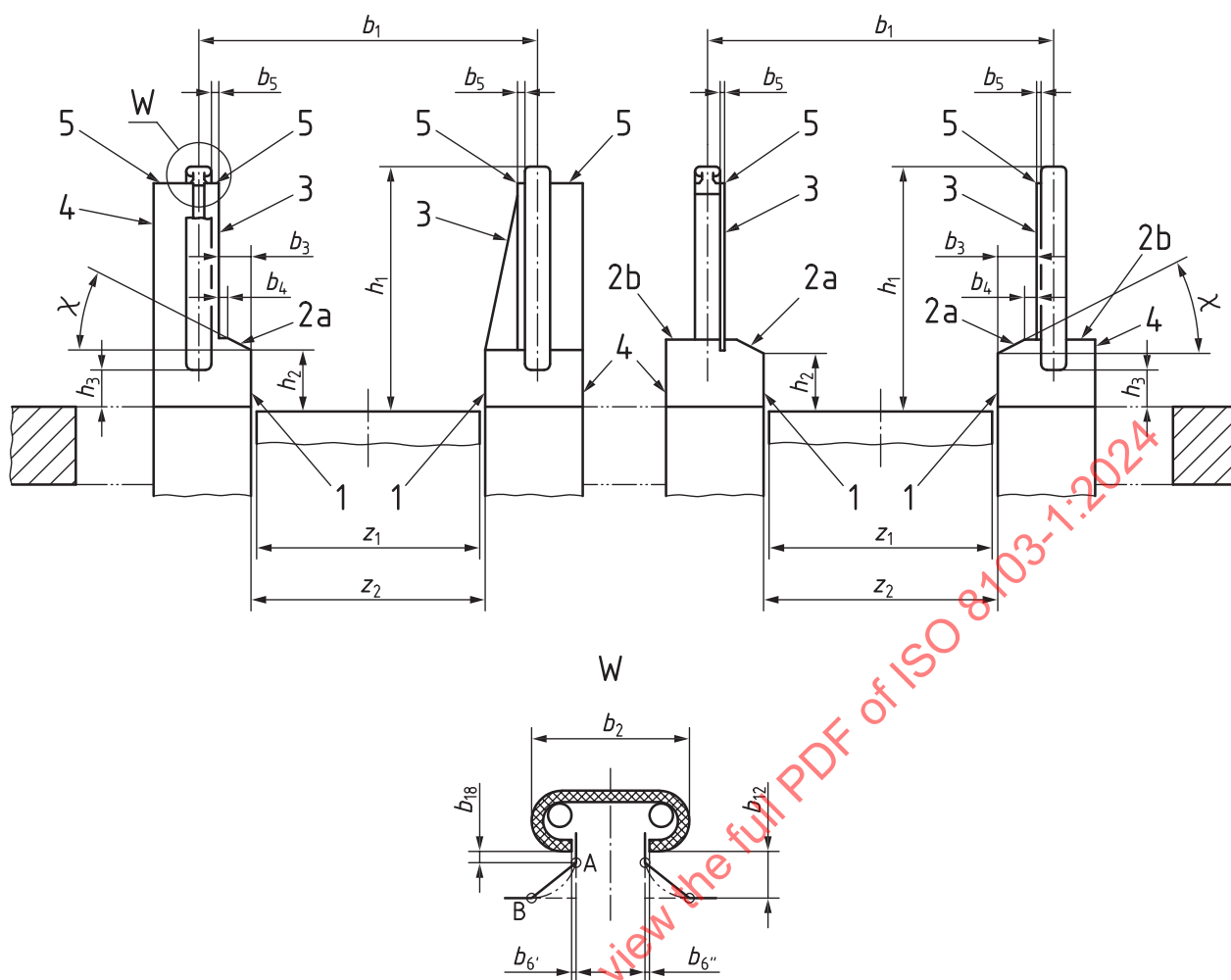


h1 0,90 m to 1,10 m	<a href="#">5.5.2.1</a>	l1 Distance between supports	-
h3 0,10 m to 0,25 m	<a href="#">5.6.4.1</a>	l2 ≥ 0,60 m	<a href="#">5.5.4.1</a>
h4 ≥ 2,30 m	<a href="#">A.2.1</a>	l3 ≥ 0,30 m	<a href="#">5.5.4.2</a>
h5 ≥ 0,30 m	<a href="#">A.2.4</a>	l4 ≥ 0,30 m	<a href="#">5.6.4.2</a>
h6 ≤ 4 mm	<a href="#">5.7.3.3.2</a>	α Angle of inclination	
h7 ≥ 10 mm (step treads and pallets)	<a href="#">5.3.2.2.6</a>	β ≤ 35°	<a href="#">5.7.3.2.3</a>
h7 ≥ 5 mm (belts)	<a href="#">5.3.2.3.3</a>		

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

Figure 5 — Escalator (elevation), principal dimensions

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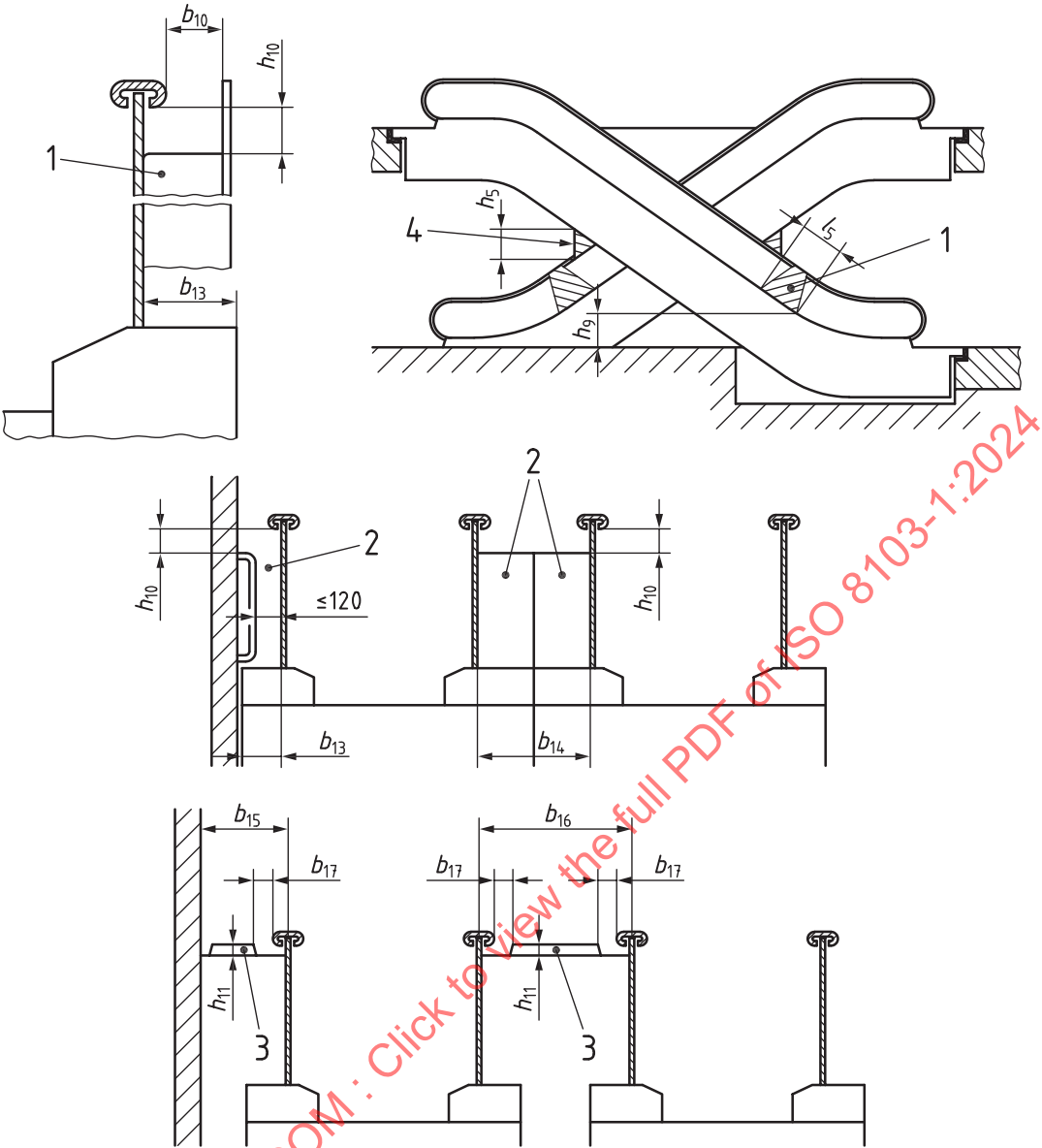
## Key

- |    |   |   |  |
|----|---|---|--|
| 1  | skirting ( <a href="#">5.5.3</a> )              | 3 | interior panel ( <a href="#">5.5.2.4</a> )     |
| 2a | lower inner decking ( <a href="#">5.5.2.6</a> ) | 4 | exterior panel ( <a href="#">5.2.1.2</a> )     |
| 2b | lower outer decking ( <a href="#">5.5.2.2</a> ) | 5 | balustrade decking ( <a href="#">5.5.2.2</a> ) |

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

**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](#))
- 2

access restriction device ([5.5.2.2](#))
- 3

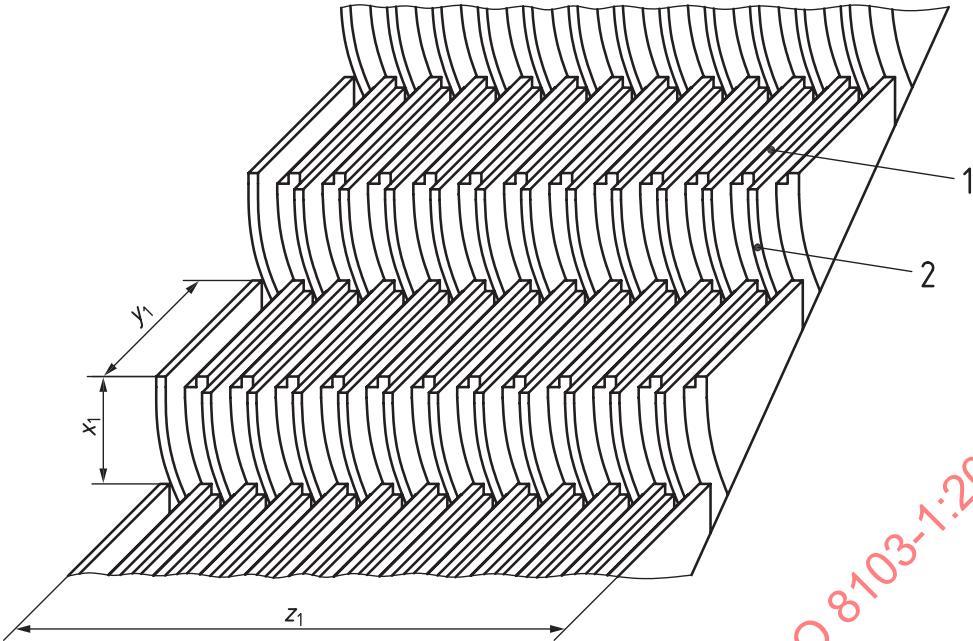
anti-slide device ([5.5.2.2](#))
- 4

vertical deflector ([A.2.4](#))

Principal dimensions	Clause	Principal dimensions	Clause
$b_{13}, b_{14}, b_{15}, b_{16}$	<a href="#">5.5.2.2</a>	$h_{10} = 25 \text{ mm to } 150 \text{ mm}$	<a href="#">5.5.2.2</a>
$b_{17} \geq 100 \text{ mm}$	<a href="#">5.5.2.2</a>	$h_{11} \geq 20 \text{ mm}$	<a href="#">5.5.2.2</a>
$h_5 \geq 0,30 \text{ m}$	<a href="#">A.2.4</a>	$l_5 \geq 1\,000 \text{ mm}$	<a href="#">5.5.2.2</a>
$h_9 = (1\,000 \pm 50) \text{ mm}$	<a href="#">5.5.2.2</a>	$b_{10} \geq 80 \text{ mm}$	<a href="#">A.2.2</a>

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
$x_1 \leq 0,24 \text{ m}$	<a href="#">5.3.2.2.1</a>
$y_1 \geq 0,38 \text{ m}$	<a href="#">5.3.2.2.2</a>
$z_1 \text{ 0,58 m to 1,10 m}$	<a href="#">5.3.2.1</a>

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

**Figure 8 — Steps, principal dimensions**

Dimensions in millimetres

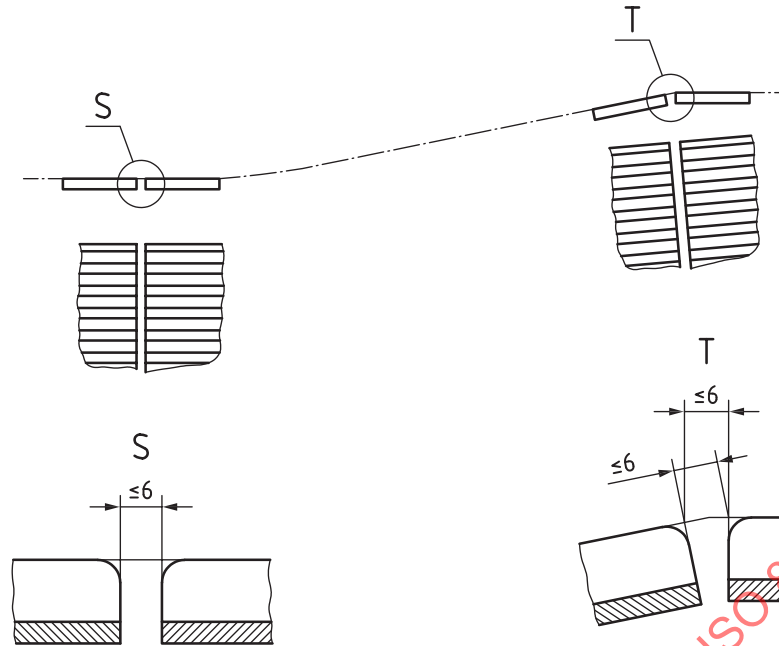


Figure 9 — Pallets, clearance and mesh depth (pallet type moving walk without meshed front and rear edges) in lower and upper landing and transition curves

Dimensions in millimetres

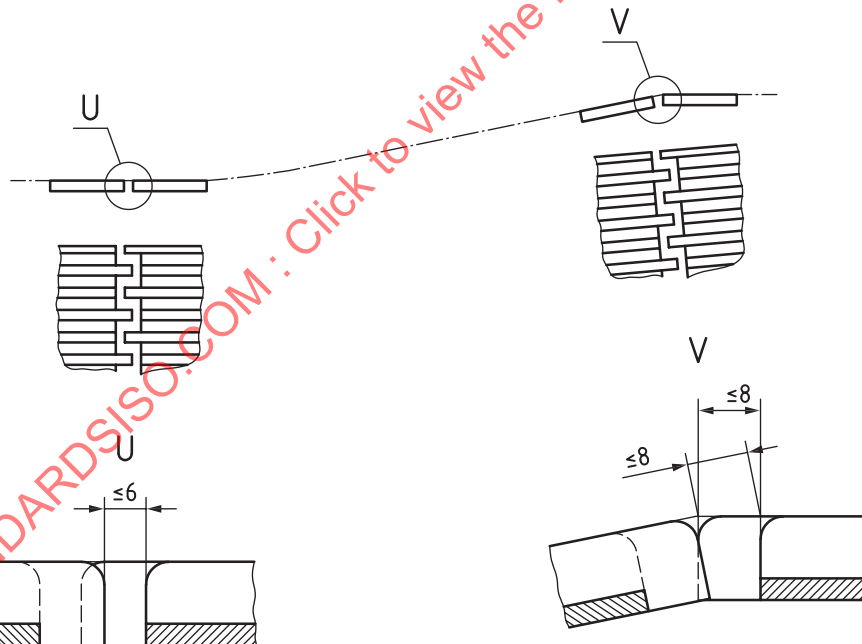
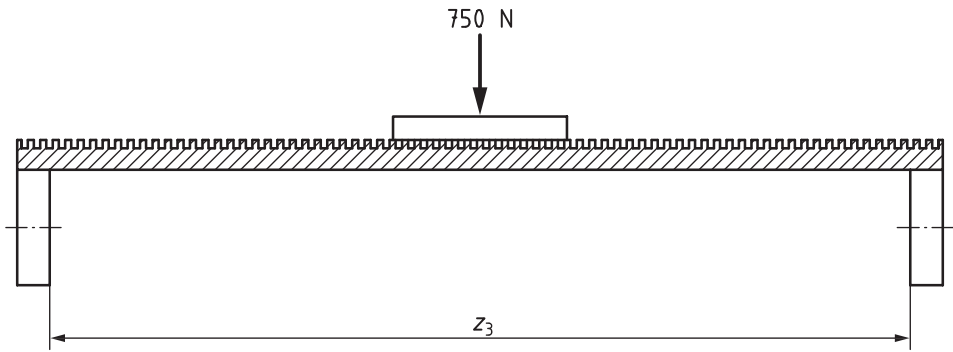


Figure 10 — Pallets, clearance and mesh depth (pallet type moving walk with meshed front and rear edges) in lower and upper landing and transition curves



Key

Symbol for quantity/Designation	Clause
$z_3$ Transverse distance between the supporting rollers	<a href="#">5.3.3.2.4</a>

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 document 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 document.

**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<sup>5)</sup>:

- 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 60947-5-1<sup>6)</sup>:

- 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 60947-4-1:2010, Annex F) are open.

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

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

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



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	<a href="#">5.12.1.2</a>	<a href="#">Annex B</a>	Yes <sup>a</sup>
B	Protection of motors	<a href="#">5.12.1.3</a>	EN 60947-4-1	Yes <sup>b</sup>
C	Protection of safety devices	<a href="#">5.12.1.4</a>	-	Yes
D	Protection against electrostatic loading	<a href="#">5.12.1.5</a>	-	No
<sup>a</sup> Failure lock (see <a href="#">5.12.2.8</a> ) is not required for <a href="#">5.12.1.2.2</a> a) and b).				
<sup>b</sup> Failure lock is not applicable for <a href="#">5.12.1.3.3</a> .				

### 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 60947-4-1:2010<sup>7)</sup>).

**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](#).

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

**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<sup>8)</sup> 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	<a href="#">5.12.2.2</a>
B	Monitoring of safety devices	<a href="#">5.12.2.3</a>
C	Power supply for safety devices	<a href="#">5.12.2.4</a>
D	Actuation of safety devices	<a href="#">5.12.2.5</a>
E	Means of safety devices	<a href="#">5.12.2.6</a>
F	Events to be detected by safety devices	<a href="#">5.12.2.7</a> ( <a href="#">Table 8</a> )
G	Function of failure lock	<a href="#">5.12.2.8</a>
H	Function for detecting deviations of the electrical braking sequence	<a href="#">5.12.2.9</a> ( <a href="#">Table 9</a> )

#### 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](#));

8) "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.

- 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 for 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 60947-5-1:2004<sup>9)</sup>:

- 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.

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

### 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](#).

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 62061:2005<sup>10)</sup>.

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



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.

**Table 8 — Events to be detected by safety devices**

#	Description	Reference	Means of safety device	Failure lock	Enabled in inspection mode
A	Detection of excessive speed	<a href="#">5.12.2.7.2</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 2)	Yes	Yes
B	Detection of unintentional reversal of the direction of travel	<a href="#">5.12.2.7.3</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 2)	Yes	Yes
C	Detection of non-lifting of the auxiliary brake	<a href="#">5.12.2.7.4</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 1)	Yes	No
D	Detection of breakage or undue elongation of parts immediately driving the steps, pallets or the belt	<a href="#">5.12.2.7.5</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 1)	Yes	Yes
E	Detection of movement of tensioning device	<a href="#">5.12.2.7.6</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 1)	Yes	Yes
F	Detection of entrapment at comb	<a href="#">5.12.2.7.7</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (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	<a href="#">5.12.2.7.8</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 2)	No	No
H	Detection of entrapment at hand rail entry	<a href="#">5.12.2.7.9</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 1)	No	Yes
I	Detection of sagging step or pallet	<a href="#">5.12.2.7.10</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 2)	Yes	No
J	Detection of missing step or pallet	<a href="#">5.12.2.7.11</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 2)	Yes	No
K	Detection of non-lifting of the operational brake	<a href="#">5.12.2.7.12</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 1)	Yes	No
L	Detection of speed deviation of the hand rail	<a href="#">5.12.2.7.13</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 1)	No	No
M	Detection of opened inspection cover	<a href="#">5.12.2.7.14</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 1)	No	No
N	Detection of the actuation of the stop device for emergency situations	<a href="#">5.12.2.7.15</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 1)	No	Yes



Table 8 (continued)

#	Description	Reference	Means of safety device	Failure lock	Enabled in inspection mode
O	Detection of installed hand winding device	<a href="#">5.12.2.7.16</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 1)	Yes	Yes
P	Detection of the maintenance and repair stop switch	<a href="#">5.12.2.7.17</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 2)	No	Yes
Q	Detection of the actuation of the stop device on the inspection control device	<a href="#">5.12.2.7.18</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 2)	No	Yes
R	Detection of the absence/presence of a removable barrier intended to prevent access of shopping trolleys and baggage carts	<a href="#">5.12.2.7.19</a>	<a href="#">5.12.2.6.1</a> or <a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (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 ( $\alpha \geq 6^\circ$ ) 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 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 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 ISO 13850:2015 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 ISO 13850:2015.

#### 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 ISO 13850:2015. 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 ISO 13850:2015 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 ISO 13850:2015 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

#### 5.12.2.9.1 General

**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	<a href="#">5.12.2.9.2</a>	<a href="#">5.12.2.6.2</a> or <a href="#">5.12.2.6.3</a> (SIL 2)	Yes	No

#### 5.12.2.9.2 Detection of time deviations for the braking sequence for electrical braking

A device shall be provided to detect the exceeding of the requirements of 5.12.3.5.2.2.2.

### 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	<a href="#">5.12.3.2</a>	<a href="#">5.12.1.1</a> ( <a href="#">Table 6</a> , item A)
B	Automatic operation – Starting in predetermined direction	<a href="#">5.12.3.3</a>	<a href="#">5.12.1.1</a> ( <a href="#">Table 6</a> , item A)
C	Automatic operation – Starting in 2-Direction-Mode	<a href="#">5.12.3.4</a>	<a href="#">5.12.1.1</a> ( <a href="#">Table 6</a> , item A)
D	Stopping the escalator or moving walk	<a href="#">5.12.3.5</a>	<a href="#">5.12.1.1</a> ( <a href="#">Table 6</a> , item A)
E	Making unavailable and stopping by operator – manually operated	<a href="#">5.12.3.6</a>	<a href="#">5.12.1.1</a> ( <a href="#">Table 6</a> , item A), <a href="#">5.12.3.5</a>
F	Stopping – automatically operated	<a href="#">5.12.3.7</a>	<a href="#">5.12.1.1</a> ( <a href="#">Table 6</a> , item A), <a href="#">5.12.3.5</a>
G	Stopping by stop device for emergency situations, manually operated	<a href="#">5.12.3.8</a>	<a href="#">5.12.3.5</a>
H	Stopping initiated by protective and safety devices and functions	<a href="#">5.12.3.9</a>	<a href="#">5.12.3.5</a>
I	Preventing from starting when permitted stopping distance exceeded	<a href="#">5.12.3.10</a>	<a href="#">5.4.2.1.3.1</a> , <a href="#">5.4.2.1.3.4</a> , <a href="#">5.12.2.8</a>
J	Intended reversal of direction of travel	<a href="#">5.12.3.11</a>	-
K	Reactivation for automatic restart	<a href="#">5.12.3.12</a>	<a href="#">5.12.1.1</a> ( <a href="#">Table 6</a> , item A)
L	Inspection control	<a href="#">5.12.3.13</a>	<a href="#">5.12.2.7.18</a> , <a href="#">5.12.3.5</a>

#### 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<sup>2</sup>.

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  $0,3 \text{ m/s}^2$

#### 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  $0,5 \text{ m/s}^2$ .

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

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  $0,3 \text{ m}$  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) the start of the step/pallet band with an acceleration of not more than  $0,3 \text{ m/s}^2$ .



### 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 General

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 Electrical braking

**5.12.3.5.2.2.1** 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.

**5.12.3.5.2.2.2** 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 [5.12.2.9.2](#) 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 (see also [5.4.2.2.5](#)):

- 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.

#### 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 [5.12.3.3](#) and [5.12.3.4](#).

### 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.

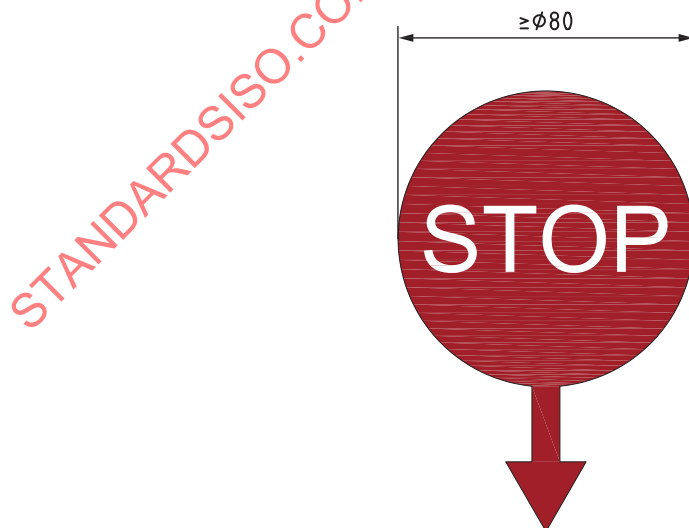
The distances between stop devices for emergency situations shall not exceed:

- 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 [1.2](#).

Dimensions in millimetres



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

**Figure 12 — Stop device indicator**

**5.12.3.8.2** Stop devices for emergency situations shall be safety devices according to [5.12.2.6.1](#).

NOTE Devices according to ISO 13850:2015 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 ISO 13850:2015.

#### **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 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 simultaneous actuation by the use of both hands, one hand on the direction-control-device and the other hand on the RUN-control-device, in order to activate and to maintain any operation of the escalator/moving walk.

NOTE Simultaneous actuation is independent of any time lag between the initiation of each of the two control devices.

**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 inspection 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 inspection 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 inspection 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 subclauses in this document. Secondary subclauses, which are not listed in the table, are verified as part of the quoted subclause. All verification records shall be kept by the manufacturer.

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

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

Clause	Testing <sup>a</sup>	Measurement <sup>b</sup>	Calculation <sup>c</sup>	Visual inspection <sup>d</sup>
<a href="#">5.2.1.1</a>				x
<a href="#">5.2.1.2</a>	x <sup>e</sup>		x <sup>e</sup>	
<a href="#">5.2.1.3</a>				x
<a href="#">5.2.1.4</a>				x
<a href="#">5.2.1.5</a>				x
<a href="#">5.2.2</a>		x		
<a href="#">5.2.3</a>				x
<a href="#">5.2.4</a>			x	x
<a href="#">5.2.5</a>			x	
<a href="#">5.3.1</a>		x		
<a href="#">5.3.2</a>		x		
<sup>a</sup> The result of the test is to show that the escalator/moving walk works as intended, including the electric safety devices. <sup>b</sup> The result of the measurement is to show that the stated measurable parameters have been met. <sup>c</sup> Calculations will verify that the design characteristics of the provided components meet the requirements. <sup>d</sup> 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. <sup>e</sup> Alternatively.				

Table 11 (continued)

Clause	Testing <sup>a</sup>	Measurement <sup>b</sup>	Calculation <sup>c</sup>	Visual inspection <sup>d</sup>
<a href="#">5.3.3</a>	x		x	
<a href="#">5.3.4</a>		x		
<a href="#">5.3.5</a>		x		
<a href="#">5.4.1.2</a>		x		
<a href="#">5.4.1.3.1</a>				x
<a href="#">5.4.1.3.2</a>			x	
<a href="#">5.4.1.4</a>				x
<a href="#">5.4.2.1.1</a>	x			
<a href="#">5.4.2.1.2</a>	x			
<a href="#">5.4.2.1.3.1</a>			x	
<a href="#">5.4.2.1.3.2</a>		x		
<a href="#">5.4.2.1.3.3</a>			x	
<a href="#">5.4.2.1.3.4</a>		x		
<a href="#">5.4.2.2.1</a>				x
<a href="#">5.4.2.2.2</a>			x	
<a href="#">5.4.2.2.3</a>				x
<a href="#">5.4.2.2.5</a>	x			
<a href="#">5.4.3.1</a>				x
<a href="#">5.4.3.2</a>	x		x	
<a href="#">5.4.3.3</a>				x
<a href="#">5.4.4.1</a>			x	
<a href="#">5.4.4.2</a>				x
<a href="#">5.5.1</a>				x
<a href="#">5.5.2.1</a>		x		
<a href="#">5.5.2.2</a>		x		x
<a href="#">5.5.2.3</a>			x	
<a href="#">5.5.2.4</a>		x		x
<a href="#">5.5.2.5</a>		x		
<a href="#">5.5.2.6</a>		x		
<a href="#">5.5.3.1</a>		x		
<a href="#">5.5.3.2</a>		x		-
<a href="#">5.5.3.3</a>	x			
<a href="#">5.5.3.4</a>	x	x		x
<a href="#">5.5.4</a>		x		
<a href="#">5.5.5.1</a>		x		x
<a href="#">5.5.5.2</a>		x		x

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

<sup>b</sup> The result of the measurement is to show that the stated measurable parameters have been met.

<sup>c</sup> Calculations will verify that the design characteristics of the provided components meet the requirements.

<sup>d</sup> 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.

<sup>e</sup> Alternatively.

Table 11 (continued)

Clause	Testing <sup>a</sup>	Measurement <sup>b</sup>	Calculation <sup>c</sup>	Visual inspection <sup>d</sup>
<a href="#">5.6.1</a>	x	x		
<a href="#">5.6.2.1</a>		x		x
<a href="#">5.6.2.2</a>		x		
<a href="#">5.6.2.3</a>		x		
<a href="#">5.6.3</a>		x		
<a href="#">5.6.4.1</a>		x		
<a href="#">5.6.4.2</a>		x		
<a href="#">5.6.4.3</a>				x
<a href="#">5.6.5</a>				x
<a href="#">5.7.1</a>	x	x		
<a href="#">5.7.2.1</a>		x		
<a href="#">5.7.2.2</a>		x		
<a href="#">5.7.2.3</a>		x		
<a href="#">5.7.2.4</a>		x		
<a href="#">5.7.2.5</a>				x
<a href="#">5.7.3.1</a>				x
<a href="#">5.7.3.2.1</a>		x		x
<a href="#">5.7.3.2.2</a>		x		x
<a href="#">5.7.3.2.3</a>		x		x
<a href="#">5.7.3.2.4</a>				x
<a href="#">5.7.3.2.5</a>				x
<a href="#">5.7.3.2.6</a>	x			
<a href="#">5.7.3.3.1</a>		x		
<a href="#">5.7.3.3.2</a>		x		
<a href="#">5.8.1</a>				x
<a href="#">5.8.2.1</a>		x		
<a href="#">5.8.2.2</a>				x
<a href="#">5.8.2.3</a>		x		
<a href="#">5.8.3</a>		x		x
<a href="#">5.9</a>	x			
<a href="#">5.10</a>				x
<a href="#">5.11.3.1</a>	x			x
<a href="#">5.11.3.2</a>				x
<a href="#">5.11.3.3</a>				x
<a href="#">5.11.4.1</a>				x
<a href="#">5.11.4.2</a>				x

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

<sup>b</sup> The result of the measurement is to show that the stated measurable parameters have been met.

<sup>c</sup> Calculations will verify that the design characteristics of the provided components meet the requirements.

<sup>d</sup> 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.

<sup>e</sup> Alternatively.

Table 11 (continued)

Clause	Testing <sup>a</sup>	Measurement <sup>b</sup>	Calculation <sup>c</sup>	Visual inspection <sup>d</sup>
<a href="#">5.11.4.3.1</a>				x
<a href="#">5.11.4.3.2</a>				x
<a href="#">5.11.4.3.4</a>				x
<a href="#">5.11.4.3.5</a>				x
<a href="#">5.11.4.3.6</a>				x
<a href="#">5.11.4.3.7</a>				x
<a href="#">5.11.4.4</a>				x
<a href="#">5.12.1.2</a>				x
<a href="#">5.12.1.3</a>				x
<a href="#">5.12.1.4</a>	x			
<a href="#">5.12.1.5</a>				x
<a href="#">5.12.2.2</a>	x			
<a href="#">5.12.2.3</a>				x
<a href="#">5.12.2.4</a>				x
<a href="#">5.12.2.5</a>				x
<a href="#">5.12.2.6.1.2</a>				x
<a href="#">5.12.2.6.1.3</a>		x		
<a href="#">5.12.2.6.1.4</a>				x
<a href="#">5.12.2.6.2</a>	x			
<a href="#">5.12.2.6.3</a>	x			
<a href="#">5.12.2.7</a>	x			
<a href="#">5.12.2.8</a>	x			
<a href="#">5.12.2.9</a>	x			
<a href="#">5.12.3.2</a>	x			
<a href="#">5.12.3.3</a>	x			
<a href="#">5.12.3.4</a>	x			
<a href="#">5.12.3.5</a>	x			
<a href="#">5.12.3.6</a>	x			
<a href="#">5.12.3.7</a>	x			
<a href="#">5.12.3.8</a>	x			x
<a href="#">5.12.3.9</a>	x			
<a href="#">5.12.3.10</a>	x			
<a href="#">5.12.3.11</a>	x			
<a href="#">5.12.3.12</a>	x			x
<a href="#">5.12.3.13.1</a>				x
<a href="#">5.12.3.13.2</a>		x		x

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

<sup>b</sup> The result of the measurement is to show that the stated measurable parameters have been met.

<sup>c</sup> Calculations will verify that the design characteristics of the provided components meet the requirements.

<sup>d</sup> 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.

<sup>e</sup> Alternatively.

Table 11 (continued)

Clause	Testing <sup>a</sup>	Measurement <sup>b</sup>	Calculation <sup>c</sup>	Visual inspection <sup>d</sup>
<a href="#">5.12.3.13.3</a>				x
<a href="#">5.12.3.13.4</a>	x			
<a href="#">Clause 7</a>				x
<a href="#">Annex A</a>		x		x
<a href="#">Annex B</a>	x			x
<a href="#">Annex G</a>		x		x
Annex <a href="#">M.2</a>		x	x	
Annex <a href="#">M.3</a>			x	
<sup>a</sup> The result of the test is to show that the escalator/moving walk works as intended, including the electric safety devices. <sup>b</sup> The result of the measurement is to show that the stated measurable parameters have been met. <sup>c</sup> Calculations will verify that the design characteristics of the provided components meet the requirements. <sup>d</sup> 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. <sup>e</sup> Alternatively.				

## 6.2 Specific data, test reports and certificates

The following documentation should be held by the manufacturer:

- stress analysis of the truss or equivalent certificate by a stress analyst;
- proof by calculation of sufficient breakage resistance of the parts directly driving the steps, pallets or the belt, e.g. step chains, racks;
- calculation of the stopping distances for loaded moving walks (see [5.4.2.1.3.4](#)) together with adjustment data;
- proof testing of steps or pallets;
- proof of the breaking strength of the step chain/pallet chain/belt;
- proof of sliding coefficients for skirting;
- proof of anti-slip properties of tread surfaces (steps, pallets, floor and comb plates without combs);
- proof of stopping distances and deceleration values;
- 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 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:

- a) "Small children shall be held firmly";
- b) "Dogs shall be carried" (see [Figure G.1](#), Reg. No. ISO 7001-BP006);
- c) "Use the handrail" (see [Figure G.2](#), Reg. No. ISO 7010-M012);
- d) "Push chairs not permitted".

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 fulfil 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"<sup>[3]</sup>)

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 document, 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 document.

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+A1:2008) 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 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<sup>[4]</sup>);
  - 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 and control 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 document;
  - 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 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 fulfil 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 Figure 5 and Figure 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 device 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.

**A.3.4** 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;
- b) a clear horizontal area of at least 0,50 m × 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<sup>[5]</sup>, 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:

- e) 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.
- f) 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.
- g) The height of traffic columns shall be at least the height of the handrail level.
- h) The height of guiding barriers shall be at least the height of the balustrade decking.
- i) 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.
- j) Guiding barriers and traffic columns are not considered as structural measures that block the exit.

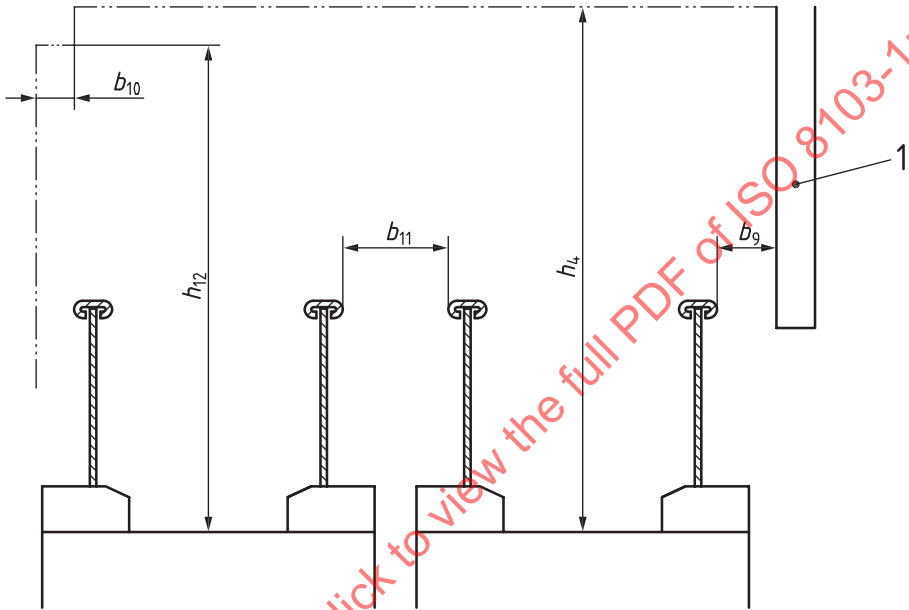
For guiding barriers and traffic columns in the immediate environment of the unrestricted area these requirements also apply. For other devices/installations outside the unrestricted area in the immediate environment requirements a), b), c) and d) apply.

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.



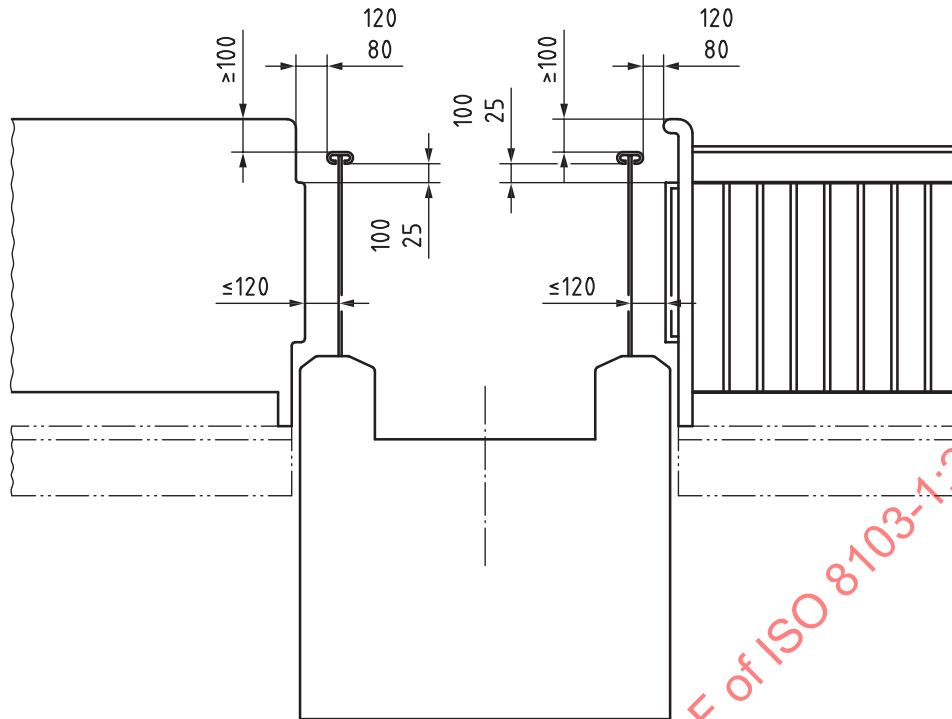
Key

- 1 obstacle (e.g. column)

Principal dimensions	Clause	Principal dimensions	Clause
$b_9 \geq 400 \text{ mm}$	<a href="#">A.2.4</a>	$h_4 \geq 2\,300 \text{ mm}$	<a href="#">A.2.1</a>
$b_{10} \geq 80 \text{ mm}$	<a href="#">A.2.2</a>	$h_{12} \geq 2\,100 \text{ mm}$	<a href="#">A.2.2</a>
$b_{11} \geq 160 \text{ mm}$	<a href="#">A.2.3</a>		

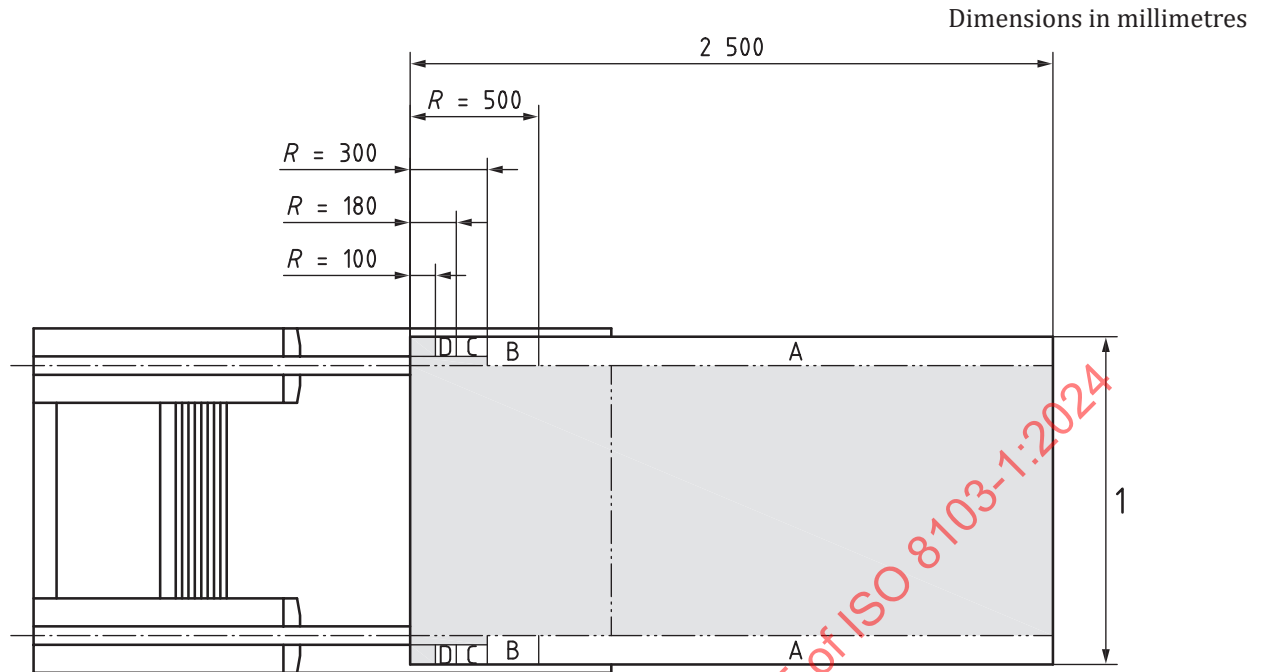
NOTE This figure has not been drawn to scale. It only serves to illustrate the requirements.

Figure A.1 — Clearances between building structure and escalator/moving walk



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

**Figure A.2 — Example of barriers at landings**



**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	No	No	No	No																
1.3.1 NTC	No	No	No	No																
1.3.2 PTC	No	No	No	No																
1.3.3 VDR	No	No	No	No																
1.3.4 IDR																				
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.														
2.4 Optocoupler	No	(2)			No	'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 opto-coupler 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><td>Voltage phase-to-earth derived from rated system voltage up to and including V<sub>rms</sub> and d.c.</td><td>Preferred series of impulse withstand voltages in volts for installation (category III)</td></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>	Voltage phase-to-earth derived from rated system voltage up to and including V <sub>rms</sub> and d.c.	Preferred series of impulse withstand voltages in volts for installation (category III)	50	800	100	1 500	150	2 500	300	4 000	600	6 000	1 000	8 000
Voltage phase-to-earth derived from rated system voltage up to and including V <sub>rms</sub> and d.c.	Preferred series of impulse withstand voltages in volts for installation (category III)																			
50	800																			
100	1 500																			
150	2 500																			
300	4 000																			
600	6 000																			
1 000	8 000																			
2.5 Hybrid circuits	No	No	No	No	No															
2.6 Integrated circuits	No	No	No	No	No	Change in function to oscillation; 'and' gates becoming 'or' gates, etc.														



Table B.1 (continued)

Component	Possible failure exclusion					Conditions for the exclusion of faults Remarks
	I	II	III	IV	V	
3 Miscellaneous						
3.1 Connectors Terminals Plugs	No	(3)				(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.
3.2 Neon bulb	No	No				
3.3 Transformer	No	(4)	(5)	(5)		(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.
3.4 Fuse		(6)				'II' means short circuit of the blown fuse. (6) Can be excluded if the fuse is correctly rated, and constructed according to EN 60269–1:2007.
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 60947–5–1:2004, 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.
<b>Key</b> III change value to higher value I Interruption IV change value to lower value II short-circuit V change of function						
a This standard is currently impacted by the amendment EN 60269-1:2007/A1:2009 and EN 60269-1:2007/A2:2014. b This standard is currently impacted by the amendment EN 60947-5-1:2004/A1:2009.						

## Annex C (normative)

### Drafting and assessing failsafe circuits

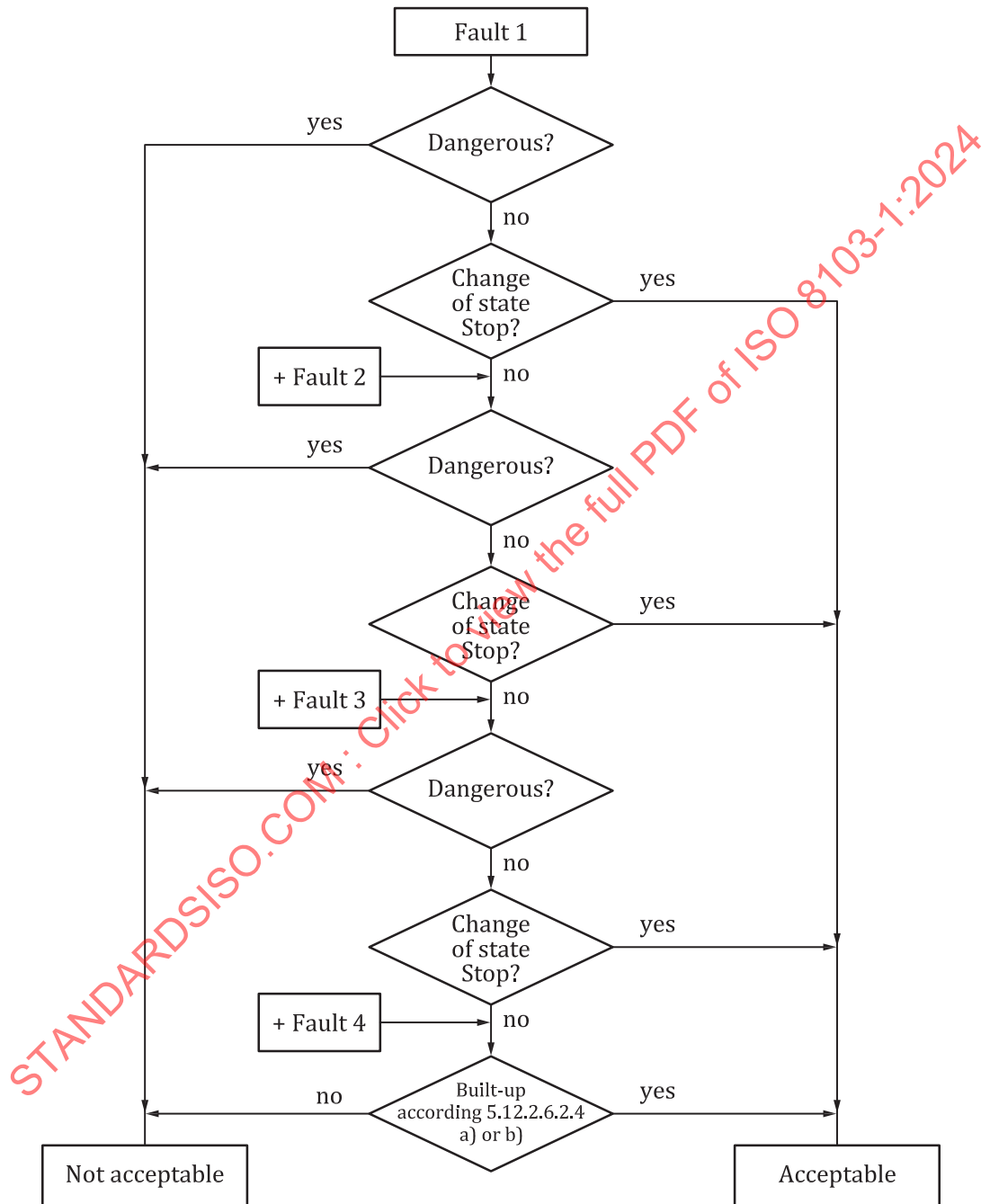


Figure C.1 — Flow chart for drafting and assessing failsafe circuits