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British Standard

## **Safety rules for the construction and installation of escalators and passenger conveyors**

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Normes de sécurité pour la construction et l'installation des escaliers mécaniques et des trottoirs roulants

Sicherheitsregeln für die Konstruktion und den Einbau von Fahrtreppen und Fahrsteigen

This European Standard EN 115 was given, as from 31 October 1983, the status of a British Standard. The status of the existing relevant British Standard BS 2655 : Part 4 is explained in the national foreword and national appendix W.

**British Standards Institution**

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## National foreword

This British Standard has been prepared under the direction of the Mechanical Engineering Standards Committee and is identical with European Standard EN 115 'Safety rules for the construction and installation of escalators and passenger conveyors'.

It is to be noted that in 1976, the Commission of the European Communities (CEC) conferred a mandate to the European Committee for Standardization (CEN) regarding the creation of a standard with a view to promoting the free traffic of escalators, pallet passenger conveyors, belt passenger conveyors and parts of this equipment, within the European Community. The CEN Conseil de Gérance accepted this mandate through Resolution 10 taken at the 4 to 5 November 1976 meeting and appointed CEN/TC 10 to carry it out. European Standard EN 115 will be presented to the CEC as the implementation of such a mandate.

Together with the publication of this British Standard BS 2655 : Part 4 has been made obsolescent by amendment action. The obsolescent requirements will be retained in

BS 2655 for reference purposes to enable new installations ordered before publication of this standard to be completed and to enable existing escalators and passenger conveyors to be maintained. The dates and conditions for implementing BS 5656 are stated in appendix W.

In addition to the requirements for escalators specified in this standard readers should note that the Health and Safety Executive (HSE) has published Guidance Note PM 34† 'Safety in the use of escalators' which describes some of the inherent hazards and areas of risk experienced in the use of escalators and recommends certain precautions that should be taken to alleviate those hazards.

Attention is drawn to the use in this standard of the comma as a decimal marker. This is to accord with European practice, but it should be noted that it is current practice in British Standards to use a full point on the baseline as a decimal marker.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

\*EN 115 contains its own contents list.

†Obtainable from HMSO.

## National appendix V

### National variations

**V.1 Introduction.** This national appendix provides details of national variations that are permitted to supplement the requirements of this British Standard.

#### V.2 Specific national variations

##### V.2.1 Clause 5.1.5.6.3

The following extract from HSE Guidance Note No 34\* is relevant.

##### '15. Deflector devices for new escalators

A deflector device is intended to minimise the likelihood of contact with the possible trapping point by causing feet to be more safely positioned, loose clothing to be kept clear or, should someone fall on the escalator, by deflecting fingers from the trapping area.

Such devices should be fitted to all escalators ordered after 1 January 1984. They should be requested from the manufacturers or their UK agents by firms and organisations purchasing escalators. Several types of deflector device can be made available. One particular type has been in use for many years in public transport undertakings. More recently other types have become available which make use of suitably placed brush bristles.'

##### V.2.2 Clause 16.2, paragraph 2

Not applicable to this British Standard. There are no such approved persons or organizations in the UK.

##### V.2.3 Clause 16.3.2

There are at present no UK regulations covering responsibility for such a register. The National Committee recommends that the register be lodged with the person(s) designated as immediately responsible for the escalator by legislation relating to the particular circumstances.

##### V.2.4 Clause 16.4

No national variation.

## National appendix W

### Dates and conditions for implementing BS 5656

(hereinafter in this national appendix referred to as 'this standard').

**W.1** This standard is applicable to all new escalators and passenger conveyors installed in such new buildings as are designed after the date of publication of this standard (31 October 1983).

**W.2** All new escalators and passenger conveyors ordered after 31 October 1983, for installation in such buildings as have not yet been commenced but for which final plans existed before 31 October 1983, should be constructed preferably in accordance with this standard or in accordance with BS 2655 : Part 4 ('Lifts, escalators, passenger conveyors and paternosters Part 4 General requirements for escalators and passenger conveyors'). If, however, such escalators and passenger conveyors installations are scheduled for commissioning after 31 October 1987, the requirements of this standard only are applicable.

**W.3** All new escalators and passenger conveyors ordered after 31 October 1983, for installation in such new buildings as were under construction or completed before that date, are permitted to be constructed in accordance with either this standard or BS 2655 : Part 4. If, however, such escalators and passenger conveyors installations are scheduled for commissioning after 31 October 1987, the requirements of this standard only are applicable unless it can be shown that compliance is not reasonably practicable.

**W.4** Such new replacement escalators and passenger conveyors and major modifications to existing escalators and passenger conveyors as are commissioned before 31 October 1987, for use in existing buildings that were built before 31 October 1983, are permitted to be in accordance with either this standard or BS 2655 : Part 4. After 31 October 1987, the requirements of this standard only are applicable unless it can be shown that compliance is not reasonably practicable. Special provisions are permissible to meet certain site conditions often present in buildings that have been in use for many years. It is intended that the use of new equipment should not automatically be restricted because certain site conditions are now more rigorous than formerly. However, any deviations from this standard will have to ensure a minimum acceptable standard of safety having regard to the circumstances affecting the installation, whilst permitting an installation of reasonable standard to be modernized or reconstructed, in stages if necessary.

## National appendix X

### Corresponding British Standards for international standards and for CENELEC harmonization documents referred to

**X.1 International standards.** Clause 2 of EN 115 lists a number of international standards that are referred to in the text of the standard. The available corresponding British Standards are as follows.

International standard	Corresponding British Standard
IEC 158-1 : 1970	BS 5424 Specification for control-gear for voltages up to and including 1000 V a.c. and 1200 V.d.c. Part 1 : 1977 Contactors (Identical)
IEC 337-1 : 1970	BS 4794 Specification for control switches (switching devices, including contactor relays, for control and auxiliary circuits, for voltages up to and including 1000 V.a.c. and 1200 V.d.c.) Part 1 : 1979 General requirements (Identical)
IEC 439 : 1973	BS 5486 Specification for factory-built assemblies of switchgear and controlgear for voltages up to and including 1000 V.a.c. and 1200 V d.c. Part 1 : 1977 General requirements (Identical)

\*See national foreword.

**X.2 CENELEC harmonization documents.** Clause 2 of EN 115 also lists a number of CENELEC harmonization documents that are referred to in the text of the standard. Some of these harmonization documents have been, or will be, the subject of British Standards:

HD 21 is reflected in:

- BS 6004 : 1975 PVC-insulated cables (non-armoured) for electrical power and lighting
- BS 6500 : 1975 Insulated flexible cords
- BS 6746 : 1976 PVC insulation and sheath of electric cables;

HD 22 is reflected in:

- BS 6007 : 1975 Rubber-insulated cables for electric power and lighting
- BS 6500 : 1975 Insulated flexible cords
- BS 6899 : 1976 Rubber insulation and sheath of electric cables;

HD 384 is reflected in the 15th edition of 'Regulations for electrical installations' published by the Institution of Electrical Engineers.

HD ——— is at present clause 32 of IEC 364-3 : 1977 for which there is no British Standard. Chapter 32 of the 15th edition of 'Regulations for electrical installations' has been reserved to cover the external influences dealt with in HD ———.

(Copies of the above publications are available from BSI Sales Department.)

**X.3 Classification of degrees of protection.** Reference is made in 13.1.2 and 14.1.2.2.2 to degrees of protection to be provided by enclosures, full information on the IP codes used is given in the following British Standards:

- BS 5490 Specification for degrees of protection provided by enclosures (Identical with IEC 529);
- BS 5420 Specification for degrees of protection of enclosures of switchgear and controlgear for voltages up to and including 1000 V.a.c and 1200 V.d.c (Identical with IEC 144).

UDC : 621.876.32 : 625.36 : 001.4 : 003.62 : 614.8

Key words: escalators, passenger conveyors, safety requirements, definitions, structural members, illumination, machine rooms, handrail, stair steps, type tests, mechanical drives, equipment specifications, dimensions, specifications, braking, electrical installations, electrical faults, safety devices, direction (of movement), marking, maintenance, acceptance inspection

English version

## Safety rules for the construction and installation of escalators and passenger conveyors

Normes de sécurité pour la construction  
et l'installation des escaliers  
mécaniques et des trottoirs roulants

Sicherheitsregeln für die Konstruktion  
und den Einbau von Fahrtreppen und  
Fahrsteigen

This European Standard was accepted by CEN on 31 May 1983. CEN members are bound to comply with the requirements of CEN Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to CEN Central Secretariat has the same status as the official versions.

CEN members are the national standards organizations of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

# CEN

European Committee for Standardization  
Comité Européen de Normalisation  
Europäisches Komitee für Normung

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## Brief history

During its June 1974 meeting, Technical Committee CEN/TC 10 'Passenger, goods and service lifts' formed working group WG 2. The latter was charged with the setting up of a draft European Standard on escalators and passenger conveyors (Resolutions No. 13, 14 and 15).

The Secretariat of this working group was allocated to the German Member body.

In December 1974 the Secretariat circulated a first proposal based on the safety regulations set up by the 'International Committee for Lifts Regulations (CIRA)' for safe construction and installation of escalators.

Working group CEN/TC 10/WG 2 examined this proposal for 32 working days, which resulted in the drawing up of an amended text which was distributed in June 1977 to all CEN Member bodies for comment (document CEN/TC 10 N 49).

Document N 49 was then the subject of a second reading which was carried out by WG 2, for 14 days, in the light of the comments received.

The problem concerning the equipment intended for public services which had been raised at the commencement of the work was brought up once again, and a special meeting gathering the representatives of public transport

organizations of eight CEN Member countries had to be organized. The wishes expressed during this meeting were transmitted to WG 2 who then had to include in the draft proposal some specifications, particularly applicable to the so-called equipment 'for public services'.

For another 14 days the WG 2 has carried out a third reading on the comments given to the second reading. The result was the final draft prEN 115, December 1980.

This European Standard was adopted by CEN on the strength of its acceptance by the following member countries:

Belgium, Denmark, Germany, Greece, Italy,  
Netherlands, Spain Switzerland, United Kingdom.

It is to be noted that in 1976, the Commission of the European Communities conferred a mandate to CEN regarding the creation of a standard with a view to promoting the free traffic of escalators, pallet passenger conveyors, belt passenger conveyors and parts of this equipment, within the European Community. The CEN Conseil de Gérance accepted this mandate through Resolution 10 taken at the 4-5 November 1976 meeting and appointed CEN/TC 10 to carry it out. Standard EN 115 will be presented to the CEC as the implementation of such a mandate.



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## 0 Introduction

The purpose of this standard is to define safety rules for escalators and passenger conveyors in order to safeguard people and objects against risks of accidents during operation, maintenance and inspection work.

**0.1** It is necessary that all components

**0.1.1** are promptly dimensioned, of sound mechanical and electrical construction and made of material with adequate strength and of suitable quality and free from defects;

**0.1.2** are kept in good repair and working order. In particular, care shall be taken that the dimensions indicated are maintained despite wear; if necessary, the worn parts shall be replaced.

~~0.2 Where for elucidation of the text, a design is mentioned this shall not be considered as the only possible design. Any other solution leading to the same result is permissible if it is guaranteed that with an equivalent function the same safety level exists.~~

~~0.3 It is not the purpose of this standard to preclude new developments of escalators and passenger conveyors from becoming incorporated provided they satisfy the safety requirements of this standard.~~

**0.4** Certain escalators and passenger conveyors are subject to special operational conditions. In these cases some additional requirements have to be fulfilled, marked in this standard with the note 'for public service escalators and public service passenger conveyors'. Such operational conditions generally exist on escalators and passenger conveyors when all the following conditions apply:

(a) they are part of a public traffic system including entrance and exit points;

(b) they are suitable for regularly operating for approximately 140 h/week with a load reaching 100 % of the brake load (**12.4.4.1** and **12.4.4.3**) during periods lasting for at least 0,5 h during any time interval of 3 h.

During the planning stage it should be specified if it will be a public service escalator or public service passenger conveyor.

## 0.5 Special requirements

~~0.5.1 Fire protection and building requirements differ from country to country and so far neither have been harmonized, either on the international level or in Europe. Therefore, this standard cannot include specific requirements for fire protection. However, it is recommended that as far as possible, Escalators and passenger conveyors are made of materials that are not easy to ignite.<sup>1)</sup>~~

**0.5.2** If escalators or passenger conveyors have 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 shall be used that satisfy the particular conditions.

In addition, it is recommended that for escalators and passenger conveyors which otherwise would be exposed to weather conditions, the customer provides a roof and enclosure.

**0.6** Requirements related to the life of the escalators and passenger conveyors are not included in this standard as it depends on the place of installation and customers' special specifications.

**0.7** This standard has been drawn up taking into account in certain cases the imprudent act of the user. However, this standard takes into consideration proper use and not abuse.

~~0.8 An interpretation committee is to be 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.~~

<sup>1)</sup> 'not easy to ignite' equals 'schwer entflammbar' in German and 'difficilement inflammable' in French



## 1 Scope

**1.1** This standard is applicable for all new escalators and passenger conveyors (pallet or belt type).

**1.2** Existing escalators and passenger conveyors are not subject to this standard. It is, however, recommended that they be adapted to this standard.

## 2 References

- IEC Publication 158-1 (1970) Low-voltage controlgear. Part 1: Contactors
- IEC Publication 337-1 (1970) Control switches (low-voltage switching devices for control and auxiliary circuits, including contactor relays) Part 1: General requirements
- IEC Publication 439 (1973) Factory-built assemblies of low-voltage switchgear and controlgear
- CENELEC
- HD 21 PVC-insulated cables for rated voltages  $U_0/U$  up to and including 450/750 V
- HD 22 Rubber-insulated cables for rated voltages  $U_0/U$  up to and including 450/750 V
- HD 384 Electrical installations of buildings
- HD ... Classification of external influences (in preparation, at present clause 32 of IEC Publication 364)
- 73/23 EEC Council Directive on the harmonization of the Member States relating to electrical equipment designed for use within certain voltage limits.

## 3 Definitions

The following definitions aim to indicate the precise technical sense in which the listed terms have been used in this standard.

**escalator.** Power-driven installation with endless moving stairway for the conveyance of passengers in the upward or downward direction.

**passenger conveyor.** Power-driven installation with endless moving walkway (e.g. pallets, belt) for the conveyance of passengers either on the same or between different traffic levels.

**handrail.** Moving part intended to serve as a handhold for the passengers.

**combs.** Parts which at both landings mesh with the steps, pallets or the belt in order to facilitate the transition of passengers.

**rated speed.** Speed in the direction of the moving steps, pallets or the belt, when operating the equipment under no load condition, stated by the manufacturer as that for which the escalator or passenger conveyor had been designed and at which it should operate.

**angle of inclination.** Maximum angle to the horizontal in which the steps, the pallets or the belt move.

**theoretical capacity.** Number of persons that can be carried theoretically by the escalator or passenger conveyor in 1 h.

NOTE. For the determination of the theoretical capacity it is assumed that on one step with an average depth of 0,4 m, and per 0,4 m visible length of a pallet or belt, there are carried:

- 1 person at a nominal width  $z_1 = 0,6$  m
- 1,5 persons at a nominal width  $z_1 = 0,8$  m
- 2 persons at a nominal width  $z_1 = 1,0$  m.

The theoretical capacity calculation is then:

$$c_t = \frac{v}{0,4} \times 3600 \times k$$

$c_t$  = theoretical capacity (pers/h)

$v$  = rated speed (m/s)

For the most common widths there will be

$$\text{factor } \begin{cases} k = 1 & \text{for } z_1 = 0,6 \text{ m} \\ k = 1,5 & \text{for } z_1 = 0,8 \text{ m} \\ k = 2 & \text{for } z_1 = 1,0 \text{ m} \end{cases}$$

With this formula the theoretical capacity will be:

Nominal width m	Rated speed m/s		
	0,5	0,65	0,75
0,6	4 500 pers/h	5 850 pers/h	6 750 pers/h
0,8	6 750 pers/h	8 775 pers/h	10 125 pers/h
1,0	9 000 pers/h	11 700 pers/h	13 500 pers/h

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## 4 Symbols

### 4.1 Units

The units used are chosen from the International System of units (SI).

### 4.2 Symbols

Clause	Measurements (in the order they appear in the document)	Symbol	Unit
3	theoretical capacity	$c_t$	pers/h
3	rated speed	$v$	m/s
3	factor for different step width	$k$	—
5.1.5.6	vertical distance between top edge of skirting or bottom edge of cover joints and the tread surface of the steps, pallets or belt	$h_2$	mm
5.1.5.7	angle of inclination between the interior profile and the balustrade interior panelling	$\gamma$	degree
5.1.5.7.1	horizontal part of the interior profile that directly joins the balustrade interior panelling	$b_4$	mm
5.1.5.9	newel including the handrail in longitudinal direction measured from the combs	$l_2$	m
5.2.2	root of the comb teeth	$L_1$	—
5.2.3	free height above the steps, pallets or belt	$h_4$	m
5.2.4	vertical obstruction	$h_5$	m
5.2.4	distance between the centreline of the handrail and an obstacle	$b_9$	m
5.3 and 8.1.3	nominal width for the load carrying area (step pallet or belt)	$z_1$	m
5.3	distance between supports	$l_1$	m
7.2	horizontal portion of the handrail in the direction of landing measured from the root of the comb teeth	$l_3$	m
7.3.1	distance between the handrail profile and guide or cover profiles	$b_6$	mm
7.3.2	width of the handrail	$b_2$	mm
7.3.3	distance between the handrail and the edge of the balustrade	$b_5$	mm
7.4	distance between the handrail centrelines	$b_1$	m
7.4	distance between skirting	$z_2$	m
7.5.1	distance between the entry of handrail into the newel and the floor	$h_3$	m
7.5.2	horizontal distance between the furthest point reached by the handrail and the point of entry into the newel	$l_4$	m
7.6	vertical distance between the handrail and step nose or pallet surface or belt surface	$h_1$	m
8.1.1	step height	$x_1$	m
8.1.2	step depth	$y_1$	m
8.2.3.2 and 8.2.4.2	width of the grooves	$b_7$	mm
8.2.3.3 and 8.2.4.3	depth of the grooves	$h_7$	mm
8.2.3.4 and 8.2.4.4	web width	$b_8$	mm
8.2.4.6.1.1	transverse distance between the supporting rollers	$z_3$	mm
8.3.2.3	design angle of the teeth of the comb	$\beta$	degree
10.1.1	angle of inclination of the escalator or passenger conveyor	$\alpha$	degree
11.3.1 and 11.4.1	mesh depth of the comb into the grooves of the tread	$h_8$	mm
11.3.2 and 11.4.2	clearance between the upper edge of the tread surface and the root of the comb teeth	$h_6$	mm
14.2.1.1	comb intersection line	$L_2$	—

## 5 Enclosure, surrounds, supporting structure and lighting

### 5.1 Enclosure of the escalator and passenger conveyor

#### 5.1.1 General

**5.1.1.1** All mechanically moved parts of the escalator or passenger conveyor 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.

**5.1.1.2** 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, and if this omission is not contrary to other regulations.

**5.1.1.3** If the underside of the escalator or passenger conveyor is enclosed it should be possible to clean it in order to prevent accumulation of dirt. If such cleaning is not possible, other precautions shall be taken to avoid the related fire hazard arising.

**5.1.2** The enclosure shall have adequate mechanical strength and rigidity.

#### 5.1.3 Inspection doors and trap doors

**5.1.3.1** Inspection doors and trap doors shall be provided only where necessary for the inspection and maintenance of the equipment.

**5.1.3.2** It shall be possible to open inspection doors and trap doors by means only of a key or a tool specially suited for that purpose, which shall be in the hands of authorized persons only.

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

**5.1.3.3** Inspection doors or trap doors which open on to adjacent escalator or passenger conveyor treadways shall be provided with safety contacts which prevent adjacent escalators or passenger conveyors from being operated when these doors are opened.

**5.1.3.4** Inspection doors and trap doors shall be imperforate and conform to the same conditions as required for the enclosure material (see 5.1.2).

#### 5.1.4 Apertures for ventilation

It shall not be possible to touch any moving part through a ventilation aperture.

#### 5.1.5 Balustrades (see figure 2)

**5.1.5.1** Balustrades shall be installed on each side of the escalator or passenger conveyor.

The balustrade consists of components for which the following terms are usual:

##### 5.1.5.1.1 Skirting (A)

Portion of the enclosure adjacent to the outer edges of the steps, pallets or belt.

##### 5.1.5.1.2 Interior profile (B)

This profile connects the skirting with the balustrade interior panelling.

##### 5.1.5.1.3 Balustrade interior panelling (C)

Interior panels between the skirting or the interior profile and the balustrade decking underneath the handrail.

##### 5.1.5.1.4 Balustrade decking (E)

This decking is situated underneath the handrail and forms the top cover of the balustrade panelling.

##### 5.1.5.1.5 Balustrade exterior panelling (D)

Exterior panelling which from the balustrade deckings encloses the escalator or passenger conveyor.

##### 5.1.5.1.6 Newel.

End of the balustrade on the landings, where the handrails change their direction of movement.

**5.1.5.2** 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.

**5.1.5.3** With a vertical force of 900 N distributed over the surface of the handrail for a length of 0,5 m there shall be no permanent deformation, no breakage or displacement of any balustrade parts.

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

Cover joints in the direction of travel (in particular between the skirting and the balustrade interior panelling) shall be arranged and formed in such a manner that the risk of trapping is reduced to a minimum.

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

The balustrade interior panelling shall have adequate mechanical strength and rigidity. When a force of 500 N is applied to the balustrade interior panelling on any point of the panelling at right angles on an area of 25 cm<sup>2</sup>, there shall be no gap greater than 4 mm and no permanent deformation (setting tolerances are permitted).

The use of glass for the balustrade interior panelling is permitted provided it is splinter-free one-layer safety glass (tempered glass) and has sufficient mechanical strength and rigidity. The thickness of the glass shall be not less than 6 mm.

**5.1.5.5** Protrusions and indentations shall not present sharp edges.

**5.1.5.6** The skirting shall be vertical. The vertical distance  $h_2$  between top edge of skirting or bottom edge of projecting cover joints and the tread surface of the steps, pallets or belt shall be at least 25 mm (see figure 2).

**5.1.5.6.1** The skirting shall be extremely rigid, plane, smooth and butt-jointed. However, special arrangements instead of butt-jointing will possibly be necessary for long passenger conveyors at the points where they pass over building expansion joints.

**5.1.5.6.2** The skirting shall yield not more than 4 mm under a single force of 1500 N acting at the most unfavourable point at right angles to the surface over an area of 25 cm<sup>2</sup>. No permanent deformation shall result from this.

**5.1.5.6.3** On escalators, the possibility of trapping between skirting and steps shall be reduced, e.g. by appropriate

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design, the use of suitable materials or suitable type of lining for the skirting.

**5.1.5.7** The interior profile and the balustrade interior panelling shall have an angle of inclination  $\gamma$  of at least  $25^\circ$  to the horizontal (see figure 2).

**5.1.5.7.1** This provision does not apply to the horizontal part of the interior profile that directly joins the balustrade interior panelling (see  $b_4$  in figure 2).

This horizontal part  $b_4$  up to the balustrade interior panelling shall be less than 30 mm.

**5.1.5.7.2** The width  $b_3$ , measured horizontally, of each interior profile inclined at an angle of less than  $45^\circ$  to the horizontal shall be less than 0,12 m (see figure 2).

**5.1.5.8** The horizontal distance (measured at right angles to the direction of travel) between the balustrade interior panelling at lower points shall always be equal to or less than the horizontal distance measured at points higher up. The maximum distance between the balustrade interior panelling at any point shall be smaller than the distance between handrails.

**5.1.5.9** The newel including the handrails shall project beyond the root of the comb teeth by at least 0,6 m in longitudinal direction (see  $L_1$  and  $I_2$  in figure 1 and detail X).

## 5.2 Surrounds of the escalator and passenger conveyor

**5.2.1** At the landings of the escalator and passenger conveyor a sufficient unrestricted area shall be available to accommodate passengers. The width of the unrestricted area shall at least correspond to the distance between the handrail centrelines (see  $b_1$  in figure 2). The depth shall be at least 2,50 m measured from the end of the balustrade. It is 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 handrail centrelines. Attention is drawn to the fact that this free area has to be considered as part of the whole traffic function and, thus, needs sometimes to be increased.

In the case of successive escalators and passenger conveyors without intermediate exits, they shall have the same theoretical capacity (see 14.2.2.4.1(j)).

**5.2.2** The landing area of escalators and passenger conveyors shall have a surface that provides a secure foothold<sup>2)</sup> for a minimum distance of 0,85 m measured from the root of the comb teeth (see  $L_1$  in figure 1 and detail X). Exempt from this are the combs mentioned in 8.3.

**5.2.3** The clear height above the steps of the escalator or pallets or belt of the passenger conveyor at all points shall be not less than 2,10 m (see  $h_4$  in figure 1); ~~(competent authority can permit exceptions).~~ *72.153*

**5.2.4** Where building obstacles can cause injuries, appropriate preventive measures shall be taken. In particular, at floor intersections and on criss-cross escalators or passenger conveyors, a vertical obstruction of not less than 0,30 m in height, not presenting any sharp cutting edges shall be placed above the balustrade decking, e.g. as an imperforate triangle (see  $h_5$  in figure 1).

It is not necessary to comply with these requirements when the distance  $b_9$  between the centreline of the handrail and any obstacle is equal to or greater than 0,50 m (see figure 2).

## 5.3 Supporting structure of the escalator or passenger conveyor

The supporting structure shall be designed in a way that it can support the dead weight of the escalator or passenger conveyor plus a passenger weight of 5000 N/m<sup>2</sup> [load carrying area = nominal width  $z_1$  (figure 2) of the escalator or passenger conveyor  $\times$  distance between supports  $I_1$  (figure 1)]. An impact factor shall not be added to the passenger load.

Based on passenger weight, the maximum calculated or measured deflection shall not exceed 1/750 of the distance between supports  $I_1$ .

### For public service escalators and public service passenger conveyors

Based on passenger load, the maximum calculated or measured deflection shall not exceed 1/1000 of the distance between supports  $I_1$ .

## 5.4 Lighting

**5.4.1** The escalator or passenger conveyor and its surrounds shall be sufficiently and adequately illuminated, especially in the vicinity of the combs.

**5.4.2** It is permissible to arrange the lighting in the surrounding space 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.

On indoor escalators or passenger conveyors the intensity of illumination shall be not less than 50 lx at the landings; on outdoor escalators or passenger conveyors it shall be not less than 15 lx at the landings, measured at floor level, ~~provided national regulations do not impose other values.~~

## 6 Machinery spaces

### 6.1 General

Driving and return stations, machinery spaces inside the truss, as well as separate machinery spaces, shall be not accessible to unauthorized persons.

These rooms shall be used only for accommodating the equipment necessary for the operation of the escalator or passenger conveyor.

Fire alarm systems, equipment for direct fire abatement and sprinkler heads, provided they are sufficiently protected against incidental damage, are permitted in these rooms. Lift driving equipment is also permitted in these rooms.

### 6.2 Accessibility *Access to machinery spaces shall comply with*

~~6.2.1 Ways and access routes to machinery spaces shall be easy and safe.~~ *NZBC D1*

The clear height of the access shall be at least 1,80 m, provided national regulations do not impose a higher value.

**6.2.2** It is preferable that authorized personnel obtain access to inspection doors and trap doors, separate machinery spaces, separate driving and return stations by means of stairs only. Where stairs are difficult to install, it is permitted to use ladders that satisfy the following conditions provided this is not contrary to national regulations:

~~(a) they shall be not liable to slip or to turn over;~~

<sup>2)</sup> 'secure foothold' equals 'trittsicher' in German and 'surface de foulée antidérapante' in French.



- ~~(b) they shall, when in position of use, form an angle of  $70^\circ$  to  $76^\circ$  to the horizontal, unless they are fixed and their height is less than 1,50 m;~~
- (c) they shall be exclusively used for this purpose and be kept always available in the vicinity; the necessary provisions shall be made for that purpose;
- (d) at the upper part of the ladder there shall be one or more handhold(s) within easy reach;
- (e) ~~when the ladders are not fastened, fixed attachment points shall be provided.~~

### 6.3 Construction and equipment of machinery spaces, driving and return stations

#### 6.3.1 General

**6.3.1.1** In machinery spaces and return stations, space with a sufficiently large standing area shall be kept free from fixed 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 m long.

**6.3.1.2** Where the maindrive or brake is arranged between the passenger side of the step, pallet or belt and the return line, a suitable sensibly horizontal 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 m.

This part is permitted to be fixed or removable. In the latter case, it shall always be available in the vicinity. Necessary provisions shall be made for this purpose.

**6.3.1.3** The size of separate machinery spaces, separate driving and return stations, and the space in front of fixed control panels shall be sufficient to permit easy and safe access for maintenance personnel to all the equipment, especially to the electrical connections.

~~Provided this is not contrary to national regulations,~~  
in particular there shall be provided:

- (a) a free space across the full width (but not less than 0,50 m) of the control panels or cabinets and 0,70 m in depth to give access to the equipment they support or contain;
- (b) a free space of at least  $0,50 \text{ m} \times 0,60 \text{ m}$  for maintenance and inspection of moving parts at points where this is necessary;
- (c) access routes, having a width of at least 0,50 m, to these free spaces.

*Specific case:* It is permitted to reduce the width of 0,50 m to 0,40 m in areas where there are no moving parts.

**6.3.1.4** In separate machinery spaces, and separate driving and return stations, and in front of fixed control panels, the clear height for movement or working shall under no circumstances be less than 1,80 m ~~provided national regulations do not impose a higher value.~~

#### 6.3.2 Lighting

Electric lighting installation in separate machinery spaces, or separate driving and return stations, shall be permanent and fixed. Electric lighting installation in driving and return stations and machine rooms 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 electric lighting installation 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 passenger conveyor (see 13.4.1 and 13.6).

#### 6.3.3 Stop switch

It shall be possible to switch off the escalator and passenger conveyor in the driving and return station.

Escalators and passenger conveyors with the driving unit arranged between the passenger side of the step, pallet or belt and the return line, or outside the return stations, shall have additional stop switches in the area of the driving unit.

The operation of these stop switches shall cause the disconnection of the power supply from the driving machine and allow the operational brake to become effective to stop the escalator or passenger conveyor.

The stop switches shall:

- (a) be of a manually opened and closed type;
- (b) have the switching positions marked unambiguously and permanently;
- (c) be safety contacts satisfying 14.1.2.2.

*Specific case:* A stop switch need not be provided in a machinery space if a main switch according to 13.4 is located therein.

### 7 Handrail (see figures 1 and 2)

#### 7.1 General

On the top of each balustrade there shall be provided a handrail moving in the same direction and at approximately the same speed as the steps, pallets or belt.

The speed of the handrail is permitted to deviate from the speed of the steps, pallets or belt within the limits of 0 % to + 2 %.

#### 7.2 Continuation of the handrail beyond the comb

The horizontal portion of the handrail shall continue longitudinally at the landings for a distance  $l_3$  (see figure 1) of at least 0,30 m past the root of the comb teeth (see  $L_1$  in figure 1 and detail X).

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

#### 7.3 Profile and position

**7.3.1** 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 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 2, detail W).

The horizontal distance  $b_{10}$  (see figure 2) between the outer edge of the handrail and walls or other obstacles shall under no circumstances be less than 80 mm. This distance shall be maintained to a height of at least 2,10 m above the steps of the escalator and above the pallets or the belt of the passenger conveyor. ~~This height is permitted to be smaller if by appropriate measures the risk of injury is avoided.~~

**7.3.2** The width  $b_2$  of the handrail shall be between 70 mm and 100 mm (see figure 2, detail W).

**7.3.3** The distance  $b_5$  between the handrail and the edge of the balustrade shall not exceed 50 mm (see figure 2).

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**7.4 Distance between the handrail centrelines**

The distance  $b_1$  between the centreline 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 2).

**7.5 Protection at the point of entry into the balustrade**

**7.5.1** The lowest point of entry of the handrail into the newel shall be at a distance  $h_3$  from the floor which shall be not less than 0,10 m and not exceed 0,25 m (see figures 1 and 2).

**7.5.2** 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 1).

**7.5.3** At the point of entry of the handrail into the newel a guard shall be installed to prevent the pinching of fingers and hands.

A switch according to 14.2.2.4.1(k) shall be provided.

**7.6 Height above the steps, pallets and the belt**

The vertical distance  $h_1$  between the handrail and step nose or pallet surface or belt surface shall be not less than 0,90 m and not exceed 1,10 m (see figures 1 and 2).

**7.7 Guiding**

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

**7.8 For public service escalators and public service passenger conveyors****Control device for handrail breakage**

If the handrail is not certified by its manufacturer for a breaking load of at least 25 kN a device shall cause the escalator or passenger conveyor to stop if the handrail breaks (see 14.2.2.4.1(m)).

**8 Steps, pallets, belt and combs****8.1 Dimensions (see figure 3)**

**8.1.1** The step height  $x_1$  shall not exceed 0,24 m.

~~If escalators are permitted to be used as emergency exit when out of service, the step height shall not exceed 0,21 m.~~

**8.1.2** The step depth  $y_1$  shall not be less than 0,38 m.

**8.1.3** For escalators and passenger conveyors the nominal width  $z_1$  shall be not less than 0,58 m and not exceed 1,10 m.

For passenger conveyors with an angle of inclination up to and including 6° larger widths are permitted.

**8.2 Construction of the steps, pallets and the belt (see figure 1, detail X and figure 3)**

**8.2.1** The steps, pallets and the belt shall match the operational conditions. They shall be able to support continuously an equally distributed load corresponding to 6000 N/m<sup>2</sup> without such deformation that would prejudice the proper functioning of the escalator or passenger conveyor.

To establish the dimensions of the belt, an area of effective width  $\times$  1,0 m length shall be taken as a basis for this specific load (in addition the requirements of 8.2.4.6.1 shall be complied with).

**8.2.2** The steps and pallets shall have been type-tested by an authorized testing authority.

The following tests are necessary for getting the certificate:

**8.2.2.1 Static test****8.2.2.1.1 Steps**

The step shall be tested for deflection with a single force of 3000 N (including weight of the plate) applied perpendicular to the tread surface on a steel plate 0,20 m  $\times$  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 (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 is to be certified.

For all inclinations smaller than the maximum inclination certified, 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.

**8.2.2.1.2 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 7500 N (including weight of the plate). The force shall be applied perpendicular to the tread surface of a steel plate 0,30 m  $\times$  0,45 m in size and at least 25 mm thick, in the centre of the tread surface, and the edge of the plate being 0,45 m long shall be arranged parallel to the lateral edge of the pallet.

For pallets with smaller or larger areas, the force and the loading area shall be changed proportionally, whereby for the loading area the ratio of edge length shall be 1:1,5; however, the force shall be not below 3000 N (including weight of the plate), the size of the plate be not smaller than 0,20 m  $\times$  0,30 m and its thickness be not less than 25 mm.

During this test the deflection measured at the tread surface shall be not more than 4 mm. There shall be no permanent deformation (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 passenger conveyor, is not required.

**8.2.2.2 Dynamic test****8.2.2.2.1 Steps**

The step shall be tested at the maximum inclination (inclined support) for which the step is to be certified, together with rollers (not rotating), axles or stub shafts (if existing). It shall be subjected to a load pulsating between 500 N and 3000 N at a frequency between approximately 5 Hz and 20 Hz for at least  $5 \times 10^6$  cycles whereby an undisturbed harmonic force flow shall be achieved. The load shall be applied perpendicular to the tread surface on a steel plate 0,20 m  $\times$  0,30 m in size and at least 25 mm thick, arranged as specified in 8.2.2.1.1, in the centre of the tread surface.



After the test the step shall show neither fracture nor permanent deformation greater than 4 mm, measured at the tread surface.

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

#### 8.2.2.2.2 Pallets

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 3000 N at a frequency between approximately 5 Hz and 20 Hz for at least  $5 \times 10^6$  cycles whereby an undisturbed harmonic 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, in the centre of the tread surface.

After the test, the pallet shall show neither fracture nor permanent deformation greater than 4 mm, measured at the tread surface.

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

#### 8.2.3 Step treads and pallets (see figure 1, detail X)

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

The step treads of the escalator shall be sensibly horizontal in the usable area of the escalator.

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

**8.2.3.3** The depth  $h_7$  of the grooves shall be not less than 10 mm.

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

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

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

#### 8.2.4 Belts (see figure 1, detail X)

**8.2.4.1** The belts shall have grooves in the direction of movement with which the teeth of the combs mesh.

**8.2.4.2** 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.

**8.2.4.3** The depth  $h_7$  of the grooves shall be not less than 5 mm.

**8.2.4.4** 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.

**8.2.4.5** 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.

#### 8.2.4.6 Belt passenger conveyors with edge supported belt

**8.2.4.6.1** Where the treadway belt is transversely rigid and is supported by rollers along its edges only, the following requirements shall apply:

**8.2.4.6.1.1** 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 0,02 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  $0,01z_3$  where  $z_3$  is the transverse distance between the supporting rollers (see  $z_3$  in figure 5).

**8.2.4.6.1.2** Additional treadway supports shall be provided at intervals not exceeding 2 m along the centreline 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 **8.2.4.6.1.1**.

#### 8.2.5 Step risers

The step risers shall be sufficiently rigid and breakage-resistant.

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

#### 8.3 Combs

##### 8.3.1 General

Combs shall be fitted at both landings to facilitate the transition of passengers.

##### 8.3.2 Construction

**8.3.2.1** The teeth of the combs shall mesh with the grooves of the steps, pallets or belt (see **11.3** and **11.4**). The width of the comb teeth shall be not less than 2,5 mm, measured at the tread surface.

**8.3.2.2** 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.

**8.3.2.3** The teeth of the comb shall have a form and inclination so that the feet of passengers, leaving the escalator or passenger conveyor, will not stub against them. The design angle  $\beta$  shown in figure 1, detail X shall not exceed  $40^\circ$ .

**8.3.2.4** The combs or their supporting structure shall be readjustable, to ensure correct meshing.

The combs shall be easily replaceable.

**8.3.2.5** On escalators and pallet passenger conveyors the combs shall be rigid and have such a design that upon trapping of foreign bodies either their teeth deflect and remain in mesh with the grooves of the steps or pallets, or they break.

On belt passenger conveyors the combs shall be rigid. Upon trapping of foreign bodies the belt webs are permitted to deflect, however, the comb teeth shall remain in mesh with the grooves.

**8.3.2.6** In the case of objects being trapped which are not dealt with by the means described in **8.3.2.5** and that give rise to risk of damaging the steps, pallets, belt or comb supporting structure, the escalator or passenger conveyor shall be stopped (see **14.2.2.4.1(i)**).

## 9 Drive for steps, pallets or belt

### 9.1 Chain drive for the steps and pallets

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

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

**9.1.2** The factor of safety of each chain shall be at least 5.

This factor is determined as the ratio between the breaking strength of the chain and the static force to which the chain is subjected when the escalator or passenger conveyor carries the passenger weight according to 5.3 together with the tension force of the tensioning device.

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

**9.1.3** The chains shall be tensioned continuously and automatically. Tension springs as tensioning device are not permitted. When weights are used for tensioning they shall be safely caught should their suspension break.

### 9.2 Drum drive for the belt

**9.2.1** The factor of safety of the belt including splicing shall be at least 5.

This factor is determined as the ratio between the breaking strength of the belt and the static force to which the belt is subjected when the passenger conveyor carries the passenger weight according to 5.3 together with the tension force of the tensioning device.

**9.2.2** The belt shall be driven by drums and be tensioned continuously and automatically. Tension springs as tensioning device are not permitted. When weights are used for tensioning they shall be safely caught should their suspension break.

### ~~9.3 Other methods of driving steps, pallets or belt~~

~~Other methods of driving are permitted if safety and operation are at least equal to those required in 9.1 and 9.2.~~

## 10 Angle of inclination of the escalator and passenger conveyor and guiding of the steps, pallets and belt

### 10.1 Angle of inclination and position of the steps

**10.1.1** The angle of inclination  $\alpha$  of the escalator shall not exceed  $30^\circ$ , but for rises not exceeding 6 m and a rated speed not exceeding 0,50 m/s the angle of inclination is permitted to be increased to a maximum of  $35^\circ$  (see  $\alpha$  in figure 1).

The angle of inclination of passenger conveyors shall not exceed  $12^\circ$ .

**10.1.2** The steps treads shall be sensibly horizontal in the usable area of the escalator.

**10.1.3** At the landings, 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 1 and detail X). A vertical difference in level between two consecutive steps of 4 mm maximum is permitted.

At rated speeds above 0,50 m/s or rises above 6 m this length shall be at least 1,20 m, measured from point  $L_1$  (see figure 1 and detail X).

### For public service escalators

At rated speeds above 0,65 m/s, it is permitted to increase this minimum length to 1,60 m, measured from point  $L_1$  (see figure 1 and detail X).

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

at least 1,00 m for rated speeds  $v \leq 0,5$  m/s

at least 1,50 m for rated speeds  $v > 0,5$  m/s

The radius of curvature in the lower transition from incline to horizontal of the escalator shall be at least 1,00 m irrespective of the rated speed.

### For public service escalators

At rated speeds above 0,65 m/s it is permitted to increase the minimum radius of curvature in the upper transition from incline to horizontal of the escalator to 2,60 m and in the lower transition from incline to horizontal of the escalator to 2,00 m.

**10.1.5** For belt passenger conveyors, the radius of curvature in the transition from incline to horizontal shall be at least 0,40 m.

For pallet passenger conveyors, it is not necessary to determine the radius of curvature because on account of the maximum permissible distance between two consecutive pallets (see 11.1) it will always be sufficiently large.

**10.1.6** At the upper landings of passenger conveyors with an inclination of more than  $6^\circ$ , the pallets or belt shall move horizontally for a length of at least 0,40 m before entering the comb.

## 10.2 Guiding of steps and pallets and belt

**10.2.1** Provisions shall be made to limit the displacement of the steps or pallets out of their guiding system should a driving device (according to clause 9) become defective, and to prevent the belt from leaving its guideway should the belt break.

This requirement applies only to the usable area of the escalator or passenger conveyor.

**10.2.2** Provisions shall be made in the area of the combs to ensure the correct meshing of the comb teeth with the grooves of the tread surface.

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

## 11 Clearance between steps or pallets and between steps or pallets or belt and skirting

### 11.1 Clearance between steps or pallets

The clearance between two consecutive steps (see also 8.2.5) or pallets in any usable position measured at the tread surface shall not exceed 6 mm (see figure 1, detail Y, Z and figure 4 except detail V).

In the area of the transition curves of passenger conveyors with meshed front edges and rear edges of the pallets, this clearance is permitted to be increased to 8 mm (see figure 4, detail V).

### 11.2 Clearance between steps or pallets or belt and skirting

**11.2.1** Where the skirting of escalators or passenger conveyors 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.

**11.2.2** Where the skirting of passenger conveyors finishes above the pallets or the belt, the clearance shall not exceed 4 mm measured vertically from the tread surface. Oscillating 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.

### 11.3 Mesh depth of the combs into the grooves of the step or pallet tread

**11.3.1** The mesh depth  $h_8$  of the combs into the grooves of the tread (see figure 1, detail X) shall be at least 6 mm.

**11.3.2** The clearance  $h_6$  (see figure 1, detail X) shall not exceed 4 mm.

### 11.4 Mesh depth of the combs into the grooves of the belt

**11.4.1** The mesh depth  $h_8$  of the combs into the grooves of the belt (see figure 1, detail X) shall be at least 4 mm.

**11.4.2** The clearance  $h_6$  (see figure 1, detail X) shall not exceed 4 mm.

## 12 Machine

### 12.1 General

Each escalator and each passenger conveyor shall be driven by at least one machine of its own.

### 12.2 Speed

**12.2.1** The rated speed of the escalator shall not exceed:

0,75 m/s for an escalator with an angle of inclination  $\alpha$  up to  $30^\circ$  inclusive;

0,50 m/s for an escalator with an angle of inclination  $\alpha$  greater than  $30^\circ$  but not greater than  $35^\circ$ .

**12.2.2** The rated speed of passenger conveyors shall not exceed 0,75 m/s.

**12.2.2.1** Contrary to 12.2.2, passenger conveyors are permitted to have a rated speed of 0,90 m/s maximum provided the width of the pallets or the belt does not exceed 1,10 m, and contrary to 10.1.6 at the landings, the pallets or the belt move horizontally for a length of at least 1,60 m before entering the combs.

**12.2.2.2** Paragraphs 12.2.2 and 12.2.2.1 do not apply to passenger conveyors with acceleration paths or passenger conveyor systems with direct transition to passenger conveyors travelling at different speeds.

**12.2.3** At rated frequency and at rated voltage, the speed measured under no load in the direction of movement of the steps and pallets or the belt is permitted to deviate from the rated speed by a maximum of  $\pm 5\%$ .

### 12.3 Link between operational brake and step, pallet or belt drive according to clause 9

**12.3.1** 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 12.6 shall be used.

**12.3.2** All driving elements shall be sufficiently dimensioned. In accordance with 9.1.2 and 9.2.1 the factor of safety for chains, belts and trapezoidal belts shall be at least 5 whereby in the case of trapezoidal belts at least 3 belts shall be applied.

## 12.4 Braking system

**12.4.1** Escalators and passenger conveyors shall have a braking system by means of which they can be brought to rest with a largely uniform deceleration and maintained stationary (operational braking); see also 14.1.2.1.6 and 14.1.2.4. There shall be no intentional delay in the application of the braking system.

**12.4.1.1** The braking system 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.

**12.4.1.2** Operational braking is permitted to be effected by an electro-mechanical brake or by other means.

Where no electro-mechanical operational brake is used, an auxiliary brake in accordance with 12.6 shall be provided.

### 12.4.2 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) or by weight(s). Self-excitation of the brake releasing device shall be impossible.

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

### 12.4.4 Brake load and stopping distances for operational brake

#### 12.4.4.1 Determination of brake load for escalators

Per step and at a nominal width  $z_1$  of

up to 0,6 m	60 kg
more than 0,6 m up to 0,8 m	90 kg
more than 0,8 m up to 1,1 m	120 kg

shall be applied.

The number of steps to be considered is determined by 'rise divided by maximal visible height of the step riser' (see  $x_1$  in figure 3).

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.

#### 12.4.4.2 Stopping distances of the escalator

The stopping distances for unloaded and downward moving loaded escalators (see 12.4.4.1) shall be between the following values:

Rated speed	Stopping distance between
0,50 m/s	min. 0,20 m and max. 1,00 m
0,65 m/s	min. 0,30 m and max. 1,30 m
0,75 m/s	min. 0,35 m and max. 1,50 m

For intermediate speeds the stopping distances are to be interpolated.

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

#### 12.4.4.3 Determination of the brake load for designing the brake for passenger conveyors

Per 0,4 m length and at a nominal width  $z_1$  of the pallets or the belt of

up to 0,6 m	50 kg
more than 0,6 m up to 0,8 m	75 kg
more than 0,8 m up to 1,1 m	100 kg

shall be applied.



In the case where passenger conveyors with an angle of inclination of up to and including  $6^\circ$  have larger nominal widths than 1,1 m another 25 kg per 0,4 m length shall be applied for each additional 0,3 m width.

To determine the brake load for passenger conveyors which in their length overcome several inclinations (differences in level), only those horizontal and inclined sections which taken together give the most unfavourable load, shall be considered.

#### **12.4.4.4 Stopping distances for passenger conveyors**

The stopping distances for unloaded and loaded passenger conveyors (see 12.4.4.3) shall be between the following values:

Rated speed	Stopping distance between
0,50 m/s	min. 0,20 m and max. 1,00 m
0,65 m/s	min. 0,30 m and max. 1,30 m
0,75 m/s	min. 0,35 m and max. 1,50 m
0,90 m/s	min. 0,40 m and max. 1,70 m

For intermediate speeds the stopping distances are to be interpolated.

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

For passenger conveyors a brake test under no load will be sufficient.

For loaded passenger conveyors, the manufacturer shall prove the stopping distances by calculation (see 16.2.1.1(c)).

### **12.5 Protection against risks of overspeed and unintentional reversal of the direction of travel**

**12.5.1** Escalators and passenger conveyors shall be equipped in such a way that they stop automatically before the speed exceeds a value of 1,2 times the rated speed (see 14.2.2.4.1(e)). Where speed control devices are used for this purpose they shall have switched off the escalator or passenger conveyor before the speed exceeds a value of 1,2 times the rated speed.

It is permissible to disregard this requirement in the case of a.c. motors with a non-friction connection with the drive for the steps, pallets or the belt and with a slip not exceeding 10 % if thereby overspeed is prevented.

**12.5.2** Escalators and inclined passenger conveyors shall be equipped in such a way that they stop automatically by the time the steps and pallets or the belt change from the preset direction of travel (see 14.2.2.4.1(e)).

### **12.6 Auxiliary brake for the non-friction part of the driving system for steps and pallets or the belt**

**12.6.1** Escalators and inclined passenger conveyors shall be equipped with auxiliary brake(s) acting immediately on the non-friction part of the driving system for the steps, pallets or the belt (one single chain is not considered to be a non-friction part), if

- (a) the coupling of the operational brake (see 12.4) and the driving wheels of the steps, pallets or the belt is not accomplished by shafts, gear wheels, multiplex chains, two or more single chains;
- or
- (b) the operational brake is not an electro-mechanical brake according to 12.4.2;
- or
- (c) the rise exceeds 6 m.

### **For public service escalators and public service passenger conveyors**

It is permissible to instal auxiliary brakes also for rises below 6 m.

**12.6.2** The auxiliary brake shall be dimensioned in such a way that escalators and passenger conveyors travelling with brake load downward are brought to rest by effective retardation and maintained stationary.

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

**12.6.4** The auxiliary brake shall become effective in either of the following conditions:

- (a) before the speed exceeds a value of 1,4 times the rated speed;
- (b) by the time the steps and pallets or the belt change from the preset direction of motion.

Its operation shall positively open the control circuit. It is not necessary that this device is operated electrically such as is the operational brake mentioned in 12.4.2.

**12.6.5** Auxiliary brakes 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 distances according to 12.4.4.2 and 12.4.4.4 are kept; otherwise a simultaneous operation of the two brakes is only permitted under the conditions of 12.6.4.

**12.6.6** Upon operation of the auxiliary brake it is not necessary to keep the stopping distances defined for the operational brake (see 12.4.4).

### **12.7 Hand winding device**

If a hand winding device is provided it shall be easily accessible and safe to operate (see 15.1.3).

If the hand winding device is placed outside machinery spaces, driving and return stations it shall not be accessible to unauthorized persons.

Crank handles or perforate hand wheels are not permitted.

### **12.8 Protection in driving stations and/or return stations**

Effective protection shall be provided for rotating parts if they are accessible and dangerous, in particular for

- (a) keys and screws in shafts;
- (b) tapes, 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 must be entered for maintenance purposes.

*Exceptional cases:* Handwheels, brake drums and similar smooth round parts.

## **13 Electrical installations and appliances**

### **13.1 General provisions**

#### **13.1.1 Limits of application**

**13.1.1.1** The requirements of this standard relating to the installation and to the constituent components of the electrical equipment apply:

- (a) to the main switch of the power circuit of the escalator or passenger conveyor and dependent circuits;
- (b) to the switch for the lighting circuit of the escalator or passenger conveyor and dependent circuits.

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

**13.1.1.2** The national regulations relating to electricity supply circuits cease at the input terminals of the switches referred to in **13.1.1.1**. They apply to the whole lighting circuit of the machinery spaces, driving and return stations.

**13.1.1.3** If the present standard contains no special provisions for the components of the electrical equipment of escalators or passenger conveyors, those of Council Directive 73/23/EEC (on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits) apply to them.

**13.1.1.4** The electrical installation of escalators or passenger conveyors shall

- (a) comply with the requirements stated in the CENELEC harmonized documents accepted by the national electro-technical committees of the EEC Member States;
- (b) where no harmonized documents on the installation of electrical appliances as referred to in (a) exist, comply with the requirements of the national rules of the country in which the escalator or passenger conveyor is installed.

**13.1.2** In separate machinery spaces and separate driving and return stations (according to **6.3.1.3**) protection against direct contact by means of enclosures providing a degree of protection of at least IP 1X is necessary.

**13.1.3** The resistance of the insulation between conductors and between conductors and earth shall be greater than  $1000 \Omega/V$  with a minimum of<sup>3)</sup>

- (a)  $500\,000 \Omega$  for power circuits and electrical safety device circuits;
- (b)  $250\,000 \Omega$  for other circuits (controls, lighting, signalling, etc.).

**13.1.4** For control and safety circuits, the mean 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.

**13.1.5** The neutral conductor and the earth-continuity conductor shall always be separate.

## **13.2 Contactors, relay contactors, components of electrical safety circuits**

### **13.2.1 Contactors and relay contactors**

**13.2.1.1** To stop the machine (see **14.1.2.4**) the main contactors shall belong to the following categories as defined in the IEC publication 158-1:

- (a) AC-3 for contactors of a.c. motors;
- (b) DC-2 for contactors of d.c. machines.

**13.2.1.2** Relay contactors (see **14.1.2.4**) shall belong to the following categories as defined in the IEC publication 337-1:

- (a) AC-11 for contactors in a.c. control circuits;
- (b) DC-11 for contactors in d.c. control circuits.

**13.2.1.3** For both, the main contactors (see **13.2.1.1**) and the relay contactors (see **13.2.1.2**) it is permissible to assume in the measures taken to comply with **14.1.1.1** that:

- (a) if one of the break contacts (normally closed) is closed, all the make contacts are open;
- (b) if one of the make contacts (normally open) is closed, all the break contacts are open.

### **13.2.2 Components of electrical safety circuits**

**13.2.2.1** When devices according to **13.2.1.2** are used as relays in a safety circuit, the assumptions of **13.2.1.3** also apply.

**13.2.2.2** 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 **14.1.1.1(f)**).

**13.2.2.3** Devices connected after electrical safety devices shall meet the requirements of **14.1.2.2.2** 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 **13.2.1.1**, **13.2.1.2** and **13.2.1.3**.

## **13.3 Protection of motors**

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

**13.3.2** 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 **13.3.3**) which shall cut off the supply to the motor in all live conductors.

**13.3.3** When the detection of overload operates on the basis of temperature increase in the windings of the motor, the circuit breaker is permitted to close automatically after sufficient cooling down has taken place, however, it shall only be possible to restart the escalator or passenger conveyor under the conditions of **14.2.1** or **14.2.1.1**.

**13.3.4** The provisions of **13.3.2** and **13.3.3** apply to each winding if the motor has windings supplied by different circuits.

**13.3.5** When the escalator or passenger conveyor driving motors are supplied by d.c. generators driven by motors, the generator driving motors shall also be protected against overload.

## **13.4 Main switches**

**13.4.1** 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, 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.

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.

**13.4.2** The operating mechanism of the main switch shall be easily and rapidly accessible after opening of the doors or trap doors. It shall have stable open and closed positions and it shall be possible to lock it in the open position.

<sup>3)</sup> These values are provisional and will be aligned later with those accepted by the CENELEC Committee 64.

**13.4.3** Main switches shall be capable of interrupting the highest current involved in normal operating conditions of the escalator or passenger conveyor. They shall have a breaking capacity corresponding to category AC-3 as defined by IEC publication 158-1.

**13.4.4** When main switches for several escalators or passenger conveyors are arranged in one machinery space it shall be possible to identify easily to which escalator or passenger conveyor they refer.

### 13.5 Electrical wiring

**13.5.1** Cables shall be selected from those standardized by CENELEC and of a quality at least equivalent to that defined by CENELEC HD 21 and HD 22, taking into account the information given in **13.1.1.3**.

**13.5.1.1** Cables as defined in clause **2.6** of CENELEC HD 21 are permitted only in conduits, ducting, or similar fittings ensuring equivalent protection. However, deviating from CENELEC HD 21, clause **2.6**, the nominal cross-sectional area of the conductors shall be not less than  $0,75 \text{ mm}^2$ .

**13.5.1.2** Rigid cables, as defined in clause **2.7** of CENELEC HD 21, are permitted only in visible mountings fixed to the walls, or in conduits, ducting or similar fittings.

**13.5.1.3** Ordinary flexible cables, as defined in clause **2.3** of CENELEC HD 22 and in clause **2.4** of CENELEC HD 21, are permitted only in conduits, ducting or similar fittings ensuring equivalent protection.

Flexible cables with a reinforced enclosure, as defined in clause **2.4** of CENELEC HD 22, are permitted to be installed rigidly in the conditions defined in **13.5.1.2** and for connection to a movable appliance or if they are subject to vibrations.

**13.5.1.4** The requirements of **13.5.1.1**, **13.5.1.2** and **13.5.1.3** need not apply to the wiring of control or distribution devices in control cabinets or on control panels

- (a) either between different pieces of electrical equipment;
- (b) or between these pieces of equipment and the connection terminals.

In these instances the requirements of clause **7.8** of the IEC publication 439 apply.

### 13.5.2 Cross-sectional area of conductors

The nominal cross-sectional area of the conductors of electrical safety circuits shall be not less than  $0,75 \text{ mm}^2$ .

### 13.5.3 Method of installation

**13.5.3.1** The electrical installation shall be provided with the indications necessary to make it easy to understand.

**13.5.3.2** Connections, connection terminals and connectors except those defined in **13.1.2** shall be located in control cabinets, control boxes or on panels provided for this purpose.

**13.5.3.3** If, after the opening of the main switch or switches of the escalator or passenger conveyor, some connection terminals remain live, they shall be clearly separated from terminals which are not live; if the voltage exceeds 50 V, they shall be suitably marked.

**13.5.3.4** Connection terminals, accidental interconnection of which could lead to a dangerous malfunction of the escalator or passenger conveyor shall be clearly separated unless their design obviates this risk.

**13.5.3.5** In order to ensure continuity of mechanical protection, the protective enclosures of cables shall enter the casings of switches and appliances, or shall have proper glands at their ends.

**13.5.3.6** If the same conduit or cable contains conductors the circuits of which have different voltages, all cables shall have the insulation specified for the highest voltage.

### 13.5.4 Connectors

Connectors and devices of the plug-in type which are placed in safety circuits and which can be extracted without the use of a tool, shall be designed in such a way that it is impossible to reinsert them incorrectly.

### 13.6 Socket outlets

**13.6.1** The supply to the socket outlets shall be independent of the supply to the machine and it shall be possible to break the supply of all phases by means of a separate switch.

**13.6.2** Socket outlets shall be

- (a) either of type 2 P + T (2 poles + earth conductor), 250 V, directly supplied by the mains;
- (b) or of a type that is supplied at a safety extra low voltage in accordance with CENELEC HD 384, clause **41**, subclause **411**.

## 14 Protection against electrical faults; controls

### 14.1 Protection against electrical faults

#### 14.1.1 General provisions

Any one of the faults envisaged in **14.1.1.1** in the electrical equipment of the escalator or passenger conveyor shall not on its own be the cause of a dangerous malfunction of the escalator or passenger conveyor.

#### 14.1.1.1 Faults 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 in an electrical 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.

**14.1.1.2** The non-opening of a contact need not be considered in the case of safety contacts conforming to **14.1.2.2**.

**14.1.1.3** The fault to earth of a circuit<sup>4)</sup> in which there is an electrical safety device shall cause the immediate stopping of the driving machine. The return to service shall not be possible except by a competent person.

<sup>4)</sup> 'fault to earth of a circuit' equals 'Masse- oder Erdschluß in einem Schaltkreis' in German and 'default d'isolement par rapport à la masse ou à la terre dans un circuit' in French.



## 14.1.2 Electrical safety devices

### 14.1.2.1 General provisions

**14.1.2.1.1** The operation of an electrical safety device for any of the events **14.2.2.4.1(b)** to (m) shall prevent the driving machine from starting or cause the immediate stopping of the driving machine according to **14.1.2.4**. The electrical safety devices shall consist of:

(a) either one or more safety contacts satisfying **14.1.2.2** directly cutting the supply to the contactors or their relay contactors;

(b) or safety circuits satisfying **14.1.2.3** consisting of:

(1) either one or more safety contacts satisfying **14.1.2.2** not directly cutting the supply to the contactors or their relay contactors;

(2) or contacts not satisfying the requirements of **14.1.2.2**.

**14.1.2.1.2** No electrical equipment shall be connected in parallel to electrical safety devices.

**14.1.2.1.3** The effects of internal or external inductance or capacitance shall not cause failures of electrical safety circuits.

**14.1.2.1.4** An output signal emanating from an electrical safety circuit shall not be altered by an extraneous signal emanating from another electrical device placed further down the same circuit, which would cause a dangerous condition to result.

**14.1.2.1.5** In safety circuits comprising two or more parallel channels, all information other than that required for the functioning of the safety circuit shall be taken from one channel only.

**14.1.2.1.6** Circuits which record or delay calls shall not, even in event of fault, prevent or intentionally delay the stopping of the driving machine through the functioning of an electrical safety device.

**14.1.2.1.7** 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 electrical safety devices due to the effects of switching. In particular, voltage peaks arising from the operation of the escalator or passenger conveyor or other equipment on the network shall not create inadmissible disturbances in electronic components (noise immunity).

### 14.1.2.2 Safety contacts

**14.1.2.2.1** The operation of a safety contact shall be by positive mechanical separation of the circuit breaking devices. This positive mechanical separation shall even occur if the contacts are welded together.

Positive mechanical separation is achieved when all the contact breaking elements 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.

**14.1.2.2.2** The safety contacts shall be provided for a rated insulation voltage of 250 V if the enclosure provides a degree of protection of at least IP 4X, or 500 V if the degree of protection of the enclosure is less than IP 4X.

Safety contacts shall belong to the following categories as defined in the IEC publication 337-1:

(a) AC-11 for safety contacts in a.c. circuits;

(b) DC-11 for safety contacts in d.c. circuits.

**14.1.2.2.3** If the protective enclosure is not at least of type IP 4X the creep distances and air gaps shall be at least 6 mm and the distances for breaking contacts at least 4 mm after separation.

The live parts of safety contacts shall be accommodated in a protective enclosure.

Protective enclosure need not be provided in the case of external influences considered as normal in the harmonization document drawn up by CENELEC CE 64 (at present IEC publication 364, clause 32).

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

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

### 14.1.2.3 Safety circuits

**14.1.2.3.1** Safety circuits shall comply with the requirements of **14.1.1** relative to the appearance of a fault.

**14.1.2.3.2** Furthermore, the following conditions apply:

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

Any restarting of the escalator or passenger conveyor shall be impossible as long as this fault persists. The possibility of the second fault leading to a dangerous situation before the escalator or passenger conveyor has been stopped by the sequence mentioned, is not considered.

(b) If a dangerous situation can only occur through the combination of several faults, the escalator or passenger conveyor shall be stopped and maintained in stopped position by the time the fault appears which in conjunction with the already existing faults would lead to a dangerous situation.

### 14.1.2.4 Operation of electrical safety devices

When operated, an electrical safety device shall prevent the setting in motion of the driving machine or immediately initiate its stopping. The operational brake shall be applied.

Electrical safety devices shall act directly on the equipment controlling the supply to the driving machine.

If, because of the power to be transmitted, relay contactors are used to control the driving machine, these shall be considered as equipment directly controlling the supply to the driving machine for starting and stopping.

### 14.1.2.5 Control of electrical safety devices

The components controlling the electrical safety devices shall be built so that they are able to function properly even under the mechanical stresses resulting from continuous operation.

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

Transmitter elements of safety circuits shall withstand, independent of the direction, a vibration of sine-wave form, with a frequency  $f$  of between 1 Hz and 50 Hz and an amplitude  $a$  (mm) which is given as a function of  $f$  by the equations:

$$a = \frac{25}{f} \text{ for values } f \text{ from 1 Hz up to 10 Hz}$$

$$a = \frac{250}{f^2} \text{ for values } f \text{ above 10 Hz up to 50 Hz}$$

NOTE. Where shock absorbers are used for the transmitter elements, they shall be considered as part of the transmitter elements.

## 14.2 Controls

### 14.2.1 Starting and making available for use the escalator or passenger conveyor

Starting of the escalator or passenger conveyor (or making it available for use when starting is automatic by a user passing a certain point) shall be effected by one or more switches available to authorized persons only (e.g. key-operated switches, switches with detachable lever, lockable protective caps for switches). Such switches shall not function concurrently as main switches described in 13.4. The person who operates the switch shall either be able to see the entire escalator or entire passenger conveyor or shall have means of ensuring that nobody is using the escalator or passenger conveyor before making this operation.

**14.2.1.1** Escalators or passenger conveyors which start automatically by the passing of a user shall start to move before the person walking reaches the comb intersection line.

This is, for instance, accomplished by:

- (a) lightrays if they are arranged at least 1,30 m before the comb intersection line (see  $L_2$  in figure 1, detail X);
- (b) contact mats if the outer edge of the contact mat is arranged at least 1,80 m before the comb intersection line. The length of the contact mat in the direction of travel shall be at least 0,85 m. Contact mats reacting to weight shall respond before the load reaches 150 N, applied to a surface of 25 cm<sup>2</sup> at any point.

Constructional measures shall discourage circumvention of the control elements.

**14.2.1.2** On escalators or passenger conveyors which start automatically by the passing of a user, the direction of travel shall be predetermined, clearly visible and marked distinctly (see 15.2).

In such cases where escalators or passenger conveyors which start automatically by the passing 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 14.2.1.1. The running time shall be not less than 10 s.

### 14.2.2 Stopping

All stopping devices shall act by interrupting current and not by the completion of a circuit of a relay.

#### 14.2.2.1 Stopping not automatically operated

Before stopping, the person who operates the switch shall have means of ensuring that nobody is using the escalator or passenger conveyor, before making this operation.

#### 14.2.2.2 Stopping automatically operated

It is permitted to design the control in such a way that the escalator or passenger conveyor is stopped automatically

after a sufficient time (at least the anticipated passenger transfer time plus 10 s) after the passenger has actuated a control element described in 14.2.1.1.

#### 14.2.2.3 Emergency stopping, not automatically operated

**14.2.2.3.1** Emergency stop devices shall be placed in conspicuous and easily accessible positions at or near to the landings of the escalator or passenger conveyor (see 15.1.2.2).

For escalators with rises above 12 m, additional emergency stop devices are permitted.

For passenger conveyors with a length of the treadway of more than 40 m, additional emergency stop devices are permitted.

**14.2.2.3.2** The emergency stop devices shall be safety contacts according to 14.1.2.2.

#### 14.2.2.4 Emergency stopping, automatically operated

**14.2.2.4.1** The escalator or passenger conveyor shall stop automatically in case of:

- (a) absence of control voltage;
- (b) fault to earth of a circuit (according to 14.1.1.3);
- (c) overload (according to 13.3.2);
- (d) overload (according to 13.3.3);
- (e) operation of the control devices at overspeed and unintentional reversal of the direction of travel (according to 12.5);
- (f) operation of the auxiliary brake (according to 12.6.4);
- (g) breakage or undue elongation of parts immediately driving the steps, pallets or the belt, e.g. chains or racks;
- (h) (unintended) reduction of the distance between the driving and return devices;
- (i) foreign bodies being trapped at the point where the steps, pallets or the belt enter the comb (according to 8.3.2.6);
- (j) stopping of a succeeding escalator or passenger conveyor where an intermediate exit does not exist (see 5.2.1);
- (k) operation of the handrail entry guard (see 7.5.3);
- (l) any part of the step or pallet is sagging so that meshing of the combs is no longer ensured at the point at which the steps or pallets enter the landing (see 8.3.1). Switching off shall be operated 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 12.4.4.2 and 12.4.4.4). The control device can be applied at any point of the steps or pallets.

Paragraph (l) does not apply for belt passenger conveyors (see 10.2.2);

- (m) for public service escalators and public service passenger conveyors operation of the device mentioned in 7.8 caused by a broken handrail.

**14.2.2.4.2** All switching-off operations in the cases 14.2.2.4.1(e) to (m) shall be performed by safety contacts or safety circuits.

### 14.2.3 Reversal of direction of travel

An intended reversal of the direction of travel shall be possible only if the escalator or passenger conveyor stands still and 14.2.1, 14.2.1.1, 14.2.1.2 and 14.2.2.2 are complied with.

Refer to NZBC F8 for signs required for escalator and moving walk installations.

**14.2.4 Restarting of the escalator or passenger conveyor**  
After each stop (14.2.2.1, 14.2.2.3, 14.2.2.4) except the one mentioned in 14.2.2.2, restarting shall be possible only by means of the switches mentioned in 14.2.1 or by means of the inspection control described in 14.2.5. It shall be observed that where stopping is effected in the cases 14.2.2.4.1(e), (f), (g) and (l), restarting shall be possible only after the stop device has been checked and reset to working order.

#### 14.2.5 Inspection control

**14.2.5.1** Escalators or passenger conveyors shall be equipped with inspection controls to permit operation during maintenance or repair or inspection by means of portable and manually operated control devices.

**14.2.5.2** For this purpose, one inspection outlet for the connection of the flexible cable of the portable 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 3,0 m. Inspection outlets shall be located in such a way that any point of the escalator or passenger conveyor can be reached with the cable.

**14.2.5.3** The operating elements of this control device shall be protected against accidental operation. The escalator or passenger conveyor is permitted to run only as long as the operating elements are switched on by permanent application of manual pressure. Each control device shall have a stop switch (according to 14.1.2.2) which once having been operated shall maintain in the open position.

**14.2.5.4** When this control device is used, all other starting switches shall be rendered inoperative.

All inspection outlets shall be arranged in such a way that when more than one control device is connected, they either become inoperative or all need to be actuated at the same time to be operative. The safety switches and safety circuits (according to 14.2.2.4) shall remain effective.

## 15 Signs, notices for use and signals

### 15.1 Plates, inscriptions and notices for use

**15.1.1** 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 passenger conveyor is in operation and/or pictographs shall be used (see figures 6, 7 and 8).

#### 15.1.2 Notices near the entrances of escalators or passenger conveyors

**15.1.2.1** The following notices for the user shall be fixed in the vicinity:

- (a) 'Small children must be held firmly';
- (b) 'Dogs must be carried';
- (c) 'Stand facing the direction of travel; keep feet away from sides';
- (d) 'Hold the handrail';

Additional notices will possibly be necessary when required by local conditions, e.g. 'Use permitted only with footwear', 'Transportation of bulky and heavy loads not permitted'.


~~Whenever possible, these notices shall be given in the form of pictographs. The minimum size of the pictographs shall be 80 mm x 80 mm. Pictographs shall be used as defined in this standard.~~

**15.1.2.2** Emergency stop devices referred to in 14.2.2.3 shall be coloured red and either on the device itself or in its immediate vicinity be marked with the inscription 'STOP'.

**15.1.2.3** ~~During maintenance, repair, inspection or similar work, the access to the escalator or passenger conveyor shall be barred to the user by suitable devices which shall bear the notice~~

'No Access'

or the valid road traffic sign

'No Entry' 

~~and be available in the vicinity.~~

Provision shall be made to prevent access to any escalator that is not operating.

#### 15.1.3 Instructions for handwinding devices

If a handwinding device is provided, corresponding instructions for use shall be available in the vicinity and the direction of travel of the escalator or passenger conveyor shall be indicated clearly.

#### 15.1.4 ~~Notices on the access doors to machinery spaces, driving and return stations~~

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

~~'Machinery Space — Danger, Access prohibited to authorized Persons'~~

#### 15.1.5 Marking of escalators and passenger conveyors

At least at one landing, the name of the manufacturer and the manufacturer's serial number shall be indicated, visible from the outside.

### 15.2 Special notices for escalators and passenger conveyors starting automatically

In the case of escalators or passenger conveyors starting automatically, a clearly visible signal system, e.g. road traffic signals, shall be provided indicating to the user whether the escalator or passenger conveyor is available for use, and its direction of travel.

## 16 Inspection and test; register; maintenance

### 16.1 General

During maintenance or repair or inspection and test, precautions shall be taken so that escalators and passenger conveyors cannot be set into motion without the knowledge and the consent of the person performing such work.

#### 16.2 Inspection and test<sup>5)</sup>

Escalators and passenger conveyors shall be inspected before their first use, after major modifications and at regular intervals.

Such inspections and tests shall be made by a competent person or a representative of an organization which is accredited by the public authority.

#### 16.2.1 First inspection and test

##### 16.2.1.1 Preliminary check

For check of compliance with the requirements of this standard, the following documentation will be sufficient.

##### 16.2.1.1.1 Calculation data:

- (a) static stress analysis of the supporting structure of the escalator or passenger conveyor or equivalent certificate by a static stress analyst;

<sup>5)</sup> For clauses 16.2, 16.3 and 16.4 national supplements are permitted.



- (b) proof by calculation of sufficient breakage resistance of the parts immediately driving the steps, pallets or the belt, e.g. step chains, racks;
- (c) calculation of the stopping distances for loaded passenger conveyors (see 12.4.4.4) together with adjustment data;
- (d) test certificate for steps or pallets;
- (e) proof of the breaking strength of the belt;
- (f) **for public service escalators and public service passenger conveyors** certificate of the handrail breaking strength.

**16.2.1.1.2** Layout drawings, description of the equipment and wiring diagrams (current flow chart with legend or explanations, and a terminal connection chart) which permit a check of compliance with the safety requirements specified in this standard.

**16.2.1.2 Constructional inspection and acceptance inspection and test**

The constructional inspection and acceptance inspection and test shall be carried out at the jobsite on completion of the escalator or passenger conveyor.

For the constructional inspection and acceptance inspection and test, the data specified in 16.2.1.1 shall be available.

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

The acceptance inspection and test comprises:

- (a) overall visual inspection;
- (b) functional test;
- (c) test of safety devices with regard to their effective operation;
- (d) test of the brake(s) of the escalator or passenger conveyor under no load, for compliance with the prescribed stopping distances (see 12.4.4.2 and 12.4.4.4). An examination of the brake adjustment according to the calculation required in 16.2.1.1(c) is also necessary.

Additionally, a test of the stopping distances under brake load can be required for escalators (see 12.4.4.1);

- (e) measurement of the insulation resistance of the different circuits between conductors and earth (see 13.1.3). For this measurement, the electronic components shall be disconnected.

Test of the electrical continuity of the connection between the earth terminal(s) in the driving station and the different parts of the escalator or passenger conveyor liable to be alive accidentally.

**16.2.2 Inspection and test after major modifications.**

A major modification is, for example, a change of the speed, of the safety devices, of the braking system or of the drive. Wherever applicable, the principles set forth for the constructional inspection and acceptance inspection and test (16.2.1.2) shall apply.

The replacement of parts by parts of same design is not considered to be a major modification.

**16.2.3 Periodic inspection and test**

The periodic inspection and test shall ascertain whether the escalator or passenger conveyor is safe in operation and shall bear on:

- (a) safety devices with regard to their effective operation;
- (b) brake(s) according to 16.2.1.2(d);
- (c) driving elements for visible signs of wear and tear and for insufficient tension of belts and chains;
- (d) steps, pallets or the belt for defects, true run and guidance;
- (e) dimensions and tolerances specified in this standard (see 0.1.2);
- (f) combs for proper condition and adjustment;
- (g) balustrade interior panelling and the skirting;
- (h) handrails.

**16.3 Register<sup>6)</sup>**

**16.3.1** The technical data of the escalator(s) or passenger conveyor(s) shall be recorded in a register or file, drawn up by the time the escalator(s) or passenger conveyor(s) is (are) put into service. This register or file shall be kept up-to-date and comprise:

- (a) a technical section indicating the date the escalator(s) or passenger conveyor(s) was (were) put into service, the characteristics of the escalator(s) or passenger(s) conveyor, modifications or alterations. Layout drawings and wiring diagrams shall be attached;

- (b) a section ~~where dated reports of the inspections and tests with observations as well as records of any accidents are kept.~~ *recording and maintenance procedures required by compliance*

~~16.3.2 This register or file shall be available to those in charge of maintenance and to the person or organization performing the periodic inspections (the national authority can indicate with reference to their regulations, who is responsible for the register).~~

**16.4 Maintenance<sup>6)</sup>**

Escalators and passenger conveyors shall be regularly maintained by competent personnel, in accordance with the service instructions of the manufacturer.

*Added July 1<sup>st</sup> 1992*

**Clause 17** Requirements for moving walks on accessible routes. (Note: Escalators are not suitable for use by people with disabilities).

**Clause 17.1** The maximum slope of a moving walk shall be 1 in 10 (5.7°).

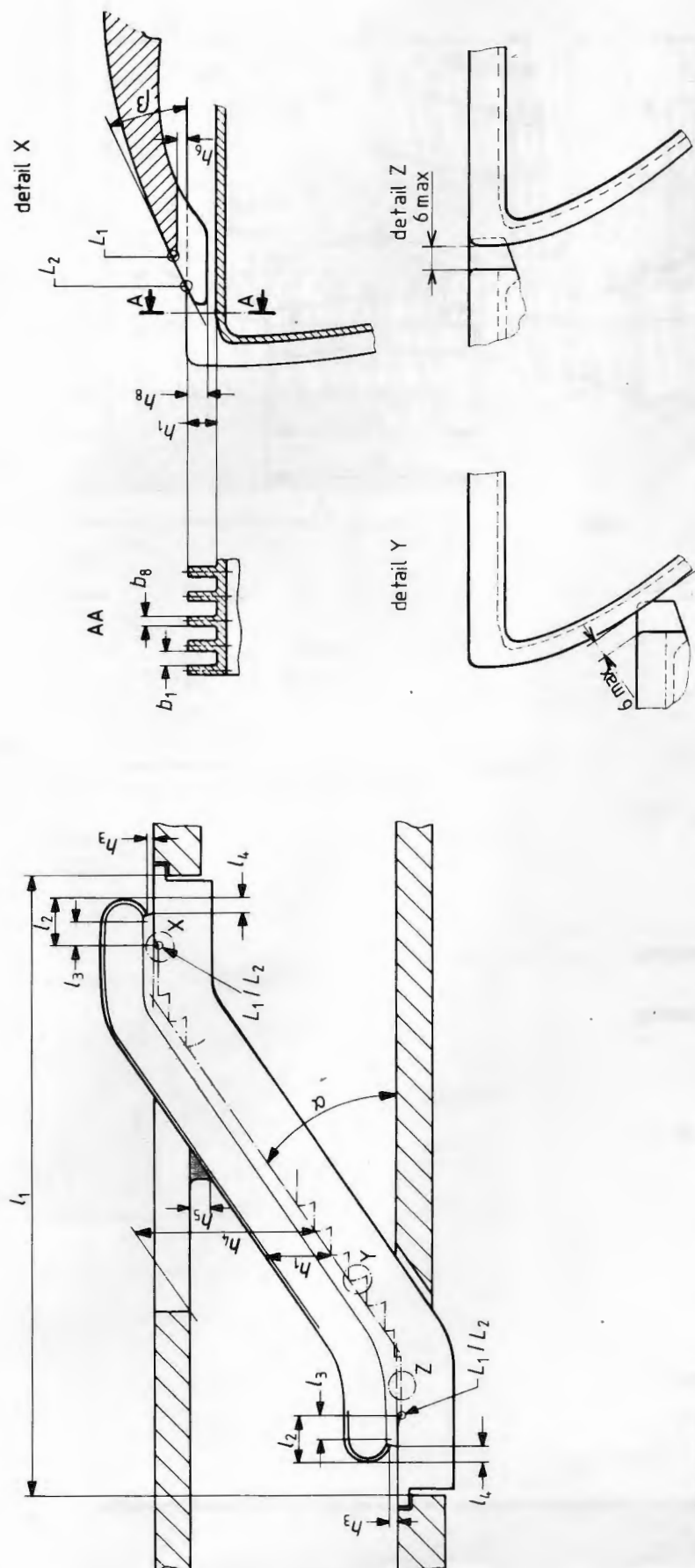
**Clause 17.2** The width of the pallet or tread shall be no less than 800 mm and no greater than 1000 mm.

**Comment:**

*The maximum width between handrails should preferably not exceed 1200 mm.*

**Clause 17.3** The moving walkway shall extend into the landings by at least 800 mm.

<sup>6)</sup> see footnote 5)



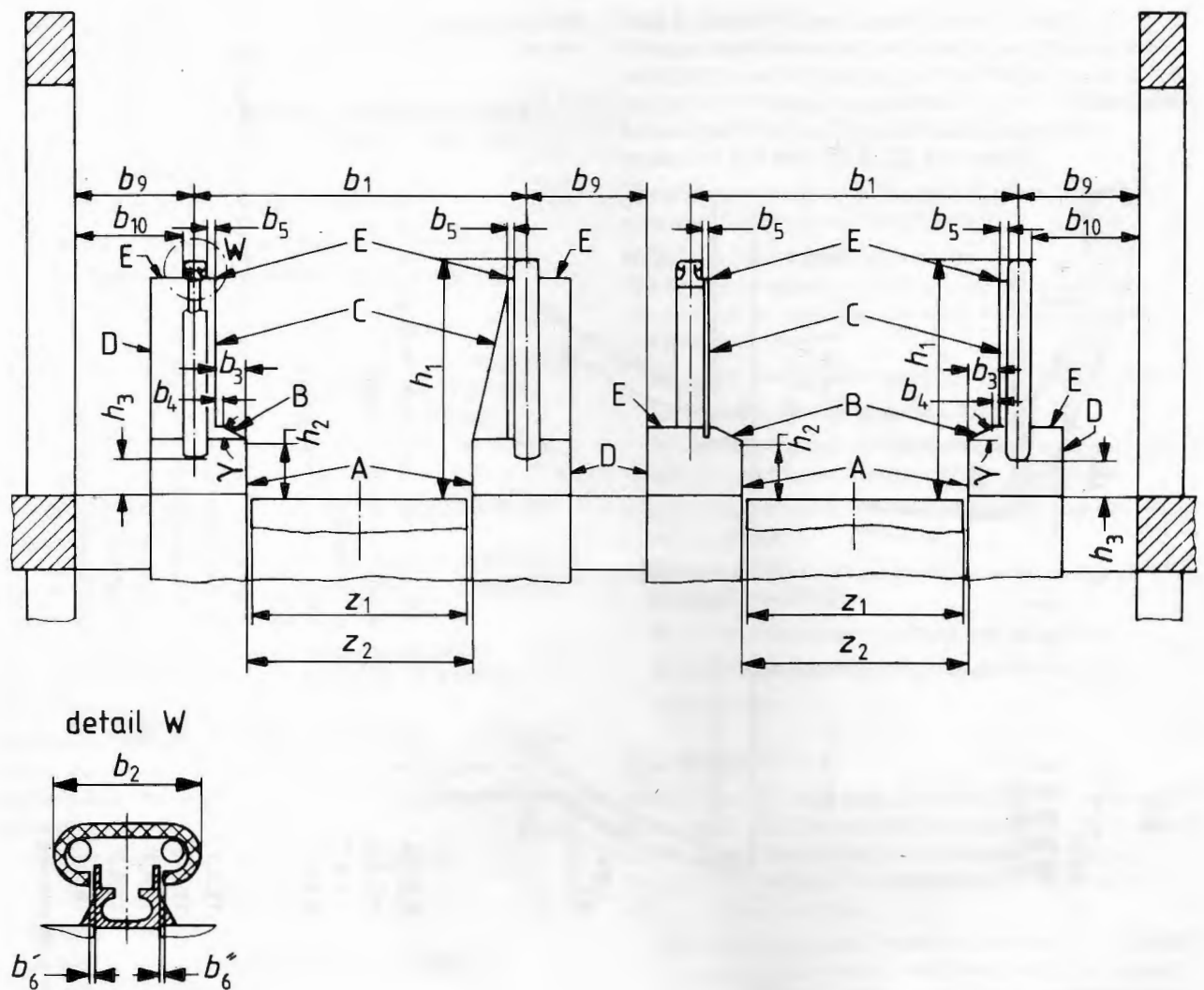
Dimensions in mm.

Subclause	Symbol	
5.1.5.9	$l_2$	$\geq 0,60$ m
5.2.2	$L_1$	Root of the comb teeth
5.2.3	$h_4$	$\geq 2,36$ m <b>2.1 m D2 453</b>
5.2.4	$h_5$	$\geq 0,30$ m
5.3	$l_1$	Distance between supports
7.2	$l_3$	$\geq 0,30$ m
7.5.1	$h_3$	$\geq 0,10$ m $\leq 0,25$ m
7.5.2	$l_4$	$\geq 0,30$ m
7.6	$h_1$	$\geq 0,90$ m $\leq 1,10$ m
8.2.3.2	$b_7$	$\geq 5$ mm $\leq 7$ mm (step treads and pallets)
8.2.3.3	$h_7$	$\geq 10$ mm (step treads and pallets)

$b_8$	$\geq$	2,5 mm $\leq 5$ mm (step treads and pallets)
$b_7$	$\geq$	4,5 mm $\leq 7$ mm (belts)
$h_7$	$\geq$	5 mm (belts)
$b_8$	$\geq$	4,5 mm $\leq 8$ mm (belts)
$\beta$	$\leq$	40°
$\alpha$		Angle of inclination of the escalator or passenger conveyor
$h_8$	$\geq$	6 mm (step treads and pallets)
$h_6$	$\leq$	4 mm (step treads and pallets)
$h_8$	$\geq$	4 mm (belts)
$h_6$	$\leq$	4 mm (belts)
$L_2$		Comb intersection line

The construction does not have to correspond to the drawing; only the indicated dimensions have to be observed.

Figure 1

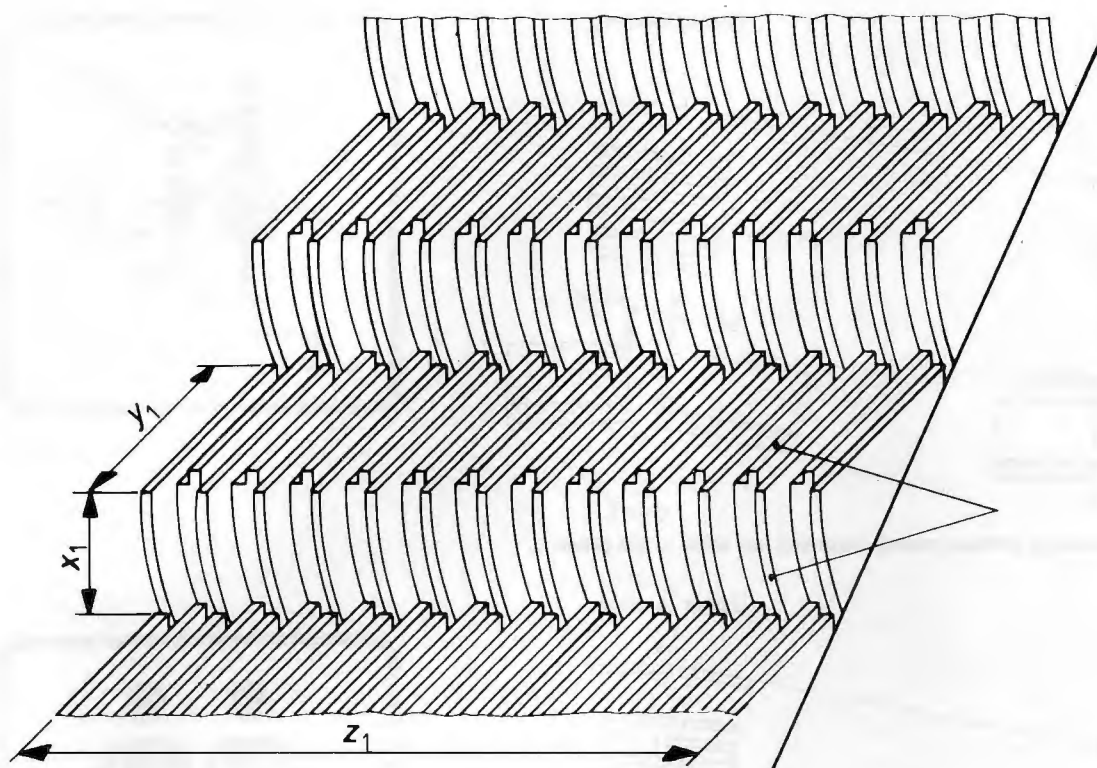


Subclause	Symbol	
5.1.5.1.1	A	Skirting
5.1.5.1.2	B	Interior profile
5.1.5.1.3	C	Balustrade interior panelling
5.1.5.1.4	E	Balustrade decking
5.1.5.1.5	D	Balustrade exterior panelling
5.1.5.6	$h_2$	$\geq 25 \text{ mm}$
5.1.5.7	$\gamma$	$\geq 25^\circ$
5.1.5.7.1	$b_4$	$< 30 \text{ mm}$
5.1.5.7.2	$b_3$	$< 0,12 \text{ m}$ (if $\gamma$ less than $45^\circ$ )
5.2.4	$b_9$	$\geq 0,50 \text{ m}$
5.3	$z_1$	Nominal width
7.3.1	$b'_6$	$\leq 8 \text{ mm}$ , $b''_6 \leq 8 \text{ mm}$
7.3.1	$b_{10}$	$\geq 80 \text{ mm}$
7.3.2	$b_2$	$\geq 70 \text{ mm} - \leq 100 \text{ mm}$
7.3.3	$b_5$	$\leq 50 \text{ mm}$
7.4	$b_1$	$\leq z_2 + 0,45 \text{ m}$
7.4	$z_2$	Distance between skirting
7.5.1	$h_3$	$\geq 0,10 \text{ m} - \leq 0,25 \text{ m}$
7.6	$h_1$	$\geq 0,90 \text{ m} - \leq 1,10 \text{ m}$

The construction of the escalator or passenger conveyor does not have to correspond to the drawing; only the indicated dimensions have to be observed.

Figure 2





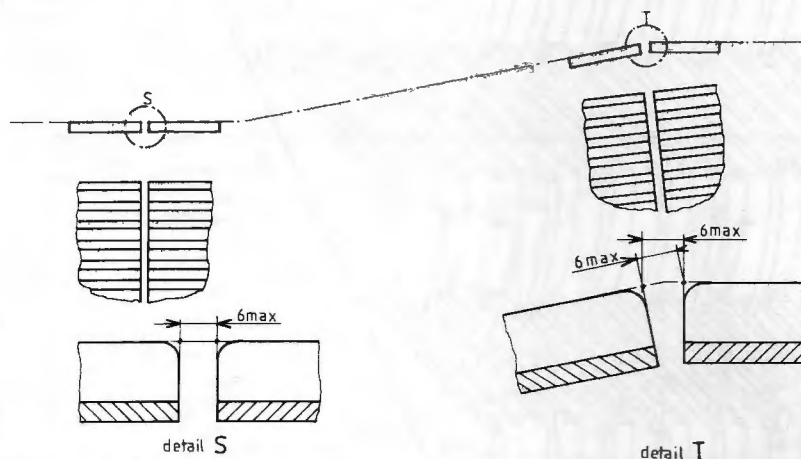
Subclause	Symbol
8.1.1	$x_1 \leq 0,24 \text{ m}$
8.1.2	$y_1 \geq 0,38 \text{ m}$
8.1.3	$z_1 \geq 0,58 \text{ m} - \leq 1,10 \text{ m}$

The construction does not have to correspond to the drawing;  
only the indicated dimensions have to be observed.

Figure 3

Lower landing

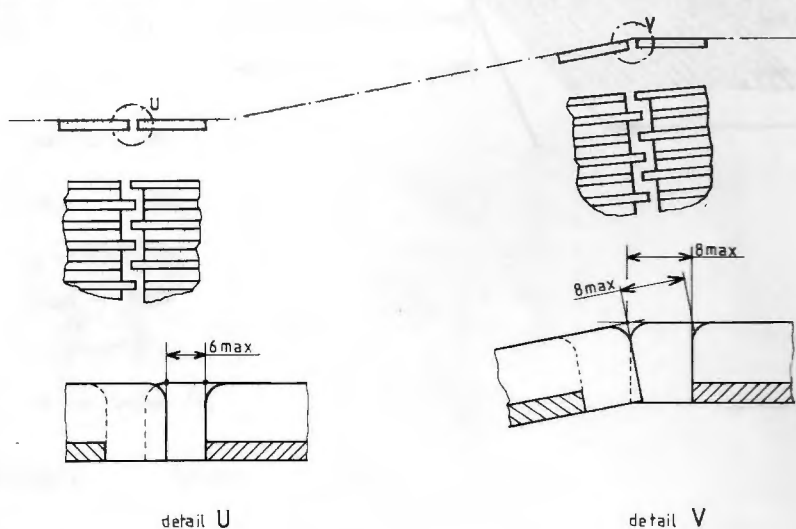
Upper landing



Pallet type passenger conveyor without meshed front and rear edges of the pallets

Lower landing

Upper landing

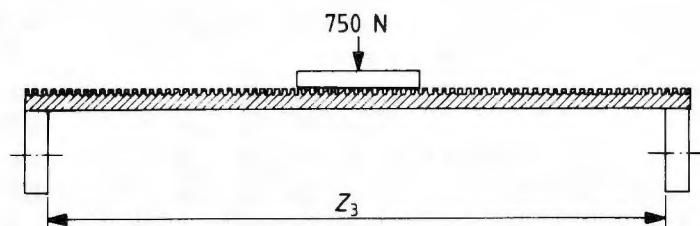


Pallet type passenger conveyor with meshed front and rear edges of the pallets

The construction does not have to correspond to the drawing; only the indicated dimensions have to be observed.

Dimensions in mm

**Figure 4**



**Subclause**

**Symbol**

**8.2.4.6.1.1**

$z_3$

Transverse distance between the supporting rollers

The construction of the escalator or passenger conveyor does not have to correspond to the drawing; only the indicated dimensions have to be observed.

**Figure 5**



Figure 6



Figure 7



Figure 8

**Note (to figures 6, 7 and 8)**  
 Colouring of pictographs  
 — blue colour on white back  
 — in figure 7, indication  
 sign (X) in red colour

## National appendices (continued)

## National appendix Y

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## National appendix Z

## National committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Mechanical Engineering Standards Committee (MEE/-) to Technical Committee MEE/49 upon which the following bodies were represented:

Associated Offices Technical Committee

Association of County Councils

British Broadcasting Corporation

British Electrical and Allied Manufacturers' Association (BEAMA)

British Railways Board

British Multiple Retailers Association

Bureau of Engineer Surveyors

Chartered Institution of Building Services

Department of Health and Social Security

Department of Industry (Mechanical Engineering)

Department of the Environment (PSA)

Department of Transport

Electrical, Electronic, Telecommunications and Plumbing Union

Engineer Surveyors' Sections of ASTMS

Federation of Wire Rope Manufacturers of Great Britain

Greater London Council

Health and Safety Executive

Independent Engineering Insurers' Committee

Institution of Mechanical Engineers

Institution of Production Engineers

London Transport Executive

Mechanical Handling Engineers' Association

National Association of Lift Makers

Post Office

Royal Association for Disability and Rehabilitation

Scottish Development Department