

Lifts and service lifts —

Part 2: Safety rules for the construction and installation of hydraulic lifts

[EN title: Safety rules for the construction and installation of lifts
and service lifts — Part 2: Hydraulic lifts]

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British Standard.

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Cooperating organizations

The European Committee for Standardization, under whose supervision this European Standard was prepared, comprises the national standards organizations of the following Western European countries.

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National foreword

This revision of BS 5655-2, which supersedes the 1983 edition, has been prepared under the direction of the Mechanical Handling Standards Committee and is identical with European Standard EN 81-2:1987.

It is the second Part of a British Standard relating to lifts and service lifts, which supersedes 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 5655-1”;*
- *Part 2: Safety rules for the construction and installation of hydraulic lifts; (implementing EN 81-2)*
- *Part 3: Electric service lifts¹⁾;*
- *Part 4.²⁾*
- *Part 5: Specification for dimensions of standard 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: Recommendations for the installation of new and the modernization of electric lifts in existing buildings¹⁾;*
- *Part 12: Recommendations for the installation of new and the modernization of hydraulic lifts in existing buildings¹⁾;*
- *Part 13: Code of practice for vandal resistant lifts¹⁾.*

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 2 of EN 81 are given in National appendix V.

¹⁾ In preparation.

²⁾ Reserved for future publications.

Prior to 30 June 1989 all new and replacement hydraulic lifts may comply with the requirements of either this standard or those of BS 5655-2:1983. The requirements of this standard only are applicable to all new installations which are tendered for after 30 June 1989, unless it can be shown that owing to space limitations, compliance is not reasonably practicable. Special provisions are permissible to meet certain site conditions often present in buildings that have been in use for many years. It is intended that the use of new equipment should not automatically be restricted because certain site conditions are now more rigorous than formerly. However, any deviations from this standard will have to ensure a minimum acceptable standard of safety having regard to the circumstances affecting the installation, whilst permitting an installation of reasonable standard to be modernized or reconstructed, in stages if necessary (see BS 5655-12³).

EXPLANATORY NOTE ON THE ARRANGEMENT OF EN 81-2. EN 81-2 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 2 and then the text of Part 2 (beginning with the “Introduction” to Part 2 and followed by the “Scope and field of application” for Part 2).

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, the EN title page, pages 2 to 90, an inside back cover 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.

³) Inpreparation.

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Key words: Lifts, goods lifts, hydraulic equipment, building codes, safety requirements, lift cars, landing doors, lift shaft, extension wires, shock absorbers, machine rooms, electrical installation, safety devices, stopping devices, locking devices, name plates, conformity tests, certification.

English version

**Safety rules
for the construction and installation
of lifts and service lifts
Part 2: Hydraulic lifts**

Règles de sécurité pour la construction et
l'installation des ascenseurs et monte-charge
Partie 2. Ascenseurs hydrauliques

Sicherheitsregeln für die Konstruktion und den
Einbau von Personen- und Lastenaufzügen,
sowie Kleingüteraufzügen
Teil 2. Hydraulische betriebene Aufzüge

This European Standard was accepted by CEN on 1987-11-27. 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.

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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 "Lifts and service lifts" the Secretariat of which is held by AFNOR.

A large number of dispositions of standard EN 81-1 on electric lifts also apply to hydraulic lifts.

For an easier reading of this standard, it seemed advisable to republish without modifications the parts also applying to hydraulic lifts in standard EN 81-2, instead of referring to standard EN 81-1 of December 1985.

In accordance with the CEN/CENELEC Rules, all CEN members are bound to implement this European Standard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, 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 safe-guarding persons and objects against the risk of accidents associated with the operation of lifts and service lifts⁴⁾.

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, or to environmental protection. 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).

⁴⁾ 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.

0.5.3 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”.

0.6.3 In the absence of another definition (N.b), it is permissible 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 is 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.

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 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:

- 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:

- c) lifts installed in buildings in existence at the time this standard is brought into application;
- d) 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;*
- *Part 3: deals with electric service lifts (in preparation);*
- *Part 4: deals with hydraulic service lifts (in preparation).*

Part 2. Hydraulic lifts

0 Introduction

See general introduction (page 3).

1 Scope and field of application

Part 2 of this standard deals with the hydraulic lifts, defined in clause 3, where the car is directly or indirectly driven by the action of one or more hydraulic single acting jacks and whereby the down movement, even with the empty car, takes place by the influence of gravity.

NOTE The text covers the safety requirements for hydraulic lifts, with rated speed v_s up to 1.0 m/s. For lifts with higher rated speed v_s additional requirements shall be applied as appropriate in order to maintain the same level of safety.

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

For lifts with double acting jacks or for traction drive or positive drive lifts driven by a hydraulic motor, Part 1 and/or 2 shall be used by analogy according to the technical characteristics of the installation.

2 References

ISO 834:1975, *Fire resistance tests — Elements of building construction*.

ISO 1219:1976, *Fluid power systems and components — Graphic symbols*.

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 controlgear 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)

clamping device (dispositif de blocage) (Klemmvorrichtung)

a mechanical device which when activated stops the car in downward motion and maintains it stationary at any point of the travel to limit the extent of creep

direct acting lift (ascenseur à action directe) (direkt angetriebener Aufzug)

hydraulic lift where the ram or cylinder is directly attached to the car or its sling

down direction valve (soupape descente) (Abwärtsventil)

electrically controlled valve in a hydraulic circuit for controlling the descent of the car

electrical anti-creep system (système électrique anti-dérive) (elektrisches Absinkkorrektursystem)

a combination of precautions against the danger of creeping

**full load pressure (pression à pleine charge)
(Druck bei Vollast)**

static pressure exerted on the piping directly connected to the jack, the car with the rated load being at rest at the highest landing level

goods passenger lift (ascenseur de charge)⁵⁾ (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

**hydraulic lift (ascenseur hydraulique)
(hydraulischer Aufzug)**

lift in which the lifting power is derived from an electrically driven pump transmitting hydraulic fluid to a jack, acting directly or indirectly on the car (multiple motors, pumps and/or jacks may be used)

indirect acting lift (ascenseur à action indirecte) (indirekt angetriebener Aufzug)

a hydraulic lift where the ram or cylinder is connected to the car or the car sling by suspension means (ropes, chains)

instantaneous safety gear (parachute à prise instantanée) (Sperrfangvorrichtung)

a safety gear in which the full gripping action 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 is almost immediate, but the reaction on the car or counterweight is limited by presence of an intermediate buffering system

jack (vérin) (Heber)

a combination of a cylinder and a ram forming a hydraulic actuating unit

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.

machine (machine) (Triebwerk)

unit which drives and stops the lift, comprising the pump, the pump motor and the control valves

**machine room (local des machines)
(Triebwerksraum)**

a room in which machine or machines and/or 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

**non-return valve (clapet de non retour)
(Rückschlagventil)**

a valve which allows flow in one direction only

**one-way restrictor (clapet freineur)
(Drossel-Rückschlagventil)**

a valve which allows free flow in one direction and restricted flow in the other direction

**overspeed governor (limiteur de vitesse)
(Geschwindigkeits-begrenzer)**

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

passenger (passager) (Fahrgast)

any person transported by a lift

**pawl device (dispositif à taquet)
(Aufsetzvorrichtung)**

a mechanical device for stopping involuntary descent of the car, and maintaining it stationary on fixed supports

⁵⁾ 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.

pit (cuvette) (Schachtgrube)

the part of the well situated below the lowest landing level served by the car

pressure relief valve (limiteur de pression) (Druckbegrenzungsventil)

a valve which limits the pressure to a pre-determined value by exhausting fluid

progressive safety gear (Parachute à prise amortie) (Bremsfangvorrichtung)

a safety gear in which deceleration is effected by a braking action 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. Different rated speeds for upward and downward direction may be stated

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)

restrictor (réducteur de débit) (Drossel)

a valve in which the inlet and outlet are connected through a restricted passage way

rupture valve (soupage de rupture) (Leitungsbruchventil)

a valve designed to close automatically when the pressure drop across the valve, caused by the increased flow in a predetermined flow direction, exceeds a pre-set amount

safety gear (Parachute) (Fangvorrichtung)

a mechanical device for stopping and maintaining stationary the lift car or counterweight in case of overspeeding in the downwards direction or breaking of the suspension

safety rope (Cable de sécurité) (Sicherheitsseil)

an auxiliary rope attached either to the car and counterweight or to the car and a fixed point for the purpose of tripping a safety gear in case of breakage of the suspension

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 m ² ; |
| 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

“shut-off” valve (robinet d’isolement) (Absperrventil)

a manually operated two-way valve which can permit or prevent flow in either direction

single acting jack (vérin à simple effet) (einfachwirkender Heber)

jack in which displacement in one direction is by fluid action and in the other by another force

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

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

4.2 Symbols

Measurements (in the order they appear in the document)	Symbol	Unit
The higher value of both rated speeds v_m and v_d	v_s	m/s
Rated speed upwards	v_m	m/s
Rated speed downwards	v_d	m/s
Standard acceleration of free fall	g_n	m/s ²
Vertical force on each guide or other part imposed during operation of safety gear or other clamping device	F_1	N
Total vertical force on guides or other parts imposed during operation of safety gear or other clamping device	F_{10}	N
Vertical force on each fixed stop imposed during pawl device operation	F_2	N
Total vertical force on fixed stops imposed during operation of pawl device	F_{20}	N
Reaction beneath one guide	F_3	N
Reaction beneath the car buffer supports	F_4	N
Sum of the mass of the empty car, the mass of the ram (in case of direct acting lifts only) and the mass of the portion of the travelling cables suspended from the car	P_1	kg
Sum of the mass of the empty car and of the mass of the ram (in case of direct acting lifts only)	P_2	kg
Rated load (mass) for lifts according to 8.2.1 or 8.2.4: or load given by Table 1.1 (8.2.1) for lifts according to 8.2.2	Q_1	kg
Cross-sectional area of the guide	A	mm ²
The higher value of both forces F_1 and F_2	F_7	N
Radius of gyration	i	mm
Maximum distance between guide brackets	l_k	mm
Coefficient of slenderness	λ	^a
Buckling stress in the guides	σ_k	N/mm ²

Measurements (in the order they appear in the document)	Symbol	Unit
Buckling factor	ω	^a
Proof stress	$R_{p0.2}$	N/mm ²
Cross-sectional area of material of ram to be calculated ($n = 1, 2, 3$)	A_n	mm ²
Reeving ratio	c_m	^a
Outside diameter of biggest ram of a telescopic jack	d_m	mm
Inner diameter of biggest ram of a telescopic jack	d_{mi}	mm
Modulus of elasticity	E	N/mm ²
Additional wall thickness	e_o	mm
Actual buckling force applied	F_5	N
Equivalent radius of gyration of a telescopic jack	i_e	mm
Radius of gyration of the ram to be calculated ($n = 1, 2, 3$)	i_n	mm
Second moment of area of the ram to be calculated ($n = 1, 2, 3$)	J_n	mm ⁴
Maximum length of rams subject to buckling	l	mm
Sum of the mass of the empty car and the mass of the portion of the travelling cables suspended from the car	P_3	kg
Mass of the ram to be calculated	P_r	kg
Mass of the ram-head equipment, if any	P_{rh}	kg
Mass of the rams acting on the ram to be calculated (in the case of telescopic jacks)	P_{rt}	kg
Full load pressure	p	MPa
Rated load (mass) displayed in the car	Q	kg
Tensile strength of material	R_m	N/mm ²
Equivalent coefficient of slenderness of a telescopic jack	λ_e	^a
Coefficient of slenderness of the ram to be calculated ($n = 1, 2, 3$)	λ_n	^a
Factors used to represent approximate values given by experimentally determined diagrams	v (nu) ϕ (phi)	—
Amplitude of vibration	a	mm
Frequency	f	Hz
Pressure measured during a downward journey with rated load in the car	p_t	MPa
Maximum speed in the case of a rupture in the hydraulic system	$v_{max.}$	m/s

Measurements (in the order they appear in the document)	Symbol	Unit
Speed measured during a downward journey with rated load in the car	v_t	m/s
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	^a
Ratio between the smallest and largest dimensions of the door entrance being tested	L	^a
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	^a
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_L	m
^a 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.

5.1.3 Jacks of a lift shall be in the same well as the car. They may extend into the ground or other spaces.

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 device 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 lifts.

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:

- 1) by the machine, the jacks and the guides; and,
- 2) by the buffers, and any safety gear, clamping device or pawl device, at the moment of application; and,
- 3) due to off-centring of loads in the car.

For evaluation of the forces during the operation of the safety gear, the clamping device, the pawl device and the buffers, 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:

- c) resist without permanent deformation;

- d) 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 5 000 N/m², and:

- a) either there shall be installed below the counter-weight 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).

(N)

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

5.7.1.1 When the ram is in its ultimate position, achieved through the means of ram stroke limitation according to 12.2.3 the following six 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 $0.1 + 0.035 v_m^2$ ⁶⁾,

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 $1.0 + 0.035 v_m^2$.

c) The free vertical 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 $0.3 + 0.035 v_m^2$.

2) the highest part of the guide shoe or rollers, of the rope attachments and of the header or parts of vertically sliding doors, if any, shall be at least $0.1 + 0.035 v_m^2$.

d) There shall be above the car sufficient space to accommodate a rectangular block not less than 0.5 m × 0.6 m × 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.

⁶⁾ $0.035 v_m^2$ represents half the gravity stopping distance corresponding to 115 % of the rated speed upwards

$$\left[\frac{1}{2} \times \frac{(1.15 v_m)^2}{2g_n} = 0.0337 v_m^2 \text{ rounded to } 0.035 v_m^2 \right]$$

e) The free vertical distance between the lowest parts of the roof of the well and the highest parts of an upwards travelling ram-head assembly shall be at least 0.1 m.

f) In the case of direct-acting lifts, the value of $0.035 v_d^2$ mentioned in a), b) and c) shall not be taken into account.

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

5.7.2 Pit

5.7.2.1 The lower part of the well shall consist of a pit, the bottom of which shall be smooth and approximately level, except for any bases for buffers, guides and jacks and for water drainage devices.

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

5.7.2.2 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.

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

- a) There shall be in the pit sufficient space to accommodate a rectangular block not less than $0.5 \text{ m} \times 0.6 \text{ m} \times 1.0 \text{ m}$ resting on one of its faces.
- b) The free vertical 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 or clamping device blocks, pawl devices, toe guards or parts of vertically sliding doors, shall be at least 0.1 m.
- c) The free vertical distance between the highest parts fixed in the pit, such as for instance jack supports, pipes and other fittings, and the lowest parts of the car, except for items detailed in b) 2) above, shall be at least 0.3 m.

d) The free vertical distance between the bottom of the pit or of equipment installed there and the lowest parts of the downwards-travelling ram-head assembly of an inverted jack shall be at least 0.5 m.

However, if it is impossible to gain involuntary access under the ram head assembly (for example by providing screens whose mesh or perforation does not exceed 75 mm horizontally or vertically and which extend vertically from 0.1 m to 2.5 m above the bottom of the pit), this vertical distance may be reduced from 0.5 m to 0.1 m minimum.

e) The free vertical distance between the bottom of the pit and the lowest guiding yoke of a telescopic jack below the car of a direct acting lift shall be at least 0.5 m.

5.7.2.4 With the car at its highest position determined by the fully compressed cushioned stop of the jack, the guide lengths of the counterweight, if there is one, shall be such as would accommodate a further guided travel of at least $0.1 \text{ m} + 0.035 v_m^2$.

5.7.2.5 There shall be in the pit:

- a) a stopping device 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**).

The stopping device shall conform to the requirements of **14.2.2.3**;

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

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 operation of safety gear or clamping device.* The total vertical force developed in guide rails or other parts during operation of safety gear or clamping device may be evaluated approximately according to the following formulae:

a) instantaneous safety gears and clamping devices

1) except captive roller type $F_{10} = 50 (P_1 + Q_1)$

2) captive roller type $F_{10} = 30 (P_1 + Q_1)$

b) progressive safety gears and clamping devices

$$F_{10} = 20 (P_1 + Q_1)$$

The vertical force in each guide rail or other part is given by the following formulae:

$$F_1 = \frac{F_{10}}{\text{number of guide rails or other parts}}$$

NOTE 2 *Evaluation of the vertical forces during operation of pawl device.* The total vertical force imposed on the fixed stops during operation of the pawl device may be evaluated approximately according to the following formulae:

a) pawl devices provided with energy accumulation type spring buffers, with or without buffered return movement.

$$F_{20} = 30 (P_1 + Q_1)$$

b) pawl devices provided with energy dissipation type buffers

$$F_{20} = 20 (P_1 + Q_1)$$

The vertical force imposed on each fixed stop is given by the following formula:

$$F_2 = \frac{F_{20}}{\text{number of fixed stopping level}}$$

NOTE 3 *Evaluation of the reactions at the bottom of the pit through the guides or other parts at the moment of operation of safety gear, clamping device or pawl device, or through activation of buffers.* The reactions may be evaluated as follows:

a) beneath each guide rail

$F_3 = 10$ times the mass of the guide (kg), plus the reaction F_1 or F_2 (N) at the moment of operation of the safety gear, clamping device or pawl device, taking the greater value as appropriate.

If the guide rails are suspended, the reactions at the points of attachment shall be evaluated by analogy to what is done in the case of guides supported at the bottom of the pit.

b) beneath the car buffer supports

$$F_4 = 40 (P_2 + Q_1)$$

c) beneath each jack

These reactions shall be evaluated as appropriate to the arrangement of this equipment in the well and to the forces imposed on it.

Symbols:

F_1 = Vertical force on each guide or other part imposed during operation of safety gear or clamping device (N)

F_{10} = Total vertical force on guides or other parts imposed during operation of safety gear or clamping device (N)

F_2 = Vertical force on each fixed stop imposed during operation of pawl device (N)

F_{20} = Total vertical force on fixed stops imposed during operation of pawl device (N)

F_3 = Reaction below each guide rail (N)

F_4 = Reaction below car buffer supports (N)

P_1 = Sum of the mass of the empty car, the mass of the ram (in the case of direct acting lifts only) and the mass of the portion of the travelling cables suspended from the car (kg)

P_2 = Sum of the mass of the empty car and the mass of the ram (in the case of direct acting lifts only) (kg)

Q_1 = Rated load for lifts according to 8.2.1 or 8.2.4: or load given by Table 1.1 (8.2.1) for lifts according to 8.2.2 (kg)

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.

6.1.2.1.2 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.

6.1.2.1.3 The pulleys in the well shall be provided with protective devices according to 9.4.1 and 9.4.2.

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; (N)
- b) equipment for air-conditioning or heating of these rooms, excluding hot water (N.a) or steam heating;
- 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 room shall preferably be placed adjacent to the well.

If the machine room is not adjacent to the well, the hydraulic piping and the electric wiring connecting the machine room with the lift well shall be installed in a duct or trough or in a section of a duct or trough, specially reserved for this purpose (see **12.3.1.2**).

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).

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

(N)

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:

- a) a clear horizontal area in front of the panels and the cabinets. This area is defined as follows: (N.c)

(N)

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 (**12.9**);

- 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.

(N)

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 2 000 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).

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).

6.4.2.2.1 There shall be a clear space of at least 0.3 m high above the 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.

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 2 000 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.

(N)

(N)

(N)

6.4.5 Stopping device. There shall be installed in the pulley room, close to the point of access, a stopping device, 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 stopping device 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 plastics materials, as part of a door panel is only permitted for the vision panels covered by 7.6.2.2.

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

(N)

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 1.

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 1, 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.

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 measured⁷⁾ at the average closing speed⁸⁾ 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;

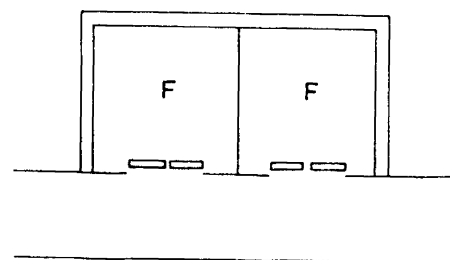
b) the average closing speed of the panels is limited to 0.3 m/s;

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

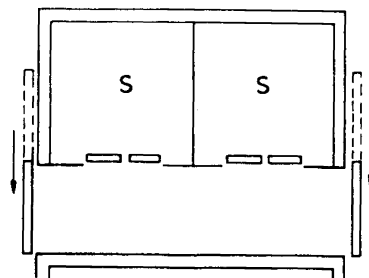
d) the car door is at least two-thirds closed before the landing door begins to close.

⁷⁾ 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.

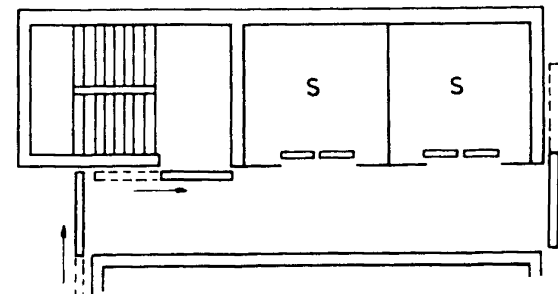
⁸⁾ The average closing speed of a sliding door is calculated over its whole travel, less:
25 mm at each end of the travel in the case of centrally closing doors;
50 mm at each end of the travel in the case of side closing doors.



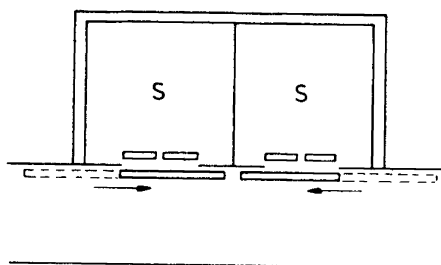
1. The lift landings are not isolated



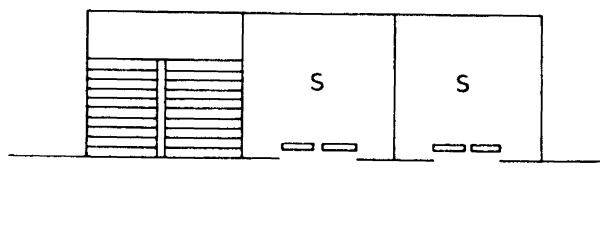
2. The lift landings are isolated



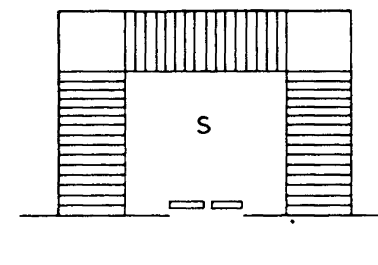
3. The lift landings and the stairwell are isolated



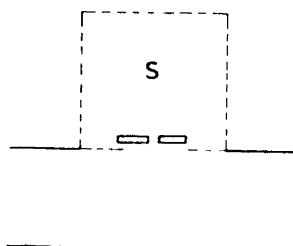
4. The lift doors are backed up by separate fire resisting doors



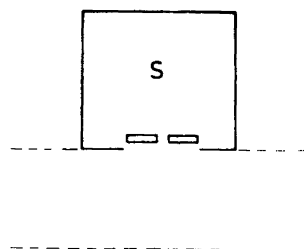
5. The lift landings common to stair landings are not isolated



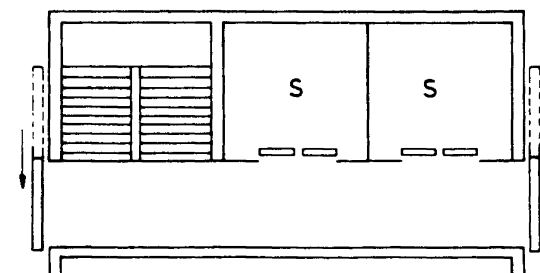
6. Lift completely surrounded by a stairwell



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 1 — Examples of arrangements

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 landing 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, relevelling or electrical anti-creeping 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 14.2.1.4 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;
- 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) 1 000 N in the case of sliding doors;
- b) 3 000 N 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 2m.

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	1 000	2.40
300	0.90	1 050	2.50
375	1.10	1 125	2.65
400	1.17	1 200	2.80
450	1.30	1 250	2.90
525	1.45	1 275	2.95
600	1.60	1 350	3.10
630	1.66	1 425	3.25
675	1.75	1 500	3.40
750	1.90	1 600	3.56
800	2.00	2 000	4.20
825	2.05	2 500 ^c	5.00

^a Minimum for 1 person lift.

^b Minimum for 2 person lift.

^c Beyond 2 500 kg add 0.16 m² for each extra 100 kg.

For intermediate loads the area is determined by linear interpolation.

8.2.2 Lifts with increased available car area. When there is a low probability of the car being overloaded with persons the available area of the car may be greater than the value determined from Table 1.1, but shall not exceed the value determined from Table 1.1.A for the corresponding rated load.

Table 1.1.A

Rated load mass	Maximum available car area (see note to 8.2.1)	Rated load mass	Maximum available car area (see note to 8.2.1)
kg	m ²	kg	m ²
400	1.68	975	3.52
450	1.84	1 000	3.60
525	2.08	1 050	3.72
600	2.32	1 125	3.90
630	2.42	1 200	4.08
675	2.56	1 250	4.20
750	2.80	1 275	4.26
800	2.96	1 350	4.44
825	3.04	1 425	4.62
900	3.28	1 500	4.80
		1 600	5.04

Beyond 1 600 kg, add 0.40 m² for each 100 kg extra.

For intermediate loads: the area is determined by linear interpolation.

8.2.2.1 Nevertheless the available car area of a lift with counterweight shall be such that a load in the car resulting from Table 1.1 (8.2.1) shall not cause a pressure exceeding 1.4 times the pressure the jack and the piping are designed for.

8.2.2.2 The lift shall be provided with an electric device preventing a start for a normal journey when the pressure exceeds the full load pressure by more than 20 %.

8.2.2.3 The design of the car, the car sling, the connection between the car and the ram (cylinder), the suspension means (of indirect acting lifts), the car safety gear, the rupture valve, the clamping device, the pawl device, the guide rails and the buffers shall be based on a load resulting from Table 1.1 (8.2.1).

8.2.3 Lifts intended to be loaded by means of handling devices. Design calculations shall take into account not only the load carried but also the weight of handling devices which may enter the car.

8.2.4 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.

8.2.5 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.

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.

8.3 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, or in the operation of the safety gear, the rupture valve, the clamping device or the pawl device, or by the 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.

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 (**14.2.1.4**), 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** or **8.2.2** the following conditions are simultaneously fulfilled:

- a) the lift is reserved for authorized and instructed users (general introduction, **0.6.2**);
- b) the speed v_s 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 **8.2.5** 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 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 speed of the lift v_s 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 and the edges shall be chamfered. Exception is made for vertically sliding doors according to **8.6.1** special case.

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. However, any such device for the unlocking zone

- shall not be active during electrical anti-creeping
- may be inactive during levelling or re-levelling.

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:

- a) to place the device (**8.9**) on a single panel (the rapid panel in the case of telescopic doors);
- b) to place the device (**8.9**) on the door driving element if the mechanical connection between this element and the panels is direct;
- c) in order to ensure locking, in the case and conditions laid down in **5.4.3.2.2**, to lock only one panel, provided that this single locking prevents the opening of the other panels (by hooking the panels in the closed position in the case of telescopic doors).

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

It is permitted to place the device (**8.9**) on a single panel, provided that,

- a) this is not the driven panel, and
- b) the driven panel is mechanically linked directly to the door driving element.

8.11 Opening the car door

8.11.1 In order to permit passengers to leave the lift car, if the lift stops for any reason close to a landing, it shall be possible with the car stopped and the supply to the door operator (if any) disconnected:

- a) to open or partly open the car door by hand from the landing;
- b) to open or partly open the car door together with the landing door linked to it if they are coupled, by hand from within the car.

8.11.2 The opening of the car door provided for in **8.11.1** shall be able to be carried out at least in the unlocking zone.

The force necessary to open it shall not exceed 300 N.

In the case of lifts covered by **5.4.3.2.2** the opening of the car door from inside the car shall be possible only when the car is in the unlocking zone.

8.12 Trap doors and emergency doors

8.12.1 Assistance to passengers in the car shall always come from outside, being provided in particular by the emergency operation mentioned in **12.9**.

8.12.2 If there is an emergency trap door in the car roof to permit the rescue and evacuation of passengers, it shall measure at least 0.35 m × 0.50 m.

8.12.3 An emergency trap door is obligatory to permit the rescue and evacuation of passengers in the case of lifts where one or two car entrances do not have a door.

8.12.4 Emergency doors may be used in the case of adjacent cars, provided, however, that the horizontal distance between cars does not exceed 0.75 m (see especially **5.2.2.1.2**).

If emergency doors exist, they shall measure at least 1.8 m high and 0.35 m wide.

8.12.5 If emergency trap doors or doors are installed, they shall conform to **8.3.2** and **8.3.3**, also to the following.

8.12.5.1 Emergency trap doors and doors shall be provided with a means for manual locking.

8.12.5.1.1 Emergency trap doors shall be opened from outside the car without a key and from inside the car with a key suited to the triangle defined in Appendix B.

Emergency trap doors shall not open towards the inside of the car.

Emergency trap doors in the open position shall not project beyond the edge of the lift car.