
Lifts and service lifts

Part 1. Safety rules for the construction and installation of electric lifts

[EN title: Safety rules for the construction and installation of lifts and service lifts – Part 1: Electric lifts]

Ascenseurs et monte-charge

Partie 1. Règles de sécurité pour la construction et l'installation des ascenseurs électriques

Personen- und Lastenaufzüge sowie Kleingüteraufzüge

Teil 1. Sicherheitsregeln für die Konstruktion und den Einbau von elektrisch betriebenen Aufzügen

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*EN 81-1 contains its own contents list on page 6 of the standard. See also the 'explanatory note on the arrangement of EN 81-1', which appears at the end of the national foreword.

National foreword

This Part of BS 5655 has been prepared under the direction of the Mechanical Handling Standards Committee and is identical with European Standard EN 81-1 : 1985 which reflects annex 1 of EEC Directive 84/529/EEC dated 17 September 1984.

This revision of BS 5655 : Part 1 becomes effective from 26 September 1986 and applies to all new lift installations tendered after that date. The 1979 edition of this standard will be superseded on that date by this revision but it will not be withdrawn until administrative amendments to the technical annex of the EEC Directive have been made.

NOTE. BSI Sales Department will respond to orders for BS 5655 : Part 1 by supplying this 1986 edition. Copies of the 1979 edition may be obtained by quoting the number 'BS 5655/1/79'.

It is the first Part of a British Standard relating to lifts and service lifts, which will be progressively published to supersede portions of relevant Parts of BS 2655, the relevant obsolescent requirements being retained for reference purposes and to enable existing lift installations to be maintained. The standard comprises the following Parts.

- Part 1 Safety rules for the construction and installation of electric lifts (implementing EN 81-1), together with PD 6500 'Explanatory supplement to BS 5655 : Part 1'
- Part 2 Specification for hydraulic lifts
- Part 3*
- Part 4*
- Part 5 Specification for dimensions of standard electric lift arrangements (implementing ISO 4190/1 and ISO 4190/3)
- Part 6 Code of practice for selection and installation
- Part 7 Specification for manual control devices, indicators and additional fittings (implementing ISO 4190/5)

- Part 8 Specification for eyebolts for lift suspension
- Part 9 Specification for guide rails (implementing ISO 7465)
- Part 10 Specification for testing and inspection of electric and hydraulic lifts
- Part 11† Specification for modernization or reconstruction.

Further Parts are anticipated.

Subclause 0.1.4 of the general introduction to EN 81 (see the explanatory note at the end of this national foreword) permits each country to append to the European Standard certain amendments that are necessary to comply with current national legislation or codes of practice; the United Kingdom national variations for Part 1 of EN 81 are given in national appendix V.

Guidance (including UK views on the requirements specified in EN 81-1, clause 12.4.2.1, paragraph 3) for purchasers and manufacturers of electric lifts regarding the adoption of EEC Council Directives 84/528/EEC and 84/529/EEC in the United Kingdom will be given in a Health and Safety Executive publication. It should be particularly noted that the Directive includes certification requirements for design and component type approval and inspection in support of the test procedures given in appendix F of EN 81-1. There are also in the Directives special requirements relating to clauses 12.4.2.1, 13.1.1.4, 13.1.2 and F.0.1.6 in the standard.

EXPLANATORY NOTE ON THE ARRANGEMENT OF EN 81-1. EN 81-1 contains the 'General introduction' and the 'Scope and field of application' for EN 81 as a whole; these are followed by a contents list for Part 1 and then the text of Part 1 (beginning with the 'Introduction' to Part 1 and followed by the 'Scope and field of application' for Part 1).

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

*Reserved for future publications.
†In preparation.

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Amendment 2-1984

Key words: lifts, goods lifts, definitions, building codes, installing, safety requirements, lift cars, landing doors, elevator shafts, compensating ropes, shock absorbers, machine rooms, electrical installations, safety devices, stopping devices, locking devices, name plate, instructions, maintenance, conformity tests, certification.

English version

Safety rules for the construction and installation of lifts and service lifts Part 1. Electric lifts

Règles de sécurité pour la construction et
l'installation des ascenseurs et monte-charge
Partie 1. Ascenseurs électriques

Sicherheitsregeln für die Konstruktion und den
Einbau von Personen- und Lastenaufzügen,
sowie Kleingüteraufzügen
Teil 1. Elektrisch betriebene Aufzüge

This European Standard was accepted by CEN on 1985-06-26. The CEN members are bound to adhere to the CEN Internal Regulations which specify under which conditions this European Standard has to be given, without any alteration, the status of a national standard.

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 is established by CEN in three official versions (English, French, German). A translation made by another member under its own responsibility, in its own language, and notified to CEN has the same status.

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CEN

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

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Brief history

This European Standard was drawn up by the Technical Committee CEN/TC 10 'Passenger, goods and service lifts', the secretariat of which is held by AFNOR.

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

Belgium, Denmark, France, Germany, Italy, Netherlands, Portugal, Spain, United Kingdom.

Amendment 2 of this standard incorporates:

(a) certain technical changes in EN 81 : Part 1 : 1977 decided by the Council of EEC (see appendix 1 of Directive 84/529/EEC of 17 September 1984);

(b) updating of references to other standards (ISO etc.);

(c) certain interpretations and comments which clarify the text, but do not affect the technical content of the standard;

(d) improvement in the alignment of the three official CEN texts (French, English and German).

Amendment 2 was accepted by CEN as a result of the positive vote of the following member countries:

Denmark, France, Germany, Greece, Italy, Netherlands, Portugal, Spain, United Kingdom.

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0. General introduction

The object of this standard is to define safety rules related to passenger, goods and service lifts with a view to safeguarding persons and objects against the risk of accidents associated with the operation of lifts and service lifts.¹⁾

0.1 In drawing up this standard the following methods have been adopted.

0.1.1 An analysis of the risks has been carried out for each component that may be incorporated in a complete lift or service lift installation.

Rules have been drawn up accordingly.

0.1.2 This standard, specially associated with lifts and service lifts, does not repeat all the general technical rules applicable to every electrical, mechanical or building construction. It is of course assumed that all components shall:

0.1.2.1 be correctly designed, be of sound mechanical and electrical construction, be made of materials with adequate strength and of suitable quality and be free of defects;

0.1.2.2 be kept in good repair and working order. It will in particular be ensured that the dimensional requirements remain fulfilled despite wear.

0.1.3 This special standard for lifts and service lifts does not give rules relating to the protection against fire of building elements. However, as these rules have a direct influence on the choice of landing doors and on the specification and design of electrical control systems, it is necessary to refer to them.

0.1.3.1 The choice of the landing doors which depends on the required behaviour in fire, is dealt with in **7.2.2**. The most common structural arrangements have been shown with the corresponding types of door designated by F and S.

However, if statutory requirements lay down for certain arrangements type F instead of type S, the National Committees may make the necessary amendment.

0.1.3.2 The electrical control systems recommended for each example of structural arrangement given are described in appendix G.

0.1.4 This special standard for lifts and service lifts cannot ignore certain specifications which do not belong intrinsically to the field of these appliances or which are not the cause of barriers to trade, but which have an effect on the safety of users or servicing personnel and the upkeep of the installation.

In certain countries these specifications come within the legislative field or accepted Codes of Practice. The National Committees may, therefore, make one or more of the following amendments to the specifications of the standard which refer to this clause:

- (a) delete the marked text;
- (b) provide additional clauses (for example, definitions, clauses concerned, frequency of inspections . . .);
- (c) replace the value indicated by a value providing greater safety.

NOTE 1. Reference to this clause appears in the body of the standard in the form (N.a, b or c). The clauses concerned are indicated in the margin by the sign (N).

NOTE 2. These amendments shall form the subject, in each country, of a national appendix.

0.2 It has, however, seemed necessary to establish certain requirements of good construction, either because they are peculiar to lift manufacture or because in the case of lift utilization the requirements may be more stringent than elsewhere.

0.3 As far as possible the standard sets out only the requirements that materials and equipment have to meet in the interests of lift safety.

0.4 When mention is made of a design for the sake of clarity, this should not be considered to be the only possible design; any other solution leading to the same result can be applied if it is equivalent in operation and at least equally safe.

0.5 A study has been made of the various accidents possible with lifts in the following areas.

0.5.1 Types of possible accidents

- (a) shearing;
- (b) crushing;
- (c) falling;
- (d) impact;
- (e) trapping;
- (f) fire;
- (g) electric shock;
- (h) damage to material;
- (i) due to wear;
- (j) due to corrosion.

0.5.2 Persons to be safeguarded

- (a) users;
- (b) servicing and inspection personnel;
- (c) persons outside the lift well, the machine room and pulley room (if any).

0.5.3 Objects to be safeguarded

- (a) loads in car;
- (b) components of the lift or service lift installation;
- (c) the building in which the lift or service lift is installed.

0.6 In the standard it has been taken into account,

0.6.1 that the users have to be safeguarded against their own negligence and unwitting carelessness;

0.6.2 that there are other categories of users for whom certain rules may be less severe (N.a). In the remainder of the text these users are referred to as 'authorized and instructed users'.

In the absence of another definition (N.b), it is permissible (N) for the use of a lift to be reserved for authorized and instructed users if the instructions given them concerning its use are issued by the person responsible for the lift and if one of the following two conditions are satisfied:

- (a) operation of the lift is only possible when a key held by authorized and instructed users only is placed in a lock situated inside or outside the car;
- (b) the lift is situated on premises to which access by the public is prohibited and which, when not locked, is permanently supervised by one or more agents of the person responsible for the lift.

0.6.3 that there are service lifts, the car of which is, by definition, not accessible to persons, for which certain rules may be less severe or even waived.

¹⁾ An interpretation committee has been established to make clear, if necessary, the spirit in which the experts have drafted the various clauses of this standard.

0.7 The standard has been drawn up, taking into account in certain cases the imprudent act of a user, but it is necessary to limit this and the possibility of two simultaneous acts of this nature or the abuse of instructions for use has not been considered.

0.8 This standard deals, in the appendices, with the way in which tests must be made on certain components, as well as on the completed lift installation, when such tests are required.

0.8.1 Referring to the lift itself, the appendices mentioned below indicate the maximum which can be required.

0.8.1.1 Appendix C. Technical dossier to be provided when a preliminary authorization is required.

0.8.1.2 Appendix D. Examinations and tests before putting a lift into service.

0.8.1.3 Appendix E. The periodical examination and tests, also the examinations and tests after an important modification or after an accident. The frequency of the periodical examination and test may be specified in the national regulations.

0.8.2 Appendix F. Type examinations on certain components of the lift permit limited and simplified testing after installation of a lift and make possible batch production of these components.

1. General scope and field of application

This standard deals with permanently installed new lifts serving defined landing levels, having a car designed for the transportation of persons and/or goods, suspended by rope(s) or chain(s) or supported by one or more rams and moving at least partially between vertical guides or guides slightly inclined to the vertical. (For appliances where the inclination of the guides to the vertical exceeds 15° , this

(N) standard may usefully be taken as a basis (N.a, b).)

It does not cover the lifts which come under the following headings: paternosters, rack and pinion elevators, screw-driven elevators, mine lifts, theatrical lifts, appliances with automatic caging, skips, lifts and hoists for building and public works sites, ships' hoists, platforms for exploration or drilling at sea, construction and maintenance appliances. However, this standard may usefully be taken as a basis.

This standard need not be applied (N.a) in the following cases:

(N)

(a) a lift installed in a private residence or as a means of access to a private residence in a building, such that the lift is inaccessible to the other occupants of the building and to the general public, and if there are specific national rules concerning this type of lift;

(b) the installation of lifts serving only two levels, specialized for transporting the handicapped and where the travel does not exceed 4 m, the speed does not exceed 0.1 m/s, and the movement of the car requires continuous pressure on a button.

Certain clauses need not be applied (N.b) to the extent that space does not permit, in the following cases:

(N)

(a) lifts installed in buildings in existence at the time this standard is brought into application;

(b) important modifications (appendix E) to a lift installed before this standard is brought into application.

This standard is divided into four Parts.

Part 1 deals with electric lifts.

Part 2 deals with hydraulic lifts (in preparation).

Part 3 deals with electric service lifts (in preparation).

Part 4 deals with hydraulic service lifts (in preparation).

Part 1. Electric lifts

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Part 1. Electric lifts

0. Introduction

See general introduction (page 4).

1. Scope and field of application

Part 1 of this standard deals with the lifts defined in clause 3, driven electrically, where the car is suspended by ropes or chains.

In particular, lifts serving exclusively for the transportation of goods, but having a car dimensioned and constructed to allow access by persons, shall be entered in the category 'lifts' and not in the category 'service lifts'. (See clause 3, 'Definitions'.)

2. References

ISO 834-1975	Fire resistance tests — Elements of building construction
ISO 2532-1974	Steel wire ropes — Vocabulary
IEC Publication	Clearances and creepage distances for low-voltage contactors (in preparation within SC 28A of the IEC, at present Appendix B of IEC Publication 158/1)
CENELEC Harmonization Documents	
HD 21 S2 - 1981	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
HD 22 S2 - 1981	Rubber insulated cables of rated voltages up to and including 450/750 V
HD 214 S2 - 1980	Recommended method for determining the comparative tracking index of solid insulating materials under moist conditions
HD 359 - 1976	Flat polyvinylchloride sheathed flexible cables
HD 360 - 1976	Rubber-insulated lift cables for normal use
HD 384-4-41 - 1980	Electrical installations of buildings Part 4: Protection for safety Chapter 41: Protection against electric shock
HD 419 - 1982	Low-voltage switchgear and control-gear contactors
HD 420 - 1982	Control switches (low-voltage switching devices for control and auxiliary circuits, including contactor relays)
HD	Classification of external influences (in preparation, at present Clause 32 of IEC Publication 364-3 - 1977)

3. Definitions

The following definitions are intended to indicate precisely the technical sense in which the terms are used in the present standard.

For convenience of reference they are grouped in alphabetical order rather than according to the types of equipment to which they apply. This is in order to avoid needless repetition.

authorized and instructed user (usager autorisé et averti) (befugter und eingewiesener Benutzer). Person authorized

by the person responsible for the installation to use the lift and who has been instructed in its use.

available car area (surface utile de la cabine) (Nutzfläche des Fahrkorbes). Area of the car measured at a height of 1.0 m above floor level, disregarding handrails, which is available for passengers or goods during operation of the lift.

In the case of a car without doors, a strip 0.1 m deep in front of each car sill is omitted from the calculation of the available area.

buffer (amortisseur) (Puffer). A resilient stop at the end of travel, and comprising a means of braking using fluids or springs (or other similar means).

goods passenger lift (ascenseur de charge)¹⁾ (Lastenaufzug). A lift mainly intended for the transport of goods, which are generally accompanied by persons.

guides (guides) (Führungsschienen). The components which provide guiding for the car sling or the counterweight, if there is one.

instantaneous safety gear (parachute à prise instantanée) (Sperrfangvorrichtung). A safety gear in which the full gripping action on the guides is almost immediate.

instantaneous safety gear with buffered effect (parachute à prise instantanée avec effet amorti) (Sperrfangvorrichtung mit Dämpfung). A safety gear in which the full gripping action on the guides is almost immediate, but the reaction on the car or counterweight is limited by presence of an intermediate buffering system.

levelling (nivelage) (Einfahren). An operation which improves the accuracy of stopping at landings.

lift (ascenseur) (Aufzug). A permanent lifting equipment serving defined landing levels, comprising a car, *whose dimensions and means of construction clearly permit the access of persons*; running at least partially between rigid vertical guides or guides whose inclination to the vertical is less than 15°.

lift car (cabine) (Fahrkorb). A part of the lift which carries the passengers and/or other loads.

lift machine (machine) (Triebwerk). The unit including the motor which drives and stops the lift.

machine room (local des machines) (Triebwerksraum). A room in which machine or machines and/or the associated equipment are placed.

minimum breaking load of a lifting rope (charge de rupture minimale d'un câble) (Mindestbruchkraft eines Seiles). This load is the product of the square of the nominal diameter of the rope (in square millimetres) and the nominal tensile strength of the wires (in newtons per square millimetre) and a coefficient appropriate to the type of rope construction. (ISO 2532).

The effective breaking load obtained in a rupture test on a sample of rope following a defined method, shall be at least equal to the minimum breaking load.

non-commercial vehicle lift (monte-voitures) (Aufzug zur Beförderung von Kraftfahrzeugen). A lift whose car is suitably dimensioned for carrying private motor cars.

overspeed governor (limiteur de vitesse) (Geschwindigkeitsbegrenzer). A device which, when the lift attains a predetermined speed, causes the lift to stop, and if necessary causes the safety gear to be applied.

¹⁾The French expression 'ascenseur de charge' has been introduced into the French language document with the aim of harmonizing the texts in the three languages of CEN and of simplifying the wording. It does not in any way define a particular or supplementary category of lift.

passenger (passager) (Fahrgast). Any person transported by a lift.

pit (cuvette) (Schachtgrube). The part of the well situated below the lowest landing level served by the car.

positive drive lift (includes drum drive) (ascenseur à treuil attelé) (Trommelaufzug, Kettenaufzug). A lift suspended by chains or lifting ropes driven by means other than friction.

positive drive service lift (includes drum drive) (monte-charge à treuil attelé) (Trommelaufzug/Kettenkleingüteraufzug). A service lift suspended by chains, or ropes driven by means other than friction.

progressive safety gear (parachute à prise amortie) (Bremsfangvorrichtung). A safety gear in which deceleration is effected by a braking action on the guides and for which special provisions are made so as to limit the forces on the car or counterweight to a permissible value.

pulley room (local des poulies) (Rollenraum). A room not containing the machine, and in which pulleys are located and in which the overspeed governors and the electrical equipment may also be housed.

rated load (charge nominale) (Nennlast). The load for which the equipment has been built and for which normal operation is guaranteed by the vendor.

rated speed (vitesse nominale) (Nenngeschwindigkeit). The speed of the car for which the equipment has been built and for which normal operation is guaranteed by the vendor.

re-levelling (isonivelage) (Nachstellung). An operation, after the lift has stopped, to permit the stopping position to be corrected during loading or unloading, if necessary by successive movements (automatic or inching).

safety gear (parachute) (Fangvorrichtung). A mechanical drive for stopping, and maintaining stationary on the guides, the lift car or counterweight in case of overspeeding in the downward direction or breaking of the suspension.

safety rope (câble de sécurité) (Sicherheitsseil). An auxiliary rope attached to the car and the counterweight for the purpose of tripping a safety gear in case of suspension failure.

service lift (monte-charge) (Kleingüteraufzug). A permanent lifting equipment serving defined landing levels, comprising a car, the interior of which is *inaccessible to persons* on account of its dimensions and means of construction, running at least partially between rigid vertical guides or guides whose inclination to the vertical is less than 15° .

To satisfy the condition of inaccessibility, the car dimensions do not exceed:

- (a) floor area 1.00 m²;
- (b) depth 1.00 m;
- (c) height 1.20 m.

A height greater than 1.20 m is permissible, however, if the car comprises several permanent compartments, each of which satisfies the above requirements.

sling (étrier) (Rahmen). The metal framework carrying the car or counterweight, connected to the means of suspension. This sling may be integral with the car enclosure.

toe guard (garde-pieds) (Schürze). An apron having a smooth vertical part extending downwards from the sill of the landing or car entrance.

traction drive lift (ascenseur à adhérence) (Treibscheiben-Aufzug). A lift whose lifting ropes are driven by friction in the grooves of the driving sheave of the machine.

traction drive service lift (monte-charge à adhérence) (Treibscheiben-Kleingüteraufzug). A service lift whose lifting ropes are driven by friction in the grooves of the driving sheave of the machine.

unlocking zone (zone de déverrouillage) (Entriegelungszone). A zone, extending above and below the stopping level, in which the car floor must be to enable the corresponding landing door to be unlocked.

user (usager) (Benutzer). Person making use of the services of a lift installation.

well (gaine) (Schacht). The space in which the car and the counterweight, if there is one, travels. This space is bounded by the bottom of the pit, the walls and the roof of the well.

4. Symbols and abbreviations

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

4.2 Symbols

Measurements (in the order they appear in the document)	Symbol	Unit
Rated speed	v	m/s
Sum of the mass of the empty car and the masses of the portion of the travelling cables and any compensation devices, suspended from the car	P	kg
Rated load (mass)	Q	kg
Ratio between the greater and the smaller static force in the parts of the rope located on either side of the traction sheave	$\frac{T_1}{T_2}$	(1)
Coefficient taking account of the acceleration, deceleration and specific conditions of the installation	C_1	(1)
Standard acceleration of free fall	g_n	m/s ²
Braking deceleration of the car	a	m/s ²
Coefficient taking account of the variation in profile of the traction sheave groove due to wear	C_2	(1)
Base of natural logarithms	e	(1)
Coefficient of friction of ropes in traction sheave grooves	f	(1)
Coefficient of friction between steel wire ropes and sheaves	μ	(1)
Angle of wrap of the ropes on the traction sheave	α	rad
Angle of the undercut grooves or semi-circular grooves in the traction sheave	β	rad
Angle of the vee grooves in the traction sheave	γ	rad
Diameter of traction ropes	d	mm
Diameter of traction sheave	D	mm
Number of ropes	n	(1)
Specific pressure of the ropes in the traction sheave grooves	p	N/mm ²
Static force in the ropes to the car at the level of the traction sheave when the car is stationary at the lowest level with its rated load		
Speed of the ropes corresponding to the rated speed of the car		

Measurements (in the order they appear in the document)	Symbol	Unit
Buckling stress in the guides during safety gear operation	σ_k	N/mm ²
Cross section area of a guide	A	mm ²
Buckling factor	ω	(1)
Coefficient of slenderness	λ	(1)
Maximum distance between guide brackets	l_k	mm
Radius of gyration	i	mm
Radiation intensity at a distance of 1 m	W_1	W/cm ²
Radiation intensity measured at a distance equal to half the diagonal of the door entrance being tested	W_Z	W/cm ²
Absorption coefficient of the radiation measuring apparatus	a	%
Conversion factor for radiation measuring	F	(1)
Ratio between the smallest and largest dimensions of the door entrance being tested	L	(1)
Diagonal of the door entrance being tested	Z	m
Width of the 'door assembly' being tested	l	m
Width of the free passage of the door being tested	E	m
Number of panels of the door being tested	n_v	(1)
Total permissible mass	$(P+Q)_1$	kg
Tripping speed of overspeed governor	v_1	m/s
Energy which can be absorbed by one safety gear block	K, K_1, K_2	J
Height of free fall	h	m
Mass necessary to compress the spring of a buffer completely	C_r	kg
Total compression of the spring	F_1	m

(1) Measurement without unit

4.3 Abbreviations

Type F door. Door fulfilling all the criteria of fire resistance defined in appendix F.2.

Type S door. Door with only the degree of integrity defined in appendix F.2.

5. Lift well

5.1 General provisions

5.1.1 The requirements of this clause relate to wells containing one or more lift cars.

5.1.2 The counterweight of a lift shall be in the same well as the car.

5.2 Well enclosure

5.2.1 Each well shall be totally enclosed by imperforate walls, floor and ceiling, as defined in 5.3.

The only permissible openings are:

- (a) openings for landing doors;
- (b) openings for inspection and emergency doors to the well and inspection traps;
- (c) vent openings for escape of gases and smoke in the event of fire;
- (d) ventilation openings;
- (e) permanent openings between the well and the machine or pulley rooms.

Specific case. When the well is not required to contribute to the protection of the building against the spread of fire, it may be permitted (N.a, b):

- (a) to limit the height of the walls on faces other than the entrance faces, to a height of 2.5 m above any points normally accessible to persons;
 - (b) at the entrance faces of the well to use mesh or perforated panels upwards from a height of 2.5 m above landing level. (These means of protection are not required if the car door is locked mechanically. **(5.4.3.2.2)**)
- The dimensions of the mesh or perforations shall not exceed 75 mm measured either horizontally or vertically.

5.2.2 Inspection and emergency doors – Inspection traps

5.2.2.1 Inspection and emergency doors, and inspection traps to the well, shall not be permitted except on grounds of safety to users or the requirements of servicing.

5.2.2.1.1 Inspection doors shall have a minimum height of 1.4 m and a minimum width of 0.60 m.

Emergency doors shall have a minimum height of 1.8 m and a minimum width of 0.35 m.

Inspection traps shall have a maximum height of 0.5 m and a maximum width of 0.50 m.

5.2.2.1.2 When the distance between consecutive landing doorsills exceeds 11 m, intermediate emergency doors shall be provided, such that the distance between sills is not more than 11 m. This requirement is not called for in the case of adjacent cars, each fitted with an emergency door meeting the requirements of **8.12.4**.

5.2.2.2 Inspection and emergency doors and inspection traps shall not open towards the interior of the well.

5.2.2.2.1 The doors and traps shall be provided with a key-operated lock, capable of being reclosed and relocked without a key.

Inspection and emergency doors shall be capable of being opened from inside the well without a key even when locked.

5.2.2.2.2 Operation of the lift shall automatically depend on the maintenance in the closed position of these doors and traps. For this purpose electric safety devices in conformity with **14.1.2** shall be employed.

The operation of the lift with an inspection trap open may be permitted during inspection operations, if this operation requires continuous actuation of a device (only accessible when the trap is open) allowing the electric safety drive normally proving the closure of the trap to be shunted.

5.2.2.3 Inspection and emergency doors and inspection traps shall be imperforate and satisfy the same requirements for mechanical strength as the landing doors (N.b).

5.2.3 Ventilation of the well. The well shall be suitably ventilated. It shall not be used to provide ventilation of rooms other than those for the service of the lift.

Provision shall be made, at the top of the well, for ventilation openings, with a minimum area of 1 % of the horizontal cross section of the well to the outside either directly or via the machine or pulley rooms (N.b, c).

5.3 Walls, floor and ceiling of the well. The structure of the well shall be able to support at least the loads which may be applied by the machine, by the guides at the moment of safety gear operation, or in the case of off-centering of the load in the car, by the action of the buffers, or those which may be applied by the anti-rebound device.

For the evaluation of the forces during safety gear operation, or buffer operation, see clause 5, notes.

The walls, floor and ceiling of the well shall:

- (a) be made of incombustible durable materials which do not assist the creation of dust (N.b);
- (b) have sufficient mechanical strength.

In the case of lifts without car doors, the wall facing the car entrances shall possess mechanical strength such that when a force of 300 N is applied at right angles to the wall at any point on either face, being evenly distributed over an area of 5 cm² in round or square section, they shall:

- (a) resist without permanent deformation
- (b) resist without elastic deformation greater than 10 mm.

5.4 Construction of the walls of lift wells and landing doors facing a car entrance

5.4.1 The following requirements relating to *landing doors and walls*, or parts of walls, *facing a car entrance* shall apply over the full height of the well.

For clearances between car and wall of the lift well facing the car entrance, see clause 11.

5.4.2 The *assembly* comprising the *landing doors* and any *wall* or part of a wall facing the car entrance, shall form an imperforate surface over the full entrance width of the car, excluding the operational clearances of doors.

5.4.3 For lifts with car door

5.4.3.1 Below each landing sill over a vertical distance of not less than half the unlocking zone plus 50 mm, the wall of the lift well shall comply with the requirements of 5.4.4(a) and 5.4.4(b) below.

In addition, it shall be:

- (a) either connected to the lintel of the next door, or
- (b) extended downwards using a hard smooth chamfer whose angle to the horizontal plane shall be at least 60°. The projection of this chamfer on the horizontal plane shall be not less than 20 mm.

5.4.3.2 Elsewhere, the horizontal distance between the wall of the well and the sill or entrance frame of the car or door (or extreme edge of the doors in the case of sliding doors) shall not exceed 0.15 m. The object is to prevent:

- (a) a person falling down the well;
- (b) a person getting into the gap between car door and well during normal operation of the lift (it is with this in mind that the measurement of 0.15 m shall be checked, particularly in the case of interlinked telescopic doors).

5.4.3.2.1 A horizontal distance of 0.20 m may be permitted:

- (a) over a vertical distance of 0.5 m (maximum), or

- (b) in the case of goods passenger lifts and non-commercial vehicle lifts with vertically sliding doors.

5.4.3.2.2 The conditions laid down in 5.4.3.2 need not be observed if the car is provided with a mechanically locked door which can only be opened in the unlocking zone of a landing door.

The operation of the lift shall automatically depend on the locking of the corresponding car door except in the cases covered in 7.7.2.2. This locking shall be proved by an electric safety device in conformity with 14.1.2.

5.4.4 For lifts without car door:

- (a) The assembly described in 5.4.2 shall form a continuous vertical surface composed of smooth and hard elements, such as metal sheets, hard facings or materials equivalent with regard to friction. Plaster faced and glass walls are forbidden. Additionally, this assembly shall extend at least 25 mm on both sides beyond the full car entrance width.

- (b) Any projections shall be less than 5 mm. Projections exceeding 2 mm shall be chamfered at least 75° to the horizontal.

- (c) When the landing doors are fitted with recessed handles, the depth of the cavity on the well side shall not exceed 30 mm and the width 40 mm. The walls of the cavity above and below shall form an angle of at least 60°, preferably 75°, with the horizontal. The arrangement of the handles or bars shall limit the risk of catching and prevent fingers from being trapped behind them or becoming wedged.

5.5 Protection of any spaces located below the car or the counterweight

5.5.1 Lift wells should preferably not be situated above a space accessible to persons.

5.5.2 If accessible spaces do exist underneath the car or counterweight, the base of the pit shall be designed for an imposed load of at least 5000 N/m², and:

- (a) either there shall be installed below the counterweight buffer a solid pier extending down to solid ground, or
- (b) the counterweight shall be equipped with safety gear.

5.6 Well containing cars and counterweights belonging to several lifts or service lifts

5.6.1 In the lower part of the well there shall be a partition between the moving parts (car or counterweight) of different lifts or service lifts.

This partition shall extend at least from the lowest point of travel of car or counterweight to a height of 2.5 m above the floor of the pit (N.c).

5.6.2 Further, if the horizontal distance between the edge of the car roof and a moving part (car or counterweight) of an adjacent lift or service lift is less than 0.3 m, the partition called for in 5.6.1 shall be extended through the full height of the well and over the effective width.

This width shall be at least equal to that of the moving part (or part of this) which is to be guarded, plus 0.1 m on each side.

5.7 Headroom and pit

5.7.1 Top clearances for traction drive lifts (see note 3 at the end of clause 5).

5.7.1.1 When the counterweight rests on its fully compressed buffer(s), the following four conditions shall be satisfied at the same time:

- (a) The car guide lengths shall be such as would accommodate a further guided travel, expressed in m, of at least $0.1 + 0.035v^2$ ¹⁾.
- (b) The free vertical distance between the level of the highest area on the car roof whose dimensions comply with 8.13.1(b) (areas on parts according to 5.7.1.1(c) excluded) and the level of the lowest part of the roof of the well (including beams and components located under the roof) situated in the projection of the roof of the car, expressed in m, shall be at least $1.0 + 0.035v^2$.
- (c) The free distance, expressed in m, between the lowest parts of the roof of the well and:
 - (1) The highest pieces of equipment fixed on the roof of the car enclosure, except for those covered in (2) below, shall be at least $0.3 + 0.035v^2$.
 - (2) The highest part of the guide shoes or rollers, of the rope attachments and of the header or parts of vertically sliding doors, if any, shall be at least $0.1 + 0.035v^2$.
- (d) There shall be above the car sufficient space to accommodate a rectangular block not less than 0.5 m x 0.6 m x 0.8 m resting on one of its faces. For lifts with direct roping, the suspension ropes and their attachments may be included in this space, provided that no rope centre-line shall be at a distance exceeding 0.15 m from at least one vertical surface of the block.

5.7.1.2 When the car rests on its totally compressed buffers, the counterweight guide lengths shall be such as would accommodate a further guided travel expressed in m, of at least $0.1 + 0.035v^2$ ¹⁾.

5.7.1.3 When the retardation of the lift is positively monitored, in accordance with 12.8, the value of 0.035 in 5.7.1.1 and 5.7.1.2 for calculation of clearances may be reduced:

- (a) to 1/2 for lifts whose rated speed does not exceed 4 m/s;
- (b) to 1/3 for lifts whose rated speed exceeds 4 m/s.

However, this value may not in either event be less than 0.25 m.

5.7.1.4 For lifts which are fitted with compensating ropes having a tensioning pulley equipped with an anti-rebound device (braking or lock-down device), the value of $0.035v^2$ may be replaced in the calculation of the clearances by a figure related to the possible travel of that pulley (depending on the roping used) plus 1/500 of the travel of the car, with a minimum of 0.2 m to take account of the elasticity of the ropes.

5.7.2 Top clearances for positive drive lifts

5.7.2.1 The travel of the car upwards from the top floor until it strikes the upper buffers shall be at least 0.5 m. The car shall be guided to the limit of its buffer stroke.

5.7.2.2 When the upper buffers are fully compressed by the car the following conditions shall be satisfied at the same time.

- (a) The free vertical distance between the level of the highest area on the car roof whose dimensions comply

with 8.13.1(b) (areas on parts according to 5.7.2.2(b) excluded) and the level of the lowest part of the roof of the well (including beams and components located under the roof) situated in the projection of the roof of the car, shall be at least 1.0 m.

(b) The free distance between the lowest part of the roof of the well and:

- (1) The highest pieces of equipment fixed on the car roof, except for those covered by (2) below, shall be at least 0.3 m.
- (2) The highest part of the guide shoes or rollers, of the rope attachments, or of the header, or the parts of vertically sliding doors, if any, shall be at least 0.1 m.
- (c) There shall be above the car sufficient space to accommodate a rectangular block not less than 0.5 m x 0.6 m x 0.8 m resting on one of its faces. For lifts with direct roping, the suspension ropes or chains and their attachments may be included in this space, provided that no rope, or chain, centre-line shall be at a distance exceeding 0.15 m from at least one vertical surface of the block.

5.7.2.3 When the car rests on the fully compressed buffers the guide lengths of the counterweight, if there is one, shall be such as would accommodate a further guided travel of at least 0.3 m.

5.7.3 Pit

5.7.3.1 The lower part of the well shall consist of a pit, the bottom of which shall be smooth and approximately level, except for any buffer and guide bases and water drainage devices.

After the building-in of guide fixings, buffers, any grids, etc., the pit shall be impervious to infiltration of water.

5.7.3.2 If there is an access door to the pit, other than the landing door, it shall comply with the requirements of 5.2.2.

Such a door shall be provided if the pit depth exceeds 2.5 m and if the layout of the building so permits.

If there is no other access a permanent means shall be provided inside the well, easily accessible from the landing door, to permit competent persons to descend safely to the floor of the pit. This shall not project into the clear running space of the lift equipment.

5.7.3.3 When the car rests on its fully compressed buffers, the following conditions shall be simultaneously fulfilled.

- (a) There shall be in the pit sufficient space to accommodate a rectangular block not less than 0.5 m x 0.6 m x 1.0 m resting on one of its faces.
- (b) The clear distance between the bottom of the pit and
 - (1) the lowest portions of the car, except for items detailed in (2) below, shall be at least 0.5 m;
 - (2) the lowest parts of the guide shoes or rollers of safety gear blocks, toe guards or parts of vertical sliding doors, shall be at least 0.1 m.

5.7.3.4 There shall be in the pit:

- (a) a *switch* accessible on opening the door to the pit to stop the lift and keep it stopped, such that there is no risk of mistaking the stop position (see 15.7).

This switch shall conform to the requirements of 14.2.2.3;

- (b) an electric *socket outlet* (13.6.2).

¹⁾ $0.035v^2$ represents half the gravity stopping distance corresponding to 115 % of the rated speed $[\frac{1}{2} \times \frac{(1.15v)^2}{2g_n} = 0.0337v^2$ rounded to $0.035v^2$].

5.8 Exclusive use of the lift well. The well shall be exclusively for the lift. It shall not contain cables or devices, etc., other than for the lift. (The well may, however, contain heating equipment for the lift well excluding hot water or steam heating; however, any control and adjustment devices shall be located outside the well.)

5.9 Lighting of the well. The well shall be provided with permanent electric lighting, allowing it to be lit during repairs or servicing, even when all doors are closed.

This lighting shall comprise one lamp at most 0.5 m from the highest and lowest points in the well with intermediate lamps at 7 m, maximum spacing.

If use is made of the exception provided for in 5.2.1, specific case, this lighting may not be necessary if the electric lighting existing in the neighbourhood of the well is sufficient.

Clause 5. Notes

NOTE 1. Evaluation of the vertical forces during safety gear operation. The force (N) in each guide developed during safety gear operation may be evaluated approximately according to the following formulae:

- (a) instantaneous safety gear:
 - (1) except captive roller type $25(P + Q)$
 - (2) captive roller type $15(P + Q)$
- (b) progressive safety gear $10(P + Q)$

where

P = sum of the mass of the empty car and the masses of the portion of the travelling cables and any compensation devices, suspended from the car (kg)

Q = rated load (kg)

NOTE 2. Evaluation of the reaction at the bottom of the pit at the moment of safety gear operation or activation of buffers. The reactions (N) may be evaluated as follows:

beneath each guide:

10 times the mass of the guide (kg) plus the reaction (N) at the moment of operation of the safety gear (if the guides are suspended, the reaction at the points of attachment shall be evaluated by analogy with what is done in the case of guides supported at the bottom of the pit)

beneath the car buffer supports:

$40(P + Q)^*$

beneath the counterweight buffer supports:

40 times the mass (kg) of the counterweight.

NOTE 3. Graph illustrating the top clearances for traction drive lifts. Figure 1 is a graph illustrating these clearances.

6. Machine and pulley rooms

6.1 General provisions

6.1.1 Machines, their associated equipment and pulleys, shall be accessible only to authorized persons (maintenance, inspection and rescue).

6.1.2 The machine and its associated equipment shall be in a special room, comprising solid walls, ceiling and door and/or trap.

6.1.2.1 As exceptions to the above requirements:

6.1.2.1.1 Diverter pulleys may be installed in the headroom of the well provided that they are located outside the projection of the car roof and that examinations and tests and maintenance operations can be carried out in complete safety from the car roof or from outside the well.

*Value of 'P' is different in notes 1 and 2 due to the fact that the portions of the travelling cables and compensation devices, supported by the car, vary according to the position of the car in the well.

However, a diverter pulley, with single or double wrap, may be installed above the car roof for diverting towards the counterweight, provided that its shaft can be reached in complete safety from the car roof.

6.1.2.1.2 The traction sheave may be installed in the well, provided that:

- (a) the examinations and tests and the maintenance operations may be carried out from the machine room;
- (b) the openings between the machine room and the well are as small as possible.

6.1.2.1.3 The overspeed governor may be installed in the well, provided that the examinations and tests and the maintenance operations may be carried out from outside the well.

6.1.2.1.4 The diverter pulleys and the traction sheaves in the well shall be provided with devices to avoid:

- (a) bodily injury;
- (b) the suspension ropes or chains leaving their grooves if slack;
- (c) the introduction of foreign objects between ropes and grooves.

6.1.2.1.5 The devices used shall be such that they do not hinder examinations and tests or maintenance operations. The dismantling of these devices shall be necessary only in the following cases:

- (a) replacement of a rope;
- (b) replacement of a pulley;
- (c) re-cutting of the grooves.

6.1.2.2 The machines, their associated equipment and pulleys, may be placed in rooms used for other purposes (N.a, b) (exceptional access e.g. to flat roofs) if they are separated from the rest of the room by an enclosure at least 1.8 m high provided with a lockable access door. (N)

6.1.2.3 Machine or pulley rooms, or enclosures referred to in 6.1.2.2 shall not be used for purposes other than lifts. They shall not contain ducts, cables or devices other than for the lift.

These rooms may, however, contain:

- (a) machines for service lifts or escalators;
- (b) equipment for air-conditioning or heating of these rooms, excluding hot water (N.a) or steam heating; (N)
- (c) fire detectors or extinguishers, with a high operating temperature, appropriate for the electrical equipment, stable over a period of time, and suitably protected against accidental impact.

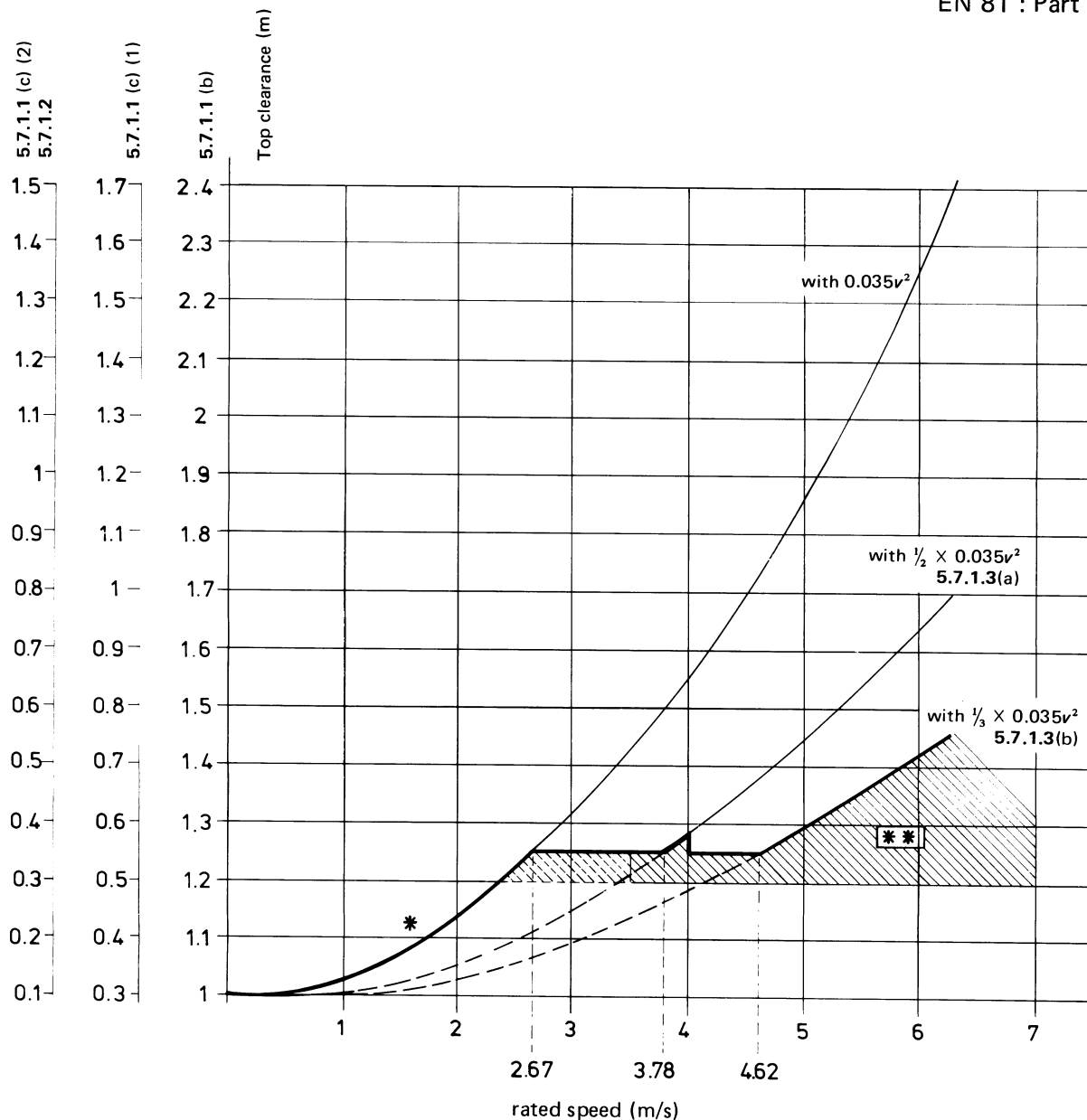
6.1.2.4 The machine rooms shall preferably be placed above the well.

6.2 Access

6.2.1 Access from the public way to the interior of the machine and pulley rooms shall:

- (a) be capable of being properly lit by (a) permanent electric light fixture(s);
- (b) be easy to use in complete safety in all circumstances without necessitating entry into private premises;

The access ways to the machine rooms and the entrances themselves shall be at least 1.8 m high. Door sills and edges with height not exceeding 0.4 m are not taken into consideration (N.c). (N)



* In heavy lines: minimum clearance possible when maximum advantage is taken of the possibilities afforded in 5.7.1.3.

** Area of values which can be obtained by calculations in accordance with 5.7.1.4 in the case of lifts with compensation pulleys fitted with an anti-rebound device. This device is only required for speeds of over 3.5 m/s but is not prohibited for lower speeds.

These values depend on the design of the anti-rebound device and the travel of the lift.

Figure 1. Graph illustrating the top clearances for traction drive lifts (5.7.1)

6.2.2 Access for persons to machine or pulley rooms shall, for preference, be effected entirely by way of stairs

(N) If it is impractical to install stairs, then ladders may be used which satisfy the following conditions (N.b, c):

- (a) they shall not be liable to slip or to turn over;
- (b) they shall, when in position, form an angle of between 70° and 76° with the horizontal, unless they are fixed and their height is less than 1.5 m;
- (c) they shall be exclusively used for this purpose and be kept always available in the vicinity of the access level; the necessary provisions shall be made for that purpose;
- (d) adjacent to the top end of the ladder, there shall be one or more hand holds within easy reach;
- (e) when the ladders are not fastened, fixed attachment points shall be provided.

6.2.3 Means of access shall be provided for the hoisting of heavy equipment during erection and, if need be, its replacement, so that this can be done safely, especially avoiding handling on stairs.

6.3 Construction and equipment of machine rooms

6.3.1 Mechanical strength, floor surface, sound insulation

6.3.1.1 Machine rooms shall be so constructed to withstand the loads and forces to which they will normally be subjected.

They shall be in durable material not favouring the creation of dust.

6.3.1.2 Room floors shall be of non-slip material.

6.3.1.3 When the function of the building requires it (e.g. dwellings, hotels, hospitals, schools, libraries, etc.) the walls, floors and ceilings of machine rooms shall absorb substantially the sounds associated with the operation of the lifts (N.b).

6.3.2 Dimensions

6.3.2.1 The dimensions of machine rooms shall be sufficient to permit easy and safe access for servicing personnel to all the components, especially the electrical equipment.

In particular there shall be provided:

- (N) (a) a clear horizontal area in front of the panels and the cabinets. This area is defined as follows: (N.c)
 - depth*, measured from the external surface of the enclosures, at least 0.7 m. This distance may be reduced to 0.6 m in front of protruding controls, (handles, etc.).
 - width*, the greater of the following values: 0.5 m or the full width of the cabinet or panel.
- (b) a clear horizontal area of at least 0.5 m × 0.6 m for servicing and inspection of moving parts at points where this is necessary and, if need be, manual emergency operation (12.5.1);
- (c) access ways to these clear spaces which shall have a width of at least 0.5 m. This value may be reduced to 0.4 m in areas where there are no moving parts.

6.3.2.2 In no case shall the clear height for movement or working be less than 1.8 m (N.c).

This full height for movement or working is taken to the underside of the structural roof beams and measured from:

- (a) the floor of the access area;
- (b) the floor of the working area.

6.3.2.3 There shall be a clear vertical distance of at least 0.3 m above the rotating parts of the machine.

6.3.2.4 When the machine room floor comprises a number of levels, differing by more than 0.5 m, stairways or steps and guard rails shall be provided.

6.3.2.5 When the floor of the machine room has any recesses greater than 0.5 m deep and less than 0.5 m wide, or any channels, they shall be covered.

6.3.3 Doors and trap doors

(N) **6.3.3.1** Access doors shall have a minimum width of 0.6 m and a minimum height of 1.8 m (N.c). They shall not open towards the inside of the room.

6.3.3.2 Access trap doors for persons shall give a clear passage at least 0.8 m × 0.8 m, and shall be counter-balanced.

All trap doors, when they are closed, shall be able to support two persons, i.e. able to resist a vertical force of 2000 N at any position, without permanent deformation.

Trap doors shall not open downwards, unless they are linked to retractable ladders. Hinges, if any, shall be of a type which cannot be unhooked.

When a trap door is in the open position, precautions shall be taken to prevent the fall of persons (e.g. a guard rail) or materials.

6.3.3.3 The doors or trap doors shall be fitted with locks having keys which can be opened without a key from inside the room.

Trap doors used only for access of material can be locked from the inside only.

6.3.4 Other openings. The dimension of holes in the slab and room floor shall be reduced to a minimum.

With the aim of removing the danger of objects falling through openings situated above the well, including those for electric cables, ferrules shall be used, which project at least 50 mm above the slab or finished floor.

6.3.5 Ventilation and temperature

6.3.5.1 Machine rooms shall be ventilated. They shall be such that the motors, and equipment, as well as electric cables, etc., are protected as far as possible from dust, harmful fumes and humidity (N.b).

(N)

Stale air from other parts of the building shall not be extracted into the machine room.

6.3.5.2 The ambient temperature in the machine room shall be maintained between +5 °C and +40 °C.

6.3.6 Lighting and socket outlets. The machine room shall be provided with permanent electric lighting on the basis of at least 200 lux at floor level. The supply for this lighting shall be in conformity with 13.6.1.

A switch placed inside close to the access point or points, at an appropriate height, shall control lighting of the room on entry.

One or more socket outlets (13.6.2) shall be provided.

6.3.7 Handling of equipment. One or more metal supports or hooks, as appropriate, shall be provided in the machine room ceiling or on the beams, conveniently positioned to permit the hoisting of heavy equipment during erection and, if need be, its replacement.

6.4 Construction and equipment of pulley rooms

6.4.1 Mechanical strength, floor surface

6.4.1.1 The pulley rooms shall be so constructed to withstand the loads and forces to which they will normally be subjected.

They shall be in durable material, not favouring the creation of dust.

6.4.1.2 The floors of the pulley rooms shall be of non-slip material.

6.4.2 Dimensions

6.4.2.1 Pulley room dimensions shall be sufficient to provide easy and safe access for servicing personnel to all the equipment.

The requirements of 6.3.2.1(b) and (c) are applicable.

6.4.2.2 The height under the roof shall be at least 1.5 m (N.c).

(N)

6.4.2.2.1 There shall be a clear space of at least 0.3 m high above the pulleys, except in the case of double wrap or deflection pulleys.

6.4.2.2.2 If there are control panels in the pulley room the provisions of 6.3.2.1 and 6.3.2.2 apply to this room.

6.4.3 Doors and trap doors

6.4.3.1 Access doors shall have a minimum width of 0.6 m and minimum height of 1.4 m (N.c). They shall not open towards the inside of the room.

(N)

6.4.3.2 Access trap doors for persons shall give a clear passage of at least 0.8 m × 0.8 m and shall be counter-balanced.

All trap doors, when they are closed, shall be able to support two persons, i.e. able to resist a vertical force of 2000 N at any position, without permanent deformation.

Trap doors shall not open downwards, unless they are linked to retractable ladders. Hinges, if any, shall be of a type which cannot be unhooked.

When a trap door is in the open position, precautions shall be taken to prevent the fall of persons (e.g. a guard rail) or materials.

6.4.3.3 Doors or trap doors shall be fitted with locks having a key, which can be opened without a key from inside the room.

6.4.4 Other openings. The dimensions of holes in the slab and pulley room floor shall be reduced to a minimum.

With the aim of removing the danger of objects falling through openings situated over the well, including those for electric cables, ferrules shall be used which project at least 50 mm above the slab or finished floor.

6.4.5 Stop switch. There shall be installed in the pulley room, close to the point of access, a stop switch, allowing the lift to be stopped and kept stopped, so arranged that there is no risk of mistaking the stop position (see **15.4.4**). The switch shall conform to the requirements of **14.2.2.3**.

6.4.6 Temperature. If there is a risk of frost or condensation in the pulley rooms, precautions shall be taken to protect the equipment (for example, heating of the bearing oil).

If the pulley rooms also contain electrical equipment, the ambient temperature shall be maintained between +5 °C and +40 °C.

6.4.7 Lighting and socket outlets. The pulley room shall be provided with permanent electric lighting, which shall be of adequate intensity. The supply for this lighting shall be in conformity with **13.6.1**. A switch, placed inside, close to the access point, at an appropriate height, shall control the lighting of the room on entry. One or more socket outlets (**13.6.2**) shall be provided.

7. Landing doors

7.1 General provisions

7.1.1 The openings in the well giving access to the lift car shall be provided with imperforate landing doors.

When closed, the clearance between panels, or between panels and uprights, lintels or sills, shall be as small as possible.

This condition is considered to be fulfilled when these clearances do not exceed 6 mm. The second sentence of **0.1.2.2** general introduction, does not apply to this value.

These clearances are measured at the back of recesses, if present.

To avoid the risk of shearing during operation, the exterior face of automatically operated sliding doors shall not have recesses or projections exceeding 3 mm. Edges of these shall be chamfered in both directions of movement.

Exception to these requirements is made for the access to the unlocking triangle defined in appendix B.

7.1.2 For details of the faces on the well side of landing doors see **5.4**.

7.2 Strength of doors and their frames

7.2.1 Doors and their frames shall be constructed in such a way that they will not become deformed in the course of time. To this end, it is recommended that they are made of metal.

The use of glass, even armoured, or of plastic materials, as part of a door panel is only permitted for the vision panels covered by **7.6.2.2**.

(N) 7.2.2 Behaviour under fire conditions (N.a) (see also the introductory note to appendix F.2).

Landing doors shall be of a model which has undergone a fire test following the procedure described in appendix F.2 and satisfied the criteria laid down therein.

7.2.2.1 Doors satisfying all the criteria are hereafter designated by the letter F.

7.2.2.2 Doors satisfying only the criteria for integrity are hereafter designated by the letter S.

7.2.2.3 Choice of types of doors according to structural arrangements: see general introduction, **0.1.3.1** and examples in figure 2.

NOTE 1. The walls of the well and the doors (apart from the lift doors) are shown with a double line when they are fire resistant, without prejudging their degree of resistance.

Fire resistant doors are presumed to close automatically, either always or in case of fire.

NOTE 2. In the case of a structural arrangement not shown in figure 2, the choice of the type of door should be made by comparison.

7.2.3 Mechanical strength. Doors, with their locks, shall possess mechanical strength such that in the locked position and when a force of 300 N is applied at right angles to the panel at any point on either face, being evenly distributed over an area of 5 cm² in round or square section, they shall:

- (a) resist without permanent deformation;
- (b) resist without elastic deformation greater than 15 mm;
- (c) operate satisfactorily after such a test.

7.2.3.1 Under the application of the force defined above in the case of lifts without car doors, the elastic deformation of the landing door towards the well interior shall not exceed 5 mm.

7.2.3.2 Under the application at the most unfavourable point of a manual force (without a tool) of 150 N in the direction of opening of horizontal sliding doors, the clearances defined in **7.1.1** may exceed 6 mm, but they shall not exceed 30 mm.

7.3 Height and width of doors

7.3.1 Height. Landing doors shall have a minimum clear height of 2 m.

7.3.2 Width. The clear entrance of the landing doors shall not extend more than 0.05 m in width beyond the clear car entrance on either side unless appropriate precautions are taken.

7.4 Sills, guides, door suspension

7.4.1 Sills. Every landing entrance shall incorporate a sill of sufficient strength to withstand the passage of loads being introduced into the car.

It is recommended that a slight counter slope be provided in front of each landing sill to avoid water from washing, sprinkling, etc., draining into the well.

7.4.2 Guides

7.4.2.1 Landing doors shall be designed to avoid, during normal operation, derailment, jamming, or displacement at the extremities of their travel.

7.4.2.2 Horizontally sliding landing doors shall be guided top and bottom.

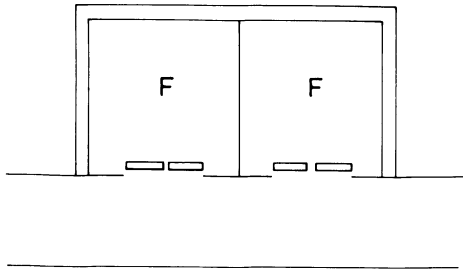
7.4.2.3 Vertically sliding landing doors shall be guided at both sides.

7.4.3 Suspension of vertically sliding doors

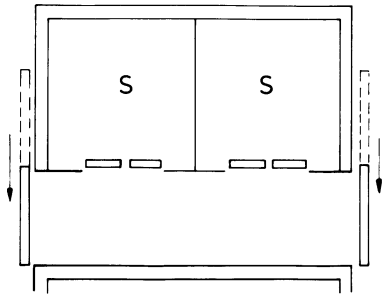
7.4.3.1 Panels of vertically sliding landing doors shall be fixed to two independent suspension elements.

7.4.3.2 Suspension elements shall be designed with a safety factor of at least 8.

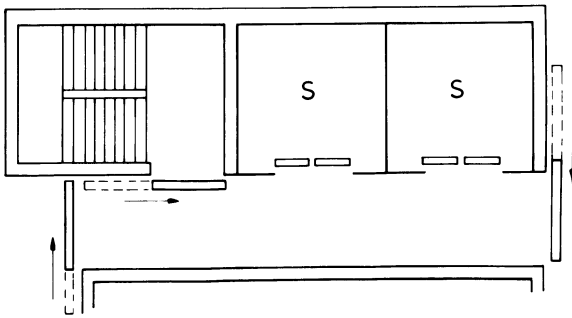
7.4.3.3 The diameter of suspension rope/pulleys shall be at least 25 times the rope diameter.



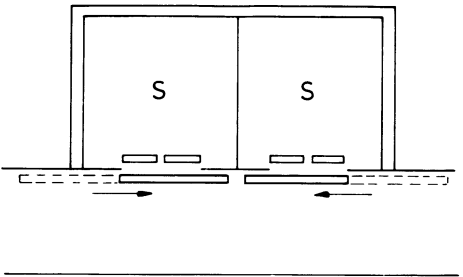
1. The lift landings are not isolated



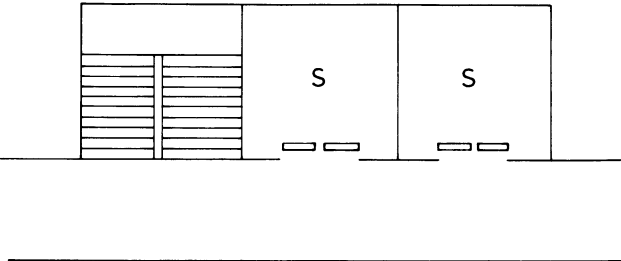
2. The lift landings are isolated



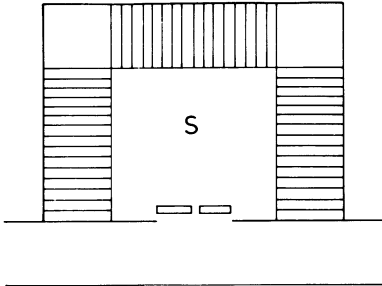
3. The lift landings and the stairwell are isolated



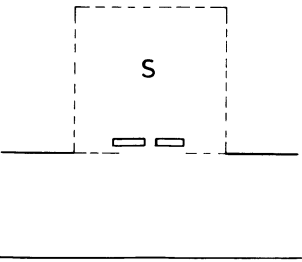
4. The lift doors are backed up by separate fire resisting doors



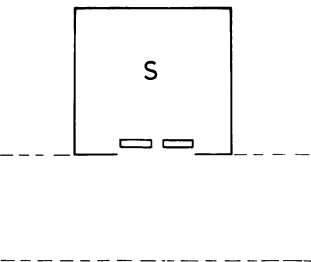
5. The lift landings common to stair landings are not isolated



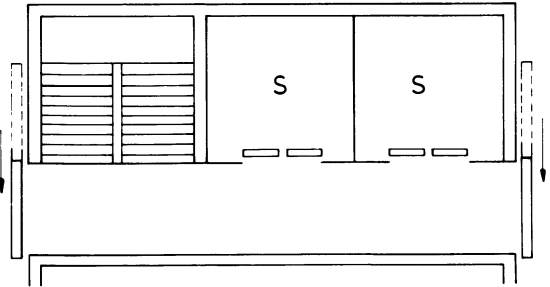
6. Lift completely surrounded by a stairwell



7. Lift adjoining a building



8. Lift installed in a hall or open space within a building



9. The lift landings common to stair landings are isolated

Figure 2. Examples of arrangements

7.4.3.4 Suspension ropes and chains shall be guarded against leaving the pulley grooves or sprockets.

7.5 Protection in relation to door operation

7.5.1 General. The doors and their surrounds shall be designed in such a way as to minimize risk of damage or injury due to jamming of a part of the person, clothing or other object.

7.5.2 Doors with power operation. Doors with power operation shall be designed to reduce to a minimum the harmful consequences of a person being struck by a door panel.

To this end the following requirements shall be met.

7.5.2.1 Horizontally sliding doors

7.5.2.1.1 Automatic power operated doors

7.5.2.1.1.1 The effort needed to prevent the door closing shall not exceed 150 N. This measurement shall not be made in the first third of the travel of the door.

7.5.2.1.1.2 The kinetic energy of the landing door and the mechanical elements to which it is rigidly connected, calculated or measured¹⁾ at the average closing speed²⁾ shall not exceed 10 J.

7.5.2.1.1.3 A protective device shall automatically initiate re-opening of the door in the event of a person being struck (or about to be struck) by the door in crossing the entrance during the closing movement.

(a) This protective device may be that of the car door (see **8.7.2.1.1.3**).

(b) The effect of the device may be neutralized during the last 50 mm of travel of each door panel.

(c) In the case of a system which makes the sensitive protective device inoperative after a fixed period of time, to counteract persistent obstructions when closing the door, the kinetic energy defined above shall not exceed 4 J during movement of the door with the protective device inoperative.

7.5.2.1.2 Doors where closing is carried out under the continuous control of the users (e.g. by continuous pressure on a button). When the kinetic energy, calculated or measured as laid down in **7.5.2.1.1.2**, exceeds 10 J, the average closing speed of the fastest panel shall be limited to 0.3 m/s.

7.5.2.2 Vertically sliding doors. This type of sliding door shall only be permitted for goods passenger lifts and non-commercial vehicle lifts.

Power closing of this type of door is permitted if all the following conditions are fulfilled:

(a) closing is carried out under the continuous control of the users;

(b) the average closing speed of the panels is limited to 0.3 m/s;

(c) the car door is of perforated or mesh panel construction as provided for in the specific case of **8.6.1**;

(d) the car door is at least two-thirds closed before the landing door begins to close.

7.5.2.3 Other types of doors. When using other types of doors (e.g. hinged) with power operation, where there is a risk when opening or closing, of striking persons, precautions

similar to those laid down for other power operated sliding doors shall be taken.

7.6 Local lighting and 'car here' signal lights

7.6.1 Natural or artificial lighting of the landings in the vicinity of landing doors shall be at least 50 lux at floor level, such that a user can see what is ahead of him when he is opening the landing door to enter the lift, even if the car light has failed.

7.6.2 'Car here' indication

7.6.2.1 In the case of landing doors with manual opening, the user must be able to know, before opening the door, whether the car is there or not.

7.6.2.2 To this effect, there shall be installed:

(a) either one or more transparent vision panels conforming to the following conditions:

(1) mechanical strength as specified in **7.2.3**;

(2) minimum thickness of 6 mm;

(3) minimum glazed area per landing door of 0.015 m² with a minimum of 0.01 m² per vision panel;

(4) width of at least 60 mm, and at most 150 mm. The lower edge of vision panels which are wider than 80 mm shall be at least 1 m above floor level;

(b) or, an illuminated 'car here' signal which can only light up when the car is about to stop or has stopped at the particular landing. The signal shall remain illuminated all the time the car remains there.

7.7 Locking and closed landing door check

7.7.1 Protection against the risk of falling. It shall not be possible in normal operation to open a landing door (or any of the panels in the case of a multi-panel door) unless the car has stopped, or is on the point of stopping, in the unlocking zone of that door.

The unlocking zone shall not extend more than 0.2 m above and below the landing level.

In the case, however, of mechanically operated car and landing doors operating simultaneously, the unlocking zone may extend to a maximum of 0.35 m above and below the landing level.

7.7.2 Protection against shearing

7.7.2.1 It shall not be possible in normal operation to start the lift nor keep it in motion if a landing door (or any of the panels in the case of a multi-panel door) is open.

However preliminary operations preparing for the movement of the car may take place.

7.7.2.2 Specific cases. Operation with doors open is permitted in the following zones:

(a) in the unlocking zone to permit levelling or releveilling at the corresponding floor level, provided the requirements of **14.2.1.2** are met;

(b) (N.a) in a zone extending to a maximum height of 1.65 m above the landing level to permit the loading or unloading of the car by authorized and instructed users (see general introduction, **0.6.2**), provided the requirements of **8.4.3**, **8.14** and **14.2.1.5** are met.

In addition:

(1) the clear height between the landing door header and the floor of the car shall be not less than 2 m;

¹⁾ Measured using, for example, a device consisting of a graduated piston acting on a spring with a spring constant of 25 N/mm, and fitted with an easy sliding ring allowing the extreme point of movement at the moment of impact to be measured. An easy calculation allows the graduation corresponding to the limits fixed to be determined.

²⁾ The average closing speed of a sliding door is calculated over its whole travel, less:
25 mm at each end of the travel in the case of centrally closing doors;
50 mm at each end of the travel in the case of side closing doors.

(2) whatever the position of the car inside this zone, it must be possible, without special operation, to effect the complete closure of the landing door.

7.7.3 Locking and emergency unlocking. Each landing door shall be provided with a locking device satisfying the requirement of 7.7.1. This device shall be protected against deliberate misuse.

7.7.3.1 The effective locking of the landing door in the closed position shall precede the movement of the car. However, operations preparing for the movement of the car may take place. The locking must be proved by an electric safety device in conformity with 14.1.2.

7.7.3.1.1 The car shall not be able to start until the locking elements are engaged by at least 7 mm (appendix F.1).

7.7.3.1.2 The connection between one of the contact elements which breaks the circuit, and the device which locks mechanically, shall be direct and foolproof, but adjustable if necessary.

7.7.3.1.3 For hinged doors, locking shall be effected as near as possible to the vertical closing edge(s) of the doors, and maintained properly even in the case of panels sagging.

7.7.3.1.4 The locking elements and their fixings shall be resistant to shock, and be made or reinforced with metal.

7.7.3.1.5 The engagement of the locking elements shall be achieved in such a way that a force in the opening direction of the door does not diminish the effectiveness of locking.

7.7.3.1.6 The lock shall resist, without permanent deformation during the test laid down in appendix F.1 a minimum force at the level of the lock and in the direction of opening of the door of:

- (a) 1000 N in the case of sliding doors;
- (b) 3000 N on the locking pin, in the case of hinged doors.

7.7.3.1.7 The locking action shall be effected and maintained by the action of gravity, permanent magnets, or springs. The springs shall act by compression, be guided and of such dimensions that, at the moment of unlocking, the coils are not compressed solid.

In the event of the permanent magnet (or spring) no longer fulfilling its function, gravity shall not cause unlocking.

If the locking element is maintained in position by the action of a permanent magnet, it shall not be possible to neutralize its effect by simple means (e.g. heat or shock).

7.7.3.1.8 The locking device shall be protected against the risk of an accumulation of dust which could hinder its proper functioning.

7.7.3.1.9 Inspection of the working parts shall be easy, as, for example, by use of a vision panel.

7.7.3.1.10 In the case where the lock contacts are in a box, the fixing screws for the cover shall be of the captive type, so that they remain in the holes in the cover or box when opening the cover.

7.7.3.2 Emergency unlocking. Each of the landing doors shall be capable of being unlocked from the outside with the aid of a key which will fit the unlocking triangle as defined in appendix B.

Keys of this type shall be given only to a responsible person. They shall be accompanied by a written instruction detailing the essential precautions to be taken in order to avoid accidents which could result from an unlocking which was not followed by effective relocking.

After an emergency unlocking, the locking device shall not be able to remain in the unlocked position with the landing door closed, when there is no action to unlock.

In the case of landing doors driven by the car door, a device (either weight or springs) shall ensure the automatic closing of the landing door if this door becomes open, for whatever reason, when the car is outside the unlocking zone.

7.7.4 Electrical device for proving the landing door closed

7.7.4.1 Each landing door shall be provided with an electrical device for proving the closed position in conformity with 14.1.2, so that the conditions imposed by 7.7.2 are satisfied.

7.7.4.2 In the case of horizontally sliding landing doors, coupled with car doors, this device may be in common with the device for proving the locked condition, provided that it is dependent upon the effective closing of the landing door.

7.7.4.3 In the case of hinged landing doors, this device shall be placed adjacent to the closing edge of the door or on the mechanical device proving the closed condition of the door.

7.7.5 Requirements common to devices for proving the locked condition and the closed condition of the door

7.7.5.1 It shall not be possible, from positions normally accessible to persons, to operate the lift with a landing door open or unlocked, after one single action not forming part of the normal operating sequence.

7.7.5.2 The means used to prove the position of a locking element shall have positive operation.

7.7.6 The case of horizontally or vertically sliding doors with multiple panels, mechanically linked

7.7.6.1 When a horizontally or vertically sliding door comprises several panels which are directly mechanically linked, it is permitted:

- (a) to lock only one panel, on condition that this single locking will prevent the opening of the other panels;
- (b) to place the door closed proving device laid down in 7.7.4.1 or 7.7.4.2, on a single panel.

7.7.6.2 When the panels are indirectly mechanically linked (e.g. by rope, belt or chain) such linkage shall be designed to resist any normally anticipated forces, be constructed with special care, and checked periodically.

It is permitted to lock only one panel on condition that this single locking will prevent the opening of other panels, and that these are not fitted with a handle. The closed position of the other panel(s), not locked by the locking device, shall be proved by an electric safety device in conformity with 14.1.2.

7.8 Closing of automatically operated doors. In normal service, automatically operated landing doors shall be closed after the necessary period of time, which may be defined according to the traffic using the lift, in the absence of a signal for the movement of the car.

8. Car and counterweight

8.1 Height of car

8.1.1 The interior clear height of the car shall be at least 2 m.

8.1.2 The clear height of the car entrance(s) for the normal access of users shall be at least 2 m.



8.2 Available car area, rated load, number of passengers

8.2.1 General case. To prevent an overloading of the car by persons the available area of the car shall be limited. To this end the relationship between rated load and maximum available area is given in table 1.1.

NOTE. Recesses and extensions, even of height less than 1 m, whether protected or not by separating doors, are only permitted if their area is taken into account in the calculation of maximum available car area.

Table 1.1

Rated load, mass	Maximum available car area	Rated load, mass	Maximum available car area
kg	m ²	kg	m ²
100 ^{a)}	0.37	900	2.20
180 ^{b)}	0.58	975	2.35
225	0.70	1000	2.40
300	0.90	1050	2.50
375	1.10	1125	2.65
400	1.17	1200	2.80
450	1.30	1250	2.90
525	1.45	1275	2.95
600	1.60	1350	3.10
630	1.66	1425	3.25
675	1.75	1500	3.40
750	1.90	1600	3.56
800	2.00	2000	4.20
825	2.05	2500 ^{c)}	5.00

(a) Minimum for 1 person lift

(b) Minimum for 2 person lift

(c) Beyond 2500 kg add 0.16 m² for each extra 100 kg.

For intermediate loads the area is determined by linear interpolation.

8.2.2 Goods passenger lifts and non-commercial vehicle lifts other than those covered by 8.2.3. The requirements of 8.2.1 shall be applied and, in addition, design calculations shall take into account not only the rated load but also the weight of handling devices which may enter the car.

8.2.3 Non-commercial vehicle lifts, the use of which is reserved for authorized and instructed users (general introduction, 0.6.2). The rated load shall be calculated at a rate of at least 200 kg/m² of available car area.

8.2.4 Number of passengers. The number of passengers shall be obtained from:

either, the formula, $\frac{\text{rated load}}{75}$, and the result

rounded down to the nearest whole number

or, table 1.2

whichever gives the smaller value.

8.3 Walls, floor and roof of the car

8.3.1 The car shall be completely enclosed by walls, floor and roof, the only permissible openings being as follows:

- (a) entrances for the normal access of users;
- (b) emergency trap doors and doors;
- (c) ventilation apertures.

8.3.2 The walls, floor and roof shall have sufficient mechanical strength. The assembly comprising the sling, guide shoes, walls, floor and roof of the car shall have sufficient mechanical strength to resist the forces which

will be applied in normal lift operation, in safety gear operation or impact of the car on its buffers.

8.3.2.1 Each wall of the car shall have a mechanical strength such that during the application of a force of 300 N, applied at right angles to the wall, at any point, from the inside of the car towards the outside, this force being evenly distributed over an area of 5 cm² in round or square section, the wall

(a) resists without any permanent deformation, and

(b) resists without elastic deformation greater than 15 mm.

8.3.2.2 The car roof shall satisfy the requirements of 8.13.

8.3.3 The walls, floor and roof shall not be made of materials likely to become dangerous through too great flammability or through the nature and quantity of gas and fumes they may generate.

8.4 Toe guards

8.4.1 Each car sill shall be fitted with a toe guard which extends to the full width of the clear landing entrance which it faces. This vertical section shall be extended downwards by a chamfer whose angle with the horizontal plane shall be greater than 60°. The projection of this chamfer on the horizontal plane shall be not less than 20 mm.

Table 1.2

Number of passengers	Minimum available car area	Number of passengers	Minimum available car area
	m ²		m ²
1	0.28	11	1.87
2	0.49	12	2.01
3	0.60	13	2.15
4	0.79	14	2.29
5	0.98	15	2.43
6	1.17	16	2.57
7	1.31	17	2.71
8	1.45	18	2.85
9	1.59	19	2.99
10	1.73	20	3.13

Beyond 20 passengers add 0.115 m² for each extra passenger.

8.4.2 The height of the vertical portion shall be at least 0.75 m.

8.4.3 In the case of a lift with a docking operation (14.2.1.5), the height of the vertical portion shall be such that, with the car in the highest loading or unloading position, it extends at least 0.10 m below the landing sill.

8.5 Car entrance

8.5.1 Car entrances shall be provided with doors.

8.5.2 Although the presence of a door is preferable in all cases, it may however be permitted for goods passenger lifts, for one car entrance or two opposite car entrances not to be fitted with doors (N.a, b) if, in addition to the provisions of 8.2.1, the following conditions are simultaneously fulfilled:

(a) the lift is reserved for authorized and instructed users (general introduction, 0.6.2);

(b) the rated speed does not exceed 0.63 m/s;

(c) the depth of the car, measured perpendicular to the doorless sill, is greater than 1.5 m;

(d) the number of passengers is calculated as laid down in **8.2.4**, disregarding however for each door-less car entrance an area of 0.1 m depth and of width equal to the width of the doorless car entrance;

(e) the buttons or switches for car control, stop and alarm are at least 0.4 m from the car entrance.

8.6 Car doors

8.6.1 The car doors shall be imperforate.

Special case. Goods passenger lifts and non-commercial vehicle lifts may use vertically sliding car doors, opening upwards, and these may be in mesh or perforated panel form. The dimensions of the mesh or perforations shall not exceed 10 mm horizontally and 60 mm vertically.

8.6.2 The car doors when closed shall, apart from the necessary clearances, completely close the car entrances.

Specific case. In the case of a lift, the use of which is reserved for authorized and instructed users (General introduction, **0.6.2**), where the height of the car entrance is greater than 2.5 m, the height of the car door may be limited to 2 m if the following conditions are simultaneously fulfilled:

- (a) the door slides vertically;
- (b) the rated speed of the lift does not exceed 0.63 m/s.

8.6.3 When closed, the clearance between panels, or between panels and uprights, lintels or sills, shall be as small as possible.

This condition is considered to be fulfilled when these clearances do not exceed 6 mm. The second sentence of **0.1.2.2**, general introduction, does not apply to this value.

These clearances are measured at the back of recesses, if present. Exception is made for vertically sliding doors, according to **8.6.1** special case.

8.6.4 In the case of hinged doors, they shall strike stops to prevent them swinging outside the car.

8.6.5 Any vision panels incorporated in car doors shall satisfy the requirements of **7.6.2.2(a)**. Such a vision panel is obligatory if one exists in the landing doors to ascertain the presence of the car. Their positions shall coincide when the car is at the level of the landing. However, this vision panel is not necessary in the car door when the latter is automatic and remains in the open position when the car is stationary at the level of a landing.

8.6.6 *Sills, guides, door suspension.* The provisions of **7.4** relevant to car doors shall be observed.

8.6.7 *Mechanical strength.* Car doors in the closed position shall possess sufficient mechanical strength such that, when a force of 300 N is applied at right angles to the door, at any point, from the inside of the car towards the outside, this force being evenly distributed over an area of 5 cm² in round or square section, they can:

- (a) resist without permanent deformation;
- (b) resist without elastic deformation greater than 15 mm;
- (c) operate satisfactorily after such a test.

8.7 Protection during operation of doors

8.7.1 *General.* The doors and the surrounds shall be designed in such a way as to minimize the harmful consequences of jamming of a part of a person, clothing or other object.

In order to avoid the risk of shearing during operation of the power operated sliding doors, the face of the doors on the car side shall not have any hollows or projections of more than 3 mm. Exception is made for vertically sliding

doors according to **8.6.1** special case. The edges shall be chamfered.

8.7.2 *Power operated doors.* Power operated doors shall be designed to minimize the harmful consequences of a person being struck by a door panel.

To this effect, the following requirements shall be met.

8.7.2.1 Horizontally sliding doors

8.7.2.1.1 Automatically power operated doors

8.7.2.1.1.1 The effort needed to prevent the door closing shall not exceed 150 N. This measurement shall not be made in the first third of the travel of the door.

8.7.2.1.1.2 The kinetic energy of the car door and of the mechanical elements which are rigidly connected to it, calculated or measured at the average closing speed, as in **7.5.2.1.1.2**, shall not exceed 10 J.

8.7.2.1.1.3 A sensitive protective device shall automatically initiate re-opening of the door in the event of a person being struck (or about to be struck) by the door in crossing the entrance during the closing movement.

- (a) The effect of the device may be neutralized during the last 50 mm of travel of each door panel.
- (b) In the case of a system which makes the sensitive protection device inoperative after a fixed period of time, to counteract persistent obstructions when closing the door, the kinetic energy defined above shall not exceed 4 J during movement of the door with the protective device inoperative.

8.7.2.1.2 *Doors where the closing is carried out under the continuous control of the users (e.g. by constant pressure on a button).* When the kinetic energy calculated or measured as indicated in **7.5.2.1.1.2** exceeds 10 J, the average closing speed of the fastest panels shall be limited to 0.3 m/s.

8.7.2.2 *Vertically sliding doors.* Power closing of this type of door is permitted if all the following conditions are fulfilled simultaneously:

- (a) the lift is a goods passenger lift;
- (b) the closing is carried out under the permanent control of the users;
- (c) the average closing speed of the panels is limited to 0.3 m/s.

8.8 *Requirements for entrances of lift cars without doors.* When a car entrance has no door, in order to minimize the risks of pinching or crushing between the car sill and the wall of the well, a photoelectric or similar device shall be used.

8.9 Electrical device for proving the car doors closed

8.9.1 It shall not be possible in normal operation to start the lift nor keep it in motion if a car door (or one panel of a multi-panel door) is open. Preliminary operations preparing for the movement of the car may take place

However, movement of the lift with car door open is permitted under the conditions laid down in **7.7.2.2**.

8.9.2 Each car door shall be provided with an electrical device for proving the closed position in conformity with **14.1.2** so that the conditions imposed by **8.9.1** are satisfied.

8.10 Case of horizontally or vertically sliding doors comprising several mechanically interlinked panels

8.10.1 If a horizontally or vertically sliding door comprises several directly mechanically linked panels, it is permitted.