BRITISH STANDARD

BS 2655-4: 1969

Incorporating Amendment Nos. 1, 2 and 3

Specification for

Lifts, escalators, passenger conveyors and paternosters —

Part 4: General requirements for escalators and passenger conveyors

UDC 621.876.3

Co-operating organizations

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Associated Offices' Technical Committee*
Association of Consulting Engineers
Association of Mining Electrical and Mechanical Engineers
Board of Trade
British Chemical Plant Manufacturers' Association
British Compressed Air Society
British Electrical and Allied Manufacturers' Association*
British Gear Manufacturers' Association
British Internal Combustion Engine Manufacturers' Association
British Steel Industry
British Mechanical Engineering Federation*
British Pump Manufacturers' Association
Crown Agents for Oversea Governments and Administrations
Department of Employment and Productivity (H.M. Factory Inspectorate)*
Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales
Engineering Equipment Users' Association*
Gas Council
Institute of Marine Engineers
Institution of Civil Engineers
Institution of Gas Engineers
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Institution of Mechanical Engineers*
Institution of Mechanical Engineers (Automobile Division)
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Locomotive and Allied Manufacturers' Association of Great Britain
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Ministry of Transport
National Coal Board
National Physical Laboratory (Ministry of Technology)
Royal Institute of British Architects

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Railways Board
Department of Health and Social Security
Draughtsmen's and Allied Technicians' Association
Electrical Trades Union
Engineers Surveyors' Association
Federation of Wire Rope Manufacturers of Great Britain
Fire Offices' Committee
Greater London Council
Institution of Electrical Engineers
Institution of Municipal Engineers
Ministry of Housing and Local Government
National Association of Lift Makers
General Post Office
Retail Trading Standards Association

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Contents

Foreword

1. This British Standard, prepared under the authority of the Mechanical Engineering Industry Standards Committee, revises, and supersedes, the 1958 edition, which was entitled BS 2655, "*Electric lifts*".

2. The new title reflects the extension of the scope of this British Standard. Amendments to Parts 1, 2 and 3 of this standard have been published, and implement the change in title. The revised Part 1 and additional new parts will be published separately and, together with Parts 2 and 3, are as follows.

Part 1. General requirements for electric, hydraulic and hand-powered lifts. This part is basically a revision of the 1958 edition of BS 2655-1, without the building requirements and list of definitions, and extended to cover the engineering and safety requirements for new hydraulic and hand-powered lifts as well as for new electric lifts.

Part 2. Single-speed polyphase induction motors for driving lifts. This part covers the type of electric motor specially designed for driving lifts. It should be used in conjunction with BS 2613[1)] and gives additional requirements including the class of lift rating and special limits of temperature rise.

Part 3. Arrangements of standard electric lifts. This part gives standard dimensions for lift wells and machine rooms in relation to lift capacity and platform sizes, for seven classes of lifts.

Part 4.General requirements for escalators and passenger conveyors. This part specifies engineering and safety requirements for escalators and passenger conveyors. The latter may be described as machines in which the passenger carrying surfaces remain parallel to the direction of motion and are uninterrupted.

Part 5. General requirements for paternosters. This part specifies engineering and safety requirements for paternosters which may be described as machines where series of cars are continuously running in closed loops, and are characterized by the car floors remaining substantially horizontal when the direction of motion is reversed at the extremities of car travel.

Part 6. Building construction requirements. This part specifies structural and fire resistance requirements for the equipment covered by Parts 1, 4 and 5.

Part 7. Testing and inspection. This part specifies tests, examination and certification of new and modified equipment covered by Parts 1, 4 and 5.

Part 8. Modernization or reconstruction of lifts. This part specifies engineering and safety requirements.

Part 9. Definitions. This part gives definitions of terms used in the remainder of the standard.

Part 10. General requirements for guarding. This part specifies requirements for the guarding of moving parts and protection against hazards from electrical equipment. It relates to equipment covered in Parts 1, 4 and 5.

CP 407:1972, *British Standard Code of Practice for electric, hydraulic and hand-powered lifts*.

This code gives general information and guidance for planning, purchasing, installation and maintenance of passenger, goods and service lifts.

3. In case of difficulty in classifying any equipment in accordance with the headings of Parts 1, 4 and 5, reference should be made to the relevant definitions in Part 9.

4. Part 4 of this standard applies to the engineering and safety requirements for escalators and passenger conveyors.

[1)] BS 2613, "*The electrical performance of rotating electrical machinery*".

5. In covering the requirements for escalators it has been borne in mind that, apart from their use by public transport undertakings, they are finding increasing application in shops and department stores. In the latter case they are frequently supplied by the manufacturers as complete units, with such items as machinery and control compartments forming an integral part of the escalator. This contrasts with the former case in which a machine room is usually provided.

6. The passenger conveyor was introduced only a few years ago as a method of transportation for moving persons over a horizontal distance with or without a change in level, and therefore as yet only limited experience is available on this form of transport. No doubt types other than those given in this part of the standard will be developed, and it is not the purpose of this part to preclude other types from being incorporated, providing they satisfy the safety standards required, giving particular attention to the movement of very young children and infirm or elderly persons who may use the facilities in shopping centres, airports, railway terminals, etc.

7. Throughout this standard the metric and imperial systems of units are used side by side, but it is important that each contract shall either use the imperial system throughout or the metric system throughout. A mixture of the two may lead to complications. It should be noted that in general, units have been converted from imperial to the metric system and then rounded off by increasing or reducing after taking into account the practical problems involved, and current Continental practice.

8. This Part of this standard is rendered obsolescent concurrently with the publication of BS 5656:1983 *"Safety rules for the construction and installation of escalators and passenger conveyors"* under the conditions stated below.

1) This standard is no longer applicable to all new escalators and passenger conveyors installed in such new buildings as are designed after the date of publication of BS 5656 (31 October 1983).

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 BS 5656 or in accordance with this standard. If, however, such installations are scheduled for commissioning after 31 October 1987, the requirements of BS 5656 only are applicable.

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 5656. If, however, such installations are scheduled for commissioning after 31 October 1987, the requirements of BS 5656 only are applicable unless it can be shown that compliance is not reasonably practicable.

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 5656. After 31 October 1987, the requirements of BS 5656 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.

The relevant requirements of this British Standard remain current only for the future maintenance and inspecting of existing installations constructed in accordance with this British Standard.

9. In addition to the requirements specified in this standard and in BS 5656 readers should note that the Health and Safety Executive have published Guidance Note PM 34[2)] "*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 on both existing and new machines.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 14 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[2)] Obtainable from HMSO.

1 General

1.1 Scope

This part of the standard applies to the engineering and safety requirements for escalators and passenger conveyors.

The requirements for escalators are based on the steps being connected and driven by means of chains. Other types of construction may be adopted provided that the same standard of safety is achieved throughout.

The requirements for passenger conveyors are based on the use of two distinct types of treadway:

1) Platforms interconnected by chains or other suitable means, and provided with grooves on the tread surface in the direction of travel (these conforming to the specified requirements for escalators).

2) Continuous endless belts with longitudinal grooves formed on the tread surface.

Such aspects as limits of speed, width and angle of inclination are covered, together with methods of assessing contract loading. Also specified are requirements for guarding, handrails, steps or belts, driving machinery and safety devices.

Diagrams of a typical cross section and details of comb teeth and tread grooves are shown, containing limiting dimensions where applicable.

The subject of potential hazards to users is discussed in Appendix A .

2 Escalators

2.1 Design requirements

2.1.1 Limit of speed. The speed of an escalator measured along the line of inclination shall not exceed 150 ft/min or 0.75 m/s.

2.1.2 Angle of inclination. For escalators having a vertical rise which does not exceed 20 ft or 6 m and whose speed does not exceed 100 ft/min or 0.50 m/s the angle of inclination shall not exceed 35°. For all other escalators the angle of inclination shall not exceed 30°.

2.1.3 Width. The width is specified at two points (see Figure 1):

1) The width measured at the tread surface shall not be less than 24 in or 600 mm nor greater than 41 in or 1 050 mm.

2) The width between the balustrades, measured at a point just below the handrails, shall not be more than 50 in or 1 250 mm, and shall not exceed the tread width by more than 10 in or 250 mm. The width between the balustrades shall at no point be greater than the width between the handrails. The width between the inner faces of the handrails shall not exceed the width between the balustrades (at a point just below the handrails) by more than 4 in or 100 mm.

2.1.4 Loads

2.1.4.1 *Contract load*. The contract load shall be based on a passenger load of 60 lb/ft^2 or 290 kg/m^2 of the total area of exposed step treads. This load shall be used in the design of brakes, step drives and power transmissions.

2.1.4.2 *Structural load*. For structural design purposes a static load rating of 90 lb/ft^2 or 440 kg/m^2 of the total area of exposed step tread shall be used.

2.1.4.3 *Step load*. Each individual step shall be designed to support a static load of 120 lb/ft^2 or 580 kg/m^2.

2.2 Steps

The surface of the steps shall be horizontal at all positions exposed to passengers. The step frames and treads shall be of non-flammable material. The exposed surface of the risers shall be smooth, and have a low coefficient of friction, or be provided with vertical grooves.

The length of any step tread in the direction of travel shall be not less than 15.7 in or 400 mm and the rise between treads on the incline shall not exceed 9.5 in or 240 mm.

The clearance between adjacent steps, and between treads and risers, shall not exceed 0.16 in or 4 mm.

The tread surface of each step shall be grooved in a direction parallel to the travel of the steps. Each groove shall be not more than 0.30 in or 7 mm wide and not less than 0.36 in or 9 mm deep, and the centre distance between adjoining grooves shall not be more than 0.39 in or 10 mm (see Figure 2). Sides of grooves may slope to provide sufficient draft angle for moulding, and may be filleted at the bottom of the grooves. At the ends of the escalator the steps shall travel in a substantially horizontal direction for the following minimum distances:

1) For contract speeds not exceeding 90 ft/min or 0.45 m/s: 16 in or 400 mm

2) For contract speeds above 90 ft/min or 0.45 m/s but not exceeding 130 ft/min or 0.65 m/s: 21 in or 535 mm

3) For contract speeds above 130 ft/min or 0.65 m/s but not exceeding 150 ft/min or 0.75 m/s: 48 in or 1 220 mm

It is acceptable within these minimum dimensions for the vertical height between two consecutive step treads to be not greater than 0.13 in or 3.5 mm.

2.3 Landing plates

The portion of landing at each end of the escalator immediately above any mechanism shall be provided with removable landing plates to give access to the driving mechanism for maintenance purposes. These landing plates shall be constructed of fire-resisting materials, and the surface shall afford a secure foothold.

2.4 Combplates

Combplates shall be provided at the entrance and exit. The combplate teeth shall mesh with, and be set into the grooves in, the tread surface such that the points are always below the upper surface of the treads. Combs shall be adjustable vertically and the sections forming the combplate teeth shall be readily replaceable.

The distance between the underside of the combplate teeth and the bottom of the tread grooves, and also the distance between the roots of the combplate teeth and the tops of the treads, shall be between 0.10 in or 2.5 mm and 0.16 in or 4 mm (see Figure 2a).

2.5 Balustrading

2.5.1 Construction. Solid panel balustrading shall be provided on each side of the steps. On the inward facing sides the balustrades shall be smooth and substantially flush. No mouldings or other projections transverse to the direction of travel shall be raised or depressed more than 0.25 in or 6 mm from the panel surface. Any such features shall be bevelled in both directions. Skirting panels immediately adjacent to the steps shall be of rigid construction, and the exposed surface shall be smooth and have a low coefficient of friction.

The horizontal width of any transition piece between that part of the balustrade adjacent to the steps and the upper part of the balustrade shall not exceed 4.8 in or 120 mm if the angle between the transverse section of the transition piece and the horizontal is 45° or less. This width may be increased to a maximum of 6.5 in or 165 mm if the angle exceeds 45°. In no case shall the angle be less than 25° (see Figure 1).

2.5.2 Change in width between balustrades. There shall be no abrupt changes in the width between balustrades in the direction of travel. Where a change is unavoidable, it shall not exceed 8 % of the greatest width. Any change in the balustrade resulting in a reduction of width shall not exceed 15° from the line of travel.

2.5.3 Glass balustrading. If glass panels are used in balustrades, the glass shall be tempered or laminated.

2.5.4 Clearance with steps. The clearances on either side of the steps, between the steps and the adjacent skirting, shall not be more than 0.19 in or 5 mm and the sum of the clearance on both sides shall not be more than 0.25 in or 6.5 mm.

2.6 Guards at ceiling intersection

A solid guard shall be provided in the intersecting angle of the deckboard and the ceiling or soffit. The vertical face of the guard shall project not less than 18 in or 450 mm horizontally from the apex of the angle. The exposed edge of the guards shall be rounded to minimize shear hazards.

NOTE Where the intersection of the deckboard and the ceiling or soffit is more than 24 in or 600 mm from the centre line of the handrail, the guard may be omitted.

2.7 Handrails

Each balustrade shall be provided with a smooth and continuous handrail moving in the same direction and substantially at the same speed as the steps, and at a height of not less than 33 in or 840 mm and not more than 41 in or 1 040 mm measured vertically from the nose of the steps.

Each moving handrail shall extend at normal height not less than 12 in or 300 mm beyond the line of the roots of the combplate teeth at each landing. The handrails shall enter into or depart from the balustrade substantially in a horizontal direction at a height not less than 4 in or 100 mm above floor level, and the furthest point reached by the balustrade beyond this point of entry (horizontally) shall be not less than 10 in or 250 mm. Guards shall be provided at these points of entry.

2.8 Driving machinery

Each escalator shall be independently driven.

Each escalator shall be provided with braking that is mechanically applied and electrically held off. This braking shall be capable of bringing the escalator to rest under conditions of maximum load, and maintaining it stationary under such conditions. Brakes shall be located either on the driving machine or the main drive shaft. When springs are used to apply brake shoes, such springs shall be in compression and adequately supported.

Where chains or belts are used to connect a driving machine to the main drive shaft, an additional brake shall be provided on this shaft which will operate automatically should the chains or belts fail. This additional brake need not be of the electrically released type if an electrically released brake is provided on the driving machine.

Braking systems shall be designed to bring the escalator smoothly to rest under all conditions of loading. Provision shall be made for handwinding the escalator in either direction, and the direction of winding corresponding to the direction of movement of the escalator steps shall be clearly indicated.

2.9 Safety factors

2.9.1 Trusses or girders. The factor of safety used in the design of escalator trusses shall be not less than 3, based on the loading specified in **2.1.4.2**. The truss shall be so designed that it will retain the steps and running gear should the track system fail to support them. Provision shall be made to retain all tension weights in the truss should they become loose.

2.9.2 Step roller tracks and steps. Tracks shall be so arranged as to prevent displacement of the steps and running gear if a step chain breaks. The factor of safety of tracks and step frames shall be not less than 3, based on the loading specified in **2.1.4.2** and **2.1.4.3**.

2.9.3 Driving machinery. The factor of safety shall be not less than 8 for steel and bronze parts, and 10 for cast iron parts, all based on the loading specified in **2.1.4.1**.

2.9.4 Chains. Chains for steps and chains or belts for transmission shall have a factor of safety of not less than 8, based on the loading specified in **2.1.4.1**. Chains whose material of construction is such that they would require periodical heat treatment shall not be used.

2.10 Operating and safety devices

2.10.1 Starting switches. Starting switches shall be provided at both ends of the escalator, and shall be of the key operated, spring off type. These switches shall be positioned so as to enable the operator, when using the key, to see the escalator steps.

There shall be no other means of starting provided.

2.10.2 Stop switch. Stop switches having red buttons or handles shall be provided in the machinery spaces at both the top and bottom of the escalator. The opening of any one of these switches shall cause the electrical supply to be disconnected from the driving machine and brake. The stop switches shall:

1) be of the manually opened and closed type;

2) be conspicuously and permanently marked STOP;

3) be positively opened mechanically, and opening shall not be solely dependent on springs.

EXCEPTION. A stop switch need not be provided in a machinery space if the main disconnect switch is located therein.

2.10.3 Emergency stop switches. Emergency stop switches having red buttons or handles shall be placed in conspicuous and accessible positions at or near each entrance and exit, and shall be protected against accidental operation. The operation of these switches shall cause the electrical supply to be disconnected from the driving machine and brake.

2.10.4 Speed governor. A speed governor shall be provided which will cause the electrical supply to the driving motor to be disconnected and will cause the brake to be operated should the speed exceed the rated speed by more than 40 %.

EXCEPTION. The speed governor is not required where the slip of the alternating current squirrel cage induction driving motor, if used, does not exceed 10 %, and the motor is directly connected to the driving machine. The governor may in this case be omitted even if chains are used to connect the driving machine to the main drive shaft.

2.10.5 Broken step-chain device. Each escalator shall be provided with a broken chain device which will cause the electrical supply to the driving motor to be disconnected and will cause the brake to be operated if a step chain breaks, or stretches unduly, or if the motion of a chain is interrupted.

2.10.6 Broken drive device. Where the driving machine is connected to the main drive shaft by chains or belts, a device shall be provided which will cause the electrical supply to the motor to be disconnected and will cause the normal brake, as well as the additional brake, to be operated if the driving chains or belts should fail.

2.10.7 Non-reversal device. A device shall be incorporated to prevent reversal from the pre-set direction of motion.

2.10.8 Power interruption. Where a safety device is required to interrupt the electrical supply such interruption shall not be subject to intentional delay. The use of a supplementary and independent device, with or without intentional delay, e.g. in conjunction with fire alarm systems, is permissible.

2.11 Machinery spaces

Reasonable access and ventilation shall be provided for inspection and maintenance.

There shall be a permanent light, suitably protected, in every machinery space which can be switched without passing over or reaching over any part of the machinery. A 3 pin socket outlet shall be fitted adjacent to the light switch.

All doors or panels provided to give access to machinery and equipment spaces for normal maintenance purposes shall be secured against unauthorized access. Removal of any such doors or panels shall expose a permanent notice reading “Danger, unauthorized access prohibited”. The characters shall be not less than 0.5 in or 13 mm high. The notice shall NOT be affixed to the back of the door or panel.

2.12 Main switches and wiring

All cables, trunking, conduit and conduit fittings necessary for the power and lighting circuits shall be installed in accordance with the I.E.E. Regulations for the electrical equipment of buildings.

All exposed metalwork liable to become electrically charged shall be efficiently bonded and earthed.

All electrical safety switches and controllers shall be enclosed to protect against accidental contact.

The incoming supply mains shall terminate in the machinery space, either in a non self-resetting circuit breaker with over-current release, or in a main switch with fuses if the controller incorporates overload protection on both power and control circuits.

2.13 Controllers

Controllers shall be totally enclosed in a metal cabinet, the front of which may be in the form of a hinged door capable of being secured in the closed position.

Non-combustible material shall be used for controller panels and their supporting frames.

Fusible cut-outs shall be so placed and constructed that the blowing of a fuse shall not cause a short circuit between adjacent conductors. Control circuits shall be protected by fuses or equivalent means independent of the protection for the main circuits.

No control system shall depend upon the completion or maintenance of an electrical circuit for the interuption of the power supply to the driving machinery or brake.

Escalators connected to polyphase a.c. power supplies shall incorporate means to prevent the units starting in the event of phase failure. Means shall be provided to stop the escalator in the event of the motor overheating.

All control circuits shall be designed to fail to safety.

Electrical interlocking shall be provided where necessary to ensure that relays and contactors operate in proper sequence.

The insulation of controller wiring shall be of a flame retardant type.

All wires shall be terminated by soldering or clamping in such a way that the wires are not damaged.

Accessible terminals, suitably marked, shall be provided for connection of incoming and outgoing cables.

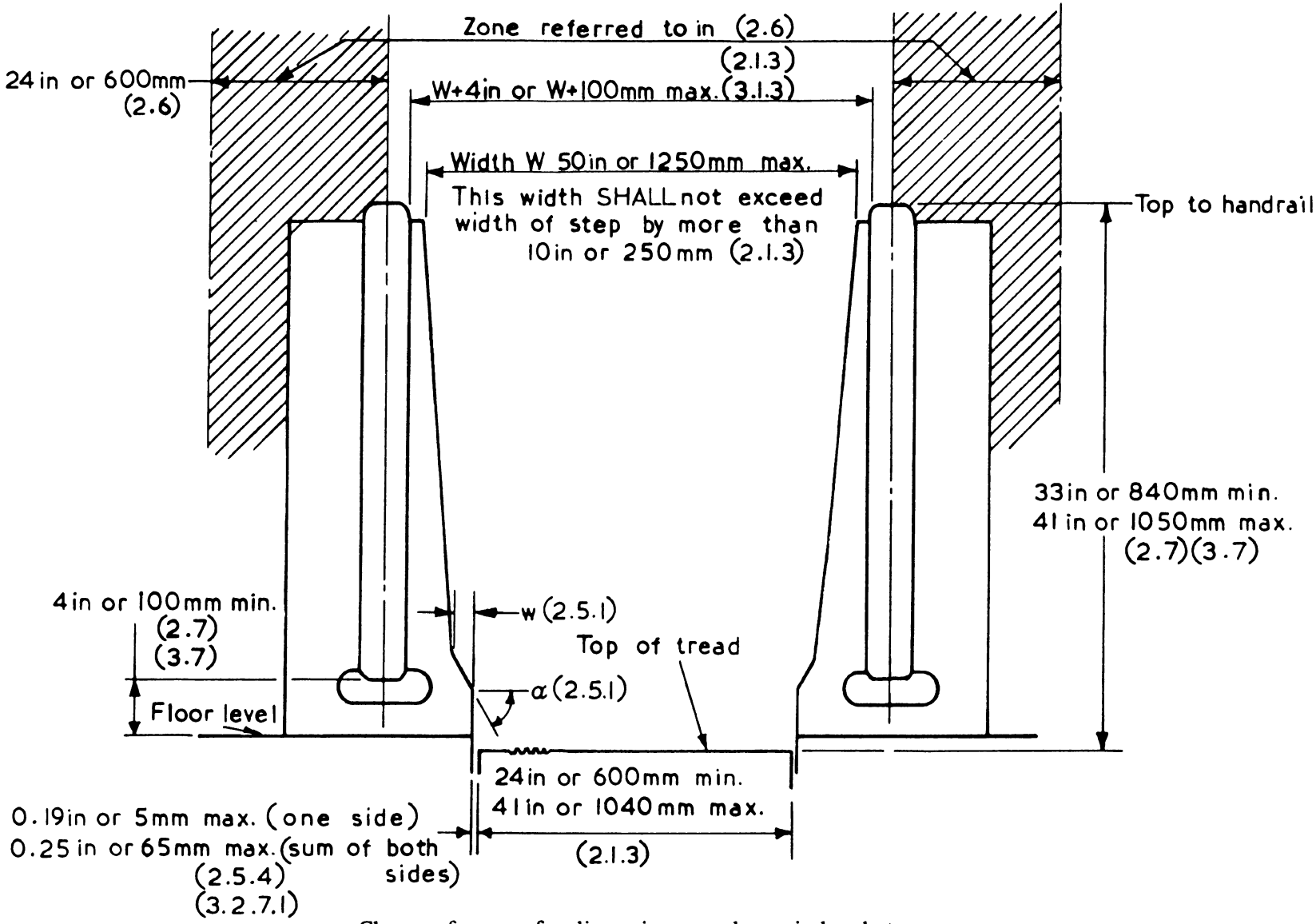
2.14 Lighting

Circuits for footlights, balustrade lighting, and machinery space lighting and socket outlets shall be independent of the power supply so that in the event of interruption of the power supply the lighting circuits will remain alive. They shall be controlled by a separate main switch and fuses.

NOTE Attention is drawn to the possible stroboscopic effect of discharge lighting.

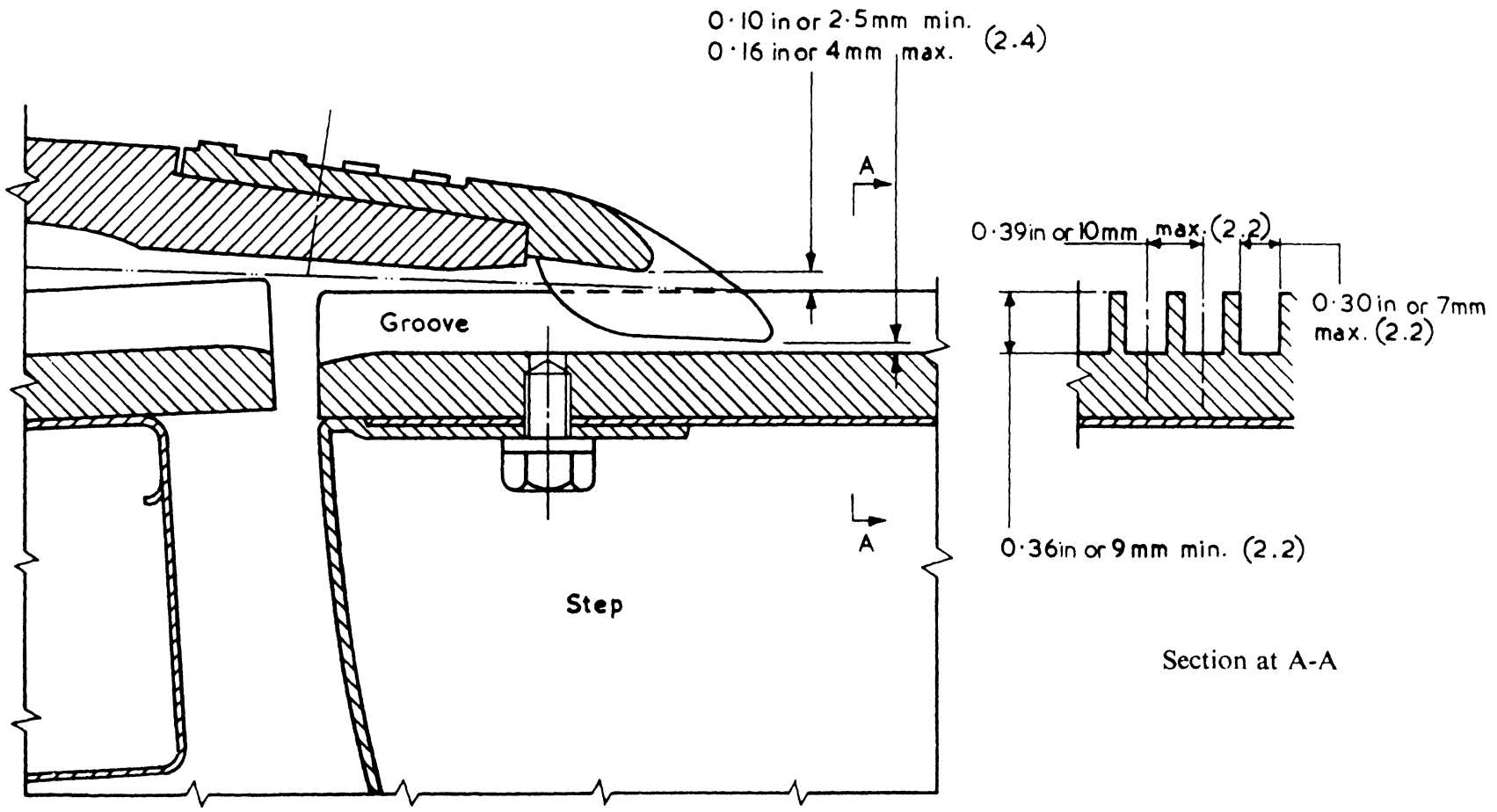
2.15 Marking

Notices advising requirements for safe use of escalators shall be provided at the top and bottom approaches of the escalator in positions readily observable by passengers before stepping on to the escalator. The notices shall be permanently and legibly marked in letters at least ⅝ in or 16 mm high. An example of a suitable form of notice is given in Appendix A .



Clause references for dimensions are shown in brackets

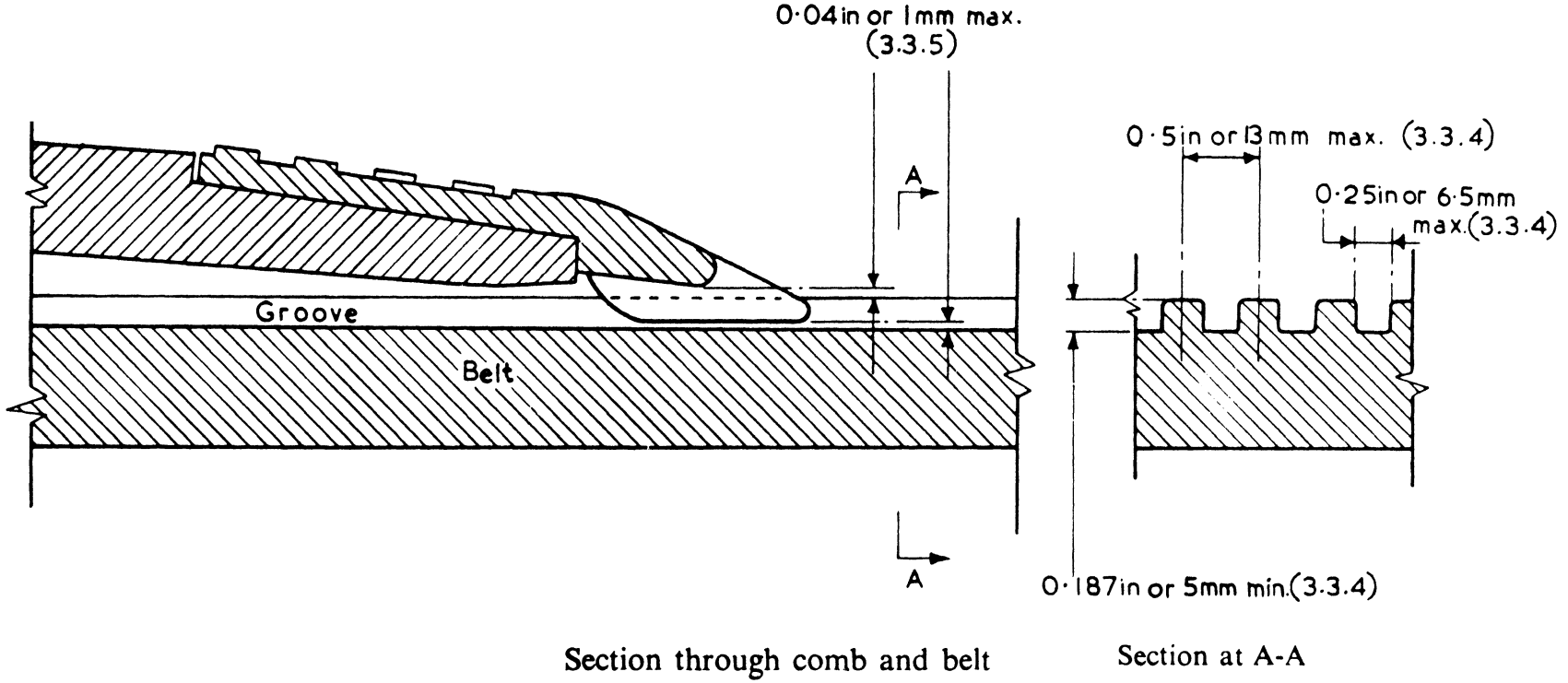
Figure 1 — Dimensions of balustrades and handrails



Section through comb and treads

Clause references for dimensions are shown in brackets

Figure 2a — Comb teeth and tread grooves



Clause references for dimensions are shown in brackets

Figure 2b — Comb teeth and belt grooves

3 Passenger conveyors

3.1 Design requirements

3.1.1 Maximum speed and treadway slope. The maximum speed of a treadway shall depend on the maximum slope at any other point than at the entrance or exit, as given in Table 1.

The angle of inclination of the treadway shall not exceed 12° from the horizontal at any point.

Table 1 — Treadway speed/slope

Maximum treadway slope at points other than entrance and exit	Maximum treadway speed
0° to 8°	180 ft/min or 0.90 m/s
Above 8° to 12°	150 ft/min or 0.75 m/s

3.1.2 Direction of entrance and exit. Entrance to or exit from a landing to a treadway shall be in the direction of travel of the conveyor.

3.1.3 Width. The requirements of **2.1.3** apply.

3.1.4 Loads

3.1.4.1 *Contract load.* The contract load shall be based on a passenger load of not less than 45 lb/ft^2 or 220 kg/m^2 of the total area of the exposed treadway. This load shall be used in the design of brakes, treadway drives, and power transmissions.

3.1.4.2 *Structural load.* For structural design purposes a static load rating of not less than 100 lb/ft^2 or 490 kg/m^2 of the total area of exposed treadway shall be used.

3.2 Treadway for pallet type passenger conveyors

3.2.1 Treadway platforms. The platforms shall be arranged to form a continuous treadway and the upper surface shall be grooved parallel to the direction of travel for the purpose of meshing with combplates at the landings. The platform and treads shall be constructed of non-flammable materials.

3.2.2 Clearance between platforms. The clearance between the ends of the treads on adjacent platforms shall not exceed 0.16 in or 4 mm.

3.2.3 Alignment of platform tread surfaces. Adjacent ends of platform tread surfaces shall not vary in elevation by more than 0.06 in or 2 mm.

3.2.4 Treadway grooves. Each treadway groove shall be not more than 0.30 in or 7 mm wide, and not less than 0.36 in or 9 mm deep, and the centre distance between adjoining grooves shall not be more than 0.39 in or 10 mm (see Figure 2). Sides of grooves may slope to provide sufficient draft angle for moulding, and may be filleted at the bottom of the grooves.

3.2.5 Transition of incline. The ends of the treadway shall be in the same plane as the landing plates, and this plane shall not exceed 5° from the horizontal. Any transition of incline on the treadway shall be made at a minimum of 60 ft or 20 m radius.

The minimum length of treadway in the same plane as the landing platform, and measured from the comb intersection, shall be 18 in or 460 mm for contract speeds not exceeding 130 ft/min or 0.65 m/s, or 36 in or 920 mm for contract speeds exceeding 130 ft/min or 0.65 m/s.

3.2.6 Platform connecting devices. Platform connecting chains, or other connecting devices between platforms, shall have a factor of safety of not less than 8 based on ultimate strength, and load rating given in **3.1.4.1**.

3.2.7 Platform wheel tracks. Wheel tracks shall be so designed and located as to prevent more than 0.13 in or 3.5 mm vertical displacement of the platforms should the connecting means between platforms break.

3.2.7.1 *Clearance with platforms.* The clearances on either side of the platforms, between the platforms and the adjacent skirting, shall not be more than 0.19 in or 5 mm and the sum of the clearances on both sides shall not be more than 0.25 in or 6.5 mm.

3.2.7.2 *Combplates.* The requirements of **2.4** apply.

3.3 Treadway for belt type passenger conveyors

3.3.1 Factor of safety. Belt type treadways shall be designed with a factor of safety of not less than 7 based on ultimate strength, and the contract load given in **3.1.4.1**.

3.3.2 Splices. Splicing of the treadway belt shall be such as to provide a continuous unbroken treadway surface of the same characteristics as the remainder of the belt.

3.3.3 Fatigue. The manufacturer shall undertake such tests as to be able to confirm that the expected life of the belt is 10 years for the specified conditions of operation.

3.3.4 Treadway grooves. The treadway surface shall be grooved in a direction parallel to its travel for the purpose of meshing with combplates at the landings. Each groove shall be not more than 0.25 in or 6.5 mm wide at the treadway surface, and not less than 0.187 in or 5 mm deep; the distance from centre to centre of adjoining grooves shall be not more than 0.5 in or 13 mm. Sides of grooves may slope for mould draft purposes and may be filleted at the bottom.

3.3.5 Combplates. The requirements of the first paragraph of **2.4** apply.

The clearance between the bottom of the comb teeth and the bottom of the treadway groove shall not exceed 0.04 in or 1 mm (see Figure 2b).

3.3.6 Roller bed. Where the treadway is supported on a series of rollers, the combination of roller spacing, belt tension and belt stiffness shall be such that the deflection in inches (or millimetres) of the treadway surface midway between rollers shall not exceed the sum of 0.1 in or 2.5 mm and 0.004 times the centre distance between rollers, when measured as follows:

The treadway surface shall be loaded midway between rollers with a 25 lb or 11.5 kg weight concentrated on a cylindrical footpiece 2 in or 50 mm long by 1 in or 25 mm diameter with its long axis across the belt. Deflection of this footpiece from its unloaded position shall not exceed the value obtained above. The rollers shall be concentric and true running within commercially accepted tolerances.

3.3.7 Edge supported belt. Where the treadway belt is transversally rigid and is supported by rollers along its edges, the following requirements shall apply:

1) With the belt fully tensioned, a load of 150 lb or 68 kg shall be applied centrally between the edge supports by means of a metal plate 6 in or 150 mm × 10 in or 250 mm × 0.75 in or 20 mm thick placed with its longitudinal axis along the length of the belt. The deflection at the centre shall not exceed $0.01L$ where L is the distance between edge supports.

2) Additional treadway supports shall be provided at intervals not exceeding 6 ft or 1.8 m along the centre line of the treadway. The supports shall be located at a level not more than 2 in or 50 mm below the underside of the treadway when it is loaded under the test conditions required by (1).

3.3.8 Clearances. The edges of treadway belt shall at no time of operation pass into the zone between the skirtings. The vertical clearance between the top of the belt and the skirting shall not exceed 0.125 in or 3.5 mm.

3.4 Landing plates

The portion of landing at each end of the treadway immediately above any mechanism shall be provided with removable landing plates to give access to the treadway driving mechanism for maintenance purposes. These landing plates shall be constructed of fire-resisting materials, and the surface shall afford a secure foothold.

3.5 Balustrading

The requirements of **2.5** apply.

3.6 Guards at ceiling intersection

On inclined passenger conveyors a solid guard shall be provided in the intersecting angle of the deckboard and any ceiling or soffit. The vertical face of the guard shall have a height of at least 8 in or 200 mm and the exposed edge of the vertical face shall be rounded to minimize shear hazards.

NOTE Where the intersection of the deckboard and a ceiling or soffit is more than 24 in or 600 mm from the centre line of the handrail, the guard may be omitted.

3.7 Handrails

Each balustrade shall be provided with a handrail moving in the same direction and at substantially the same speed as the treadway, and at a height of not less than 33 in or 840 mm and not more than 41 in or 1 040 mm measured vertically from the top of the treadway. Each moving handrail shall extend at normal height not less than 12 in or 300 mm beyond the line of the roots of the combplate teeth at each landing. The handrails shall enter into or depart from the balustrade substantially in a horizontal direction at a height not less than 4 in or 100 mm above floor level and the horizontal distance between the furthest point reached by the balustrade and this point of entry shall be not less than 10 in or 250 mm. Guards shall be provided at these points of entry.

3.8 Driving machinery

Each passenger conveyor shall be independently driven.

Each passenger conveyor shall be provided with braking that is mechanically applied and electrically held off. This braking shall be capable of bringing the passenger conveyor to rest under maximum conditions of loading, and maintaining it stationary under such conditions. This brake shall be located either on the driving machine or the main drive shaft. When springs are used to apply the brake shoes, such springs shall be in compression and adequately supported.

Where chains or belts are used to connect a driving machine to the main drive shaft, an additional brake shall be provided on this shaft which will operate automatically should the chains or belts fail. This additional brake need not be of the electrically released type if an electrically released brake is provided on the driving machine.

Braking systems shall be designed to bring the treadway smoothly to rest under all conditions of loading.

EXCEPTION. Passenger conveyors which will not run in the down direction by gravity under any load condition up to their load rating with the power supply interrupted, do not require a brake on the main drive shaft.

The electrically released brake shall stop the passenger conveyor automatically upon failure of power or when any of the safety devices operate.

Provision shall be made for handwinding the passenger conveyor in either direction, and the direction of winding corresponding to the direction of movement of the treadway shall be clearly indicated.

3.9 Safety factors

3.9.1 Supporting structure. The factor of safety used in the design of passenger conveyor supporting structures shall be not less than 3, based on the loading specified in **3.1.4.2** and the ultimate strength of the material.

Provision shall be made to retain all tension weights within the supporting structure should they become loose.

3.9.2 Platform wheel tracks and platforms. The factor of safety of tracks and platform frames shall not be less than 3, based on ultimate strength and the loading specified in **3.1.4.2**.

3.9.3 Driving machinery. The factor of safety shall not be less than 8 for steel and bronze parts, and 10 for cast iron parts, all based on the loading specified in **3.1.4.1**.

3.9.4 Chains. All chains or driving belts shall have a factor of safety of not less than 8, based on the loading specified in **3.1.4.1**. Chains whose materials of construction are such that they would require periodical heat treatment shall not be used.

3.10 Operating and safety devices

3.10.1 Starting switches. Starting switches shall be provided at both ends of the passenger conveyor and shall be of the key operated, spring-off type and positioned so as to enable the operator when using the key to see the exposed treadway.

There shall be no other means of starting provided.

3.10.2 Stop switch. Stop switches having red buttons or handles shall be provided in the machinery spaces at each end of the passenger conveyor. The opening of any one of these switches shall cause the electrical supply to be disconnected from the driving machine and brake.

The stop switches shall:

1) be of the manually opened and closed type;

2) be conspicuously and permanently marked STOP;

3) be positively opened mechanically and opening shall not be solely dependent on springs.

EXCEPTION. A stop switch need not be provided in a machinery space if the main disconnect switch is located therein.

3.10.3 Emergency stop switches. The requirements of **2.10.3** apply.

3.10.4 Speed governor. The requirements of **2.10.4** apply.

3.10.5 Broken treadway device. A device shall be provided which will cause the electrical supply to be disconnected from the driving machine and brake should the treadway belt or the connecting means between platforms break or stretch unduly. This device should also function should the normal motion of the treadway be interrupted due to an obstruction.

3.10.6 Broken drive device. The requirements of **2.10.6** apply.

3.10.7 Non-reversal device. The requirements of **2.10.7** apply.

3.10.8 Power interruption. The requirements of **2.10.8** apply.

3.11 Machinery spaces

The requirements of **2.11** apply.

3.12 Main switches and wiring

The requirements of **2.12** apply.

3.13 Controllers

The requirements of **2.13** apply.

3.14 Lighting

The requirements of **2.14** apply.

3.15 Marking

The requirements of **2.15** apply.

Appendix A Safe use of escalators and passenger conveyors

A.1 It should be appreciated that all items of moving equipment present some potential hazards to the user.

Despite the increasing application of escalators and passenger conveyors in the UK, and the more extensive use of flexible materials in footwear, the accident rate remains low. However, an analysis of accident records points to a number of potential hazards and certain recommendations can be made on this basis.

The positions of greater potential hazard to users are as follows:

1) The gaps between the sides of the moving treads and the balustrade skirting. There is a risk here of footwear being drawn in and trapped, and there is evidence of the risk being somewhat greater when the passenger is wearing shoes or boots of soft rubber or plastic composition.

This applies more particularly to escalators, where the exposed tread surface remains horizontal at all positions, whereas on passenger conveyors the treads move parallel to the direction of motion.

2) The running clearances between the tread grooves and the comb teeth (at the entrance and exit). This is another shoe trapping hazard, although the risk is very slight unless the shoes are in a bad state of repair.

3) On escalators between adjacent steps as they commence to form from the horizontal landing to the inclined portion. Maximum safety in this position is assured when the passenger stands on one step only (and not across two adjacent steps), and also by firmly grasping the moving handrail.

A.2 In order to combat the risk enumerated in 1) which is potentially the most damaging, the balustrade skirting should be firm and unyielding, and have a surface with a low coefficient of friction (**2.5.1** refers).

A.3 Suggestions have been made regarding the provision of a skirting surface which can yield at this point, with devices fitted behind it to stop the escalator movement when the devices are operated by the deflection of the surface. There are disadvantages in this, amongst the foremost of which is that the stop cannot be instantaneous. A fully loaded escalator may travel an inclined distance of some 4 ft (1.2 m) before coming to rest after a stop device has been operated, whilst a lightly loaded escalator would travel some 9 in (230 mm), the shorter distance still being sufficient to cause serious injury to a trapped foot. If stopping distances are unduly reduced, there is a real danger of passengers losing their balance. An "avalanche" of passengers could thus be caused, with grave consequences for all those involved.

A.4 Passengers should appreciate that there are certain actions they should take if maximum safety is to be achieved. To assist in this matter, notices on the subject should be displayed at the top and bottom approaches (**2.15** and **3.15** refer). Examples of suitable forms of notice are given in Figure 3.

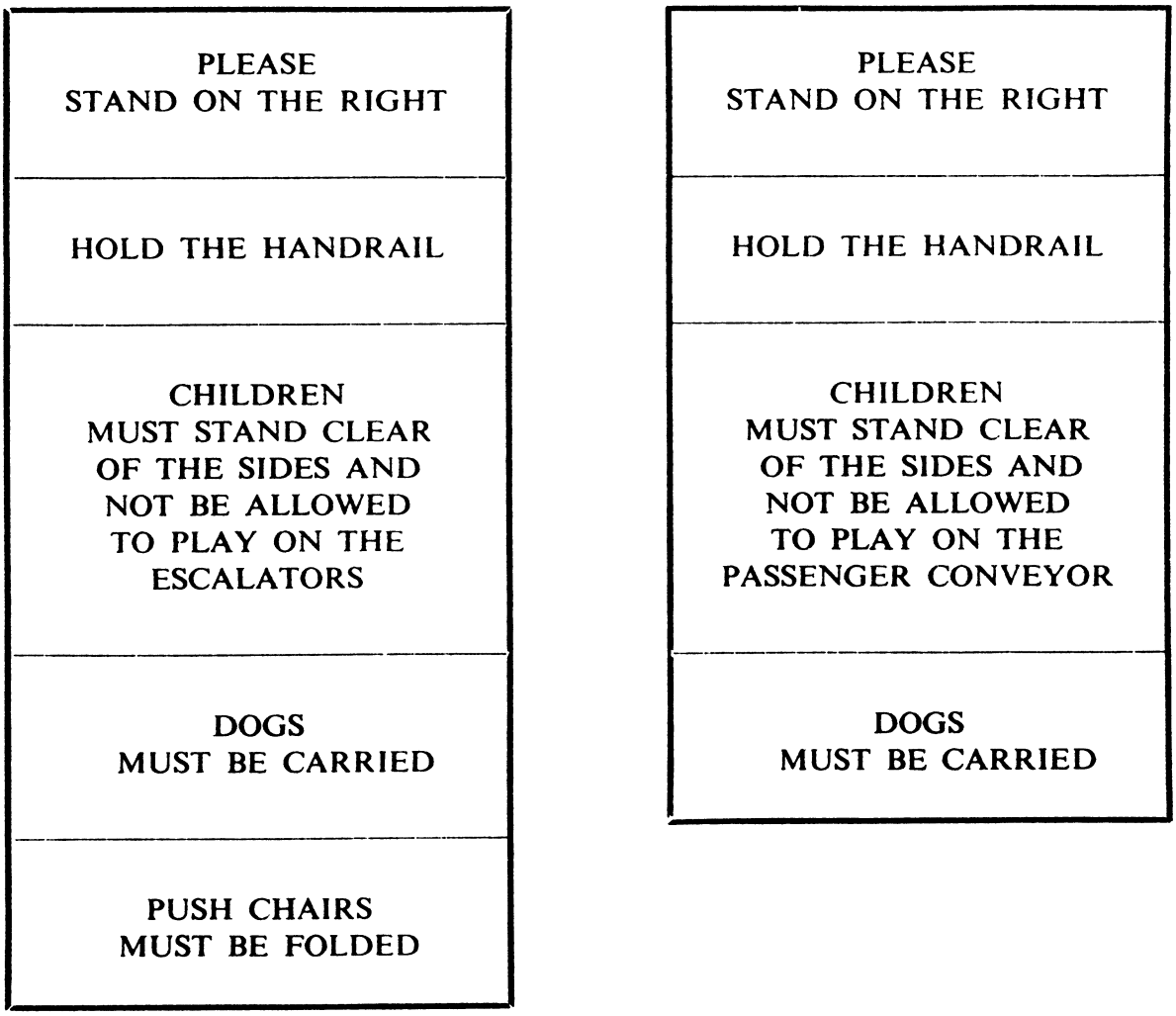


Figure 3 — Examples of suitable forms of notice for escalator and passenger conveyor approaches

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