Code of practice for the safe construction and installation of electric passenger, goods and service lifts

Established by
the International Committee for Lift Regulations (CIRA)
in co-operation with the International Labour Office

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Preface

The publication of this code of practice was approved by the Governing Body of the International Labour Office at its 180th Session (May-June 1970). The code supersedes Regulation 15 of the *Model Code of Safety Regulations for Industrial Establishments, for the Guidance of Governments and Industry*, published by the Office in 1949.

The code has been drawn up by the International Committee for Lift Regulations [1] established in accordance with a decision taken by the delegations accredited to an international meeting of experts on safety regulations for passenger, goods and service lifts that was held in Milan from 20 to 24 May 1957. After preparation by experts from seven countries [2] the code was adopted by the Committee in April 1969 and amended in January 1970. The code has also been the subject of consultations organised by the ILO with twelve countries having well developed lift industries. The observations made in the course of those consultations

[1] Commission internationale pour la réglementation des ascenseurs et monte-charge (CIRA).

[2] The following members of the Committee took part in the formulation of the code: Mr. F. SPOON, former Chairman of the Committee and former Director of the Netherlands Institute for Lift Technology; Mr. H. EGLI (Switzerland), Chairman of the Committee, former Chief of the Lift Installation Bureau of the City of Zürich; Mr. R. T. EYPELTAUER (Austria), Chairman of the Lifts Committee of the Austrian Standards Committee (ÖNA); Mr. C. FERRETTI SARTORI (Italy), Director, National Accident Prevention Institute (ENPI), and Chief of the Lifts and Hoists Inspection Service; Mr. C. F. FRANZEN (Federal Republic of Germany), former Chief of the Lifts Testing Agency; Mr. L. P. J. HUBERTS (Netherlands), Director of the Netherlands Institute for Lift Technology; Mr. K. MAHRER, European Mechanical Handling Confederation (Fédération Européenne de la Manutention, abbreviated as FEM); Mr. H. MASSART (FEM); Mr. C. G. L. MORLEY (United Kingdom), Assistant Director, Department of Mechanical and Electrical Engineering, Greater London Council, chairman of the lifts committee of the British Standards Institution; Mr. H. ROCHE (France), of the Lift Manufacturers' Federation; Mr. J. SCHROEDER (Federal Republic of Germany), of the Lifts Board of the

have been taken into account as far as possible and compromise solutions adopted whenever necessary.[1]

Federal Republic and of the VdMA; Mr. J. STAAL (FEM); Mr. J. TRAIZET (France), of the Lift Manufacturers' Federation; Mr. C. VOLPI (Italy), former Professor, Milan Polytechnic; Chairman of the Lifts Research and Regulation Board.

The International Labour Office was represented by Mr. E. HELLEN and Mr. P. E. GHERARDI, of the Occupational Safety and Health Branch.

The Secretary of the Committee was Mr. F. LAUTMANN, Chief Engineer, SOCOTEC-Bureau Securitas (France).

[1] At a later stage Mr. J. C. R. FOTHERGILL, Managing Director of Pickerings Limited, Globe Elevator Works, Stockton-on-Tees (United Kingdom), was consulted in relation to the English text.

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Introduction

The purpose of this code is to set out safety rules concerning passenger, goods and service lifts, in order to protect persons and property against the various accident hazards.

There are many national standards and regulations for lifts, and they differ in many points of detail. Some of the differences are due to circumstances peculiar to the countries concerned; most of them, however, are due to the fact that the standards and regulations have been drawn up without co-ordination and at different times. These differences could therefore be reduced to a minimum.

This code lays down safety principles corresponding to present-day techniques of lift construction and installation. It is not mandatory, and its purpose is above all to offer guidance. Countries that have not yet promulgated standards or regulations on the question may—subject to changes dictated by national needs—draw on the code when drafting such provisions, and countries where relevant national standards or regulations are already in force may consider the possibility of amending those provisions in accordance with its recommendations.

The code is not based on a compilation of existing standards and regulations, although these have been taken into account wherever possible.

Study of the various kinds of accidents involving damage to people or property which can occur in connection with lifts has led to the following classifications:

1. *Kinds of possible accidents:* *(a)* shearing; *(b)* crushing; *(c)* fall; *(d)* physical shock; *(e)* trapping; *(f)* fire; *(g)* electric shock; *(h)* damage to equipment; *(i)* wear; and *(j)* corrosion.

2. *Persons to be safeguarded:* *(a)* users in general (non-instructed); *(b)* authorised and instructed users; *(c)* installation, main-

tenance and supervisory staff; and *(d)* persons outside the lift well.

3. *Property to be safeguarded: (a)* loads in the car; *(b)* components of the lift installation; and *(c)* the building housing the lift.

It will be noted that due consideration has been given to the kinds of persons to be protected and their degree of responsibility: a distinction has been drawn between non-instructed users (particularly children), on the one hand, who should be safeguarded against their own negligence, ignorance and unwitting carelessness, and, on the other hand, authorised and instructed users, who are required to abide by certain instructions issued by the person responsible for the installation (under whose orders they usually come). Some rules could be less stringent in the case of lifts used only by persons in the latter category. For both categories, the rules guard against the danger resulting from a single deliberately committed careless act, but not against that resulting from several such acts performed simultaneously.

The following method has been followed in preparing the code. First, the risks (as listed above) which are associated with each component of a lift installation have been analysed, and a safeguarding provision produced in each case. Secondly, the requirements of this code of practice are peculiar to lifts, and do not repeat the general technical safety rules applicable to machinery, electrical installations or buildings. It is, of course, to be understood that all components should—

(a) be correctly calculated, be of sound electrical and mechanical design, be made of appropriate, good quality material, and be of adequate strength and free from defects;

(b) fulfil the requirements of the fire prevention and protection rules in the country concerned; and

(c) be kept in good repair and working order.

The recommendations deal mainly with the requirements for materials and equipment. For ease of reference, the same subject

may be mentioned in different sections of the text and under a number of different headings.

When in the interests of clarity mention is made of a particular design, it should not be regarded as the only possible one; any other solution following the same principles is acceptable, provided that it can be relied upon to be at least as efficient and at least as safe.

1. Scope

1.0.1. The present code deals with built-in hoisting appliances serving fixed levels, having an electrically driven car designed for the conveyance of persons and goods, or for the transport of goods only, and moving between vertical or substantially vertical guides.

1.0.2. It does not cover directly passenger, goods or service lifts not driven by an electric motor; appliances actuated by fluids (such as oil and hydraulic lifts); and hoisting appliances such as paternosters, rack and pinion elevators, screw-driven elevators, mine lifts, theatre elevators, automatic loading appliances, skips, building hoists for personnel and materials, ships' lifts and maintenance hoists. However, useful guidance may be obtained from this code when such equipment is being designed or installed.

1.0.3. The code consists of two parts, Part A dealing with passenger and goods lifts and Part B with service lifts, each as defined under 2.0.1 below. In Part A certain exceptions are made in respect of lifts designated for the exclusive use of authorised and instructed users.

1.0.4. To be regarded as falling within the category of lifts designated for the exclusive use of authorised and instructed users, a lift should meet one of the following two requirements:

(a) it should be possible to operate the lift only when a key is inserted in a lock inside or outside the car, the key to be in the possession only of authorised and instructed users; or

(b) the lift should be located in a place to which the public is not admitted and which, when not locked, is under the permanent supervision of one or more persons designated by the person responsible for the lift.

1.0.5. Authorisation to use the lift and the instructions relating to its use should emanate from the person responsible for the lift.

1.0.6. Since few lifts now in use have been made to be operated exclusively by a car attendant, and since the influence of such an attendant on the safety of transport is insignificant, it has been decided not to draw up special rules for attended lift cars.

1.0.7. In principle the present code is meant only for new installations.

1.0.8. In the case of new passenger, goods or service lifts to be installed in existing buildings, different requirements could be laid down or departures from these recommendations agreed to by the competent authorities, as long as the necessary safety precautions are taken, if application of the code would not be practicable owing to the layout of the premises.

1.0.9. Existing lifts should—

(a) be kept in operation only if they do not constitute serious hazards. In addition, it would be desirable to bring them into conformity with the new requirements within some time limit and to an extent consistent with the technical and financial possibilities and the extent of the hazards in each particular case;

(b) be subjected to the same regular inspections as new lifts. If not carried out by a public authority, these inspections should be carried out by a body or person licensed by the public authorities (when such licensing exists in the country concerned). such body or person to be as far as possible independent of the manufacturer and of the organisation in charge of the maintenance.

2. Definitions*

2.0.1. The following definitions are given to indicate the precise technical sense in which the listed terms have been used in this code.

Apron: vertical and smooth screen below and plumb with the landing or car sill edge.

Authorised user: person authorised to use the lift by the person responsible for the installation.[1]

Bed lift: lift in which the car is dimensioned to receive a stretcher or a hospital bed, together with at least one attendant.

Buffer: device to absorb the impact of the car or counterweight at the end of travel (e.g., by means of a fluid or spring).

Car: the part of a lift that is designed to carry persons or goods.

Contract load: maximum load, to be indicated in the car, for which normal operation is guaranteed by the manufacturer.

Contract speed: speed, stated by the manufacturer, at which the lift has been designed to operate (see also A8.6 and B8.6 below).

Drum drive lift: lift in which the suspension ropes or chains are positively driven by the machine (i.e. otherwise than by friction).

Frame: metal supporting frame or sling to which the suspension gear is attached and which carries the car or the counterweight.

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* Elsewhere in the text an asterisk after a word or expression indicates, if need be, that a definition of the word or expression is to be found in this section.

[1] See under 1.0.4 above the requirements to be met for a lift to be regarded as falling within the category of lifts designated for the exclusive use of authorised and instructed users.

Goods lift: see "Passenger and goods lift" and "Service lift" below.

Gradual safety gear: safety gear designed to limit the reaction on the car to an acceptable level when it operates.

Guaranteed breaking load of a rope: breaking load of the rope as guaranteed by the rope manufacturer. The actual breaking load found as the result of tests should always be in excess of the guaranteed breaking load.

Guides: members that guide the car or counterweight frame.

Instantaneous safety gear: safety gear which grips the guides without gradual braking effect and which is devoid of any shock-absorbing device limiting the reaction on the car.

Instructed user: person who has received instructions relating to the use of the lift and emanating from the person responsible for the installation.[1]

Levelling: operation of a special device to improve the accuracy of stopping of the car at the level of a landing.

Lift machine: entire driving unit ensuring the movement of the lift.

Machine room or space: place in which the lift machine and control gear are housed.

Net car floor area: area available to passengers during normal operation of a passenger and goods lift (measured at a height of 3ft 4in. (1m) above floor level, irrespective of skirting or handrail).

Passenger lift: see "Passenger and goods lift" below.

Passenger and goods lift: a built-in hoisting appliance, serving fixed levels, moving between vertical or substantially vertical guides, and having a car manifestly dimensioned and arranged to permit the access of persons.

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[1] See footnote 1 on previous page.

Pit: part of the well below the bottom landing served by the lift.

Re-levelling: operation of a special device to obtain accurate levelling of the car, and maintenance of the level during loading and unloadling, by successive adjustments as and when required.

Safety gear: mechanical device attached to the car or counterweight frame, and automatically stopping and holding the car or counterweight to the guides in the event of overspeed in downward motion or the breaking of the suspension gear.

Service lift: a built-in hoisting appliance, serving fixed levels, moving between vertical or substantially vertical guides, and having a car manifestly dimensioned and arranged to prevent the access of persons: the horizontal dimensions of the car (width and depth) should not exceed 3ft 4in. (1m), and its height should not exceed 4ft (1.20 m). A height of more than 4ft is permissible if the car has several fixed compartments meeting the above-mentioned requirements.

Speed governor: device operating above set speeds to stop the lift and, if necessary, to cause the safety gear to grip.

Top clearance: distance available at the top of the well and allowing movement of the car and counterweight beyond the terminal landing.

Traction drive lift: lift driven by friction between the ropes and the sheave of the machine.

User: person using a passenger or goods lift.

Well: space in which the car moves (as well as the counterweight if any). The physical limits of this space are the floor of the pit, vertical walls and the ceiling.

Well forming a chimney: lift well in which the landing doors do not all open directly on one or more staircases, on large halls of a height equal to the total height of the floors connected by the lift, or on outdoor galleries.

A Passenger and goods lifts*

A1. Lift well

A1.1. General

A1.1.1. This section applies to wells containing one or more lift cars.

A1.1.2. The counterweight of a lift should preferably be in the same well as the car.

A1.2. Enclosure of the well

A1.2.1. (1) Each well should be totally enclosed by imperforate walls, as defined in A1.6.

(2) The only permissible openings should be:

(a) landing doors (see A3);

(b) inspection and emergency doors giving access to the well, and inspection trapdoors giving access to the well from the machine room (A1.3);

(c) openings to allow the venting of gases and smoke in the event of fire (A1.4);

(d) ventilation openings (A1.5); and

(e) permanent openings between the well and the machine or pulley room.

* It will be recalled that the meaning attached to words or expressions followed by an asterisk is defined under 2.0.1 above.

Exception

However, if no special precautions against fire risk are required the imperforate enclosure may terminate at a height of not less than 8ft 3in. (2.50m) above the landing level or the nose of steps (if any) and be completed in a perforated form or by wire netting. The dimensions of the perforations or mesh should not exceed 3in. (75mm) measured either horizontally or vertically.

A1.3. Inspection or emergency doors; inspection trapdoors

A1.3.1. Inspection or emergency doors and inspection trapdoors giving access to the well should be provided only if they are necessary for the safety of the users or for maintenance.

Exception

However, if the distance between the thresholds of two consecutive landing doors exceed 33ft (10m), a means of releasing passengers from the car should be provided in addition to the emergency winding device provided for in A8.5.

A1.3.2. Inspection or emergency doors and inspection trapdoors should not open into the well.

A1.3.3. Operation of the lift should be automatically dependent on the maintenance in the closed and locked position of inspection or emergency doors and trapdoors giving access to the well.

Exception

However, it is permissible to allow operation merely with the safeguard that the doors are closed (i.e. not locked) if there is no risk of injury from a moving part of the lift. The breaking of the contacts should be by positive mechanical action, even if they are accidentally welded together.

A.1.3.4. Inspection or emergency doors and inspection trapdoors should be imperforate, and as strong and as fire-resistant as landing doors.

A1.4. Venting of gases and smoke in the event of fire

A1.4.1. When the well can be expected to act as a chimney *, it should be provided with means of ventilation allowing smoke and hot gases to escape into the open air in the event of fire. Accordingly at the top of the lift well the following should be provided:

(a) ventilation openings communicating directly with the open air; or

(b) a connection between the well and the open air by means of non-flammable ducts; or

(c) openings connecting the lift well with the machine room (or the pulley room if the machine is in the basement). In that case ventilation openings should connect the room directly with the open air.

A1.4.2. (1) Ventilation openings should be of adequate area.[1]

(2) The cross-section of ducts mentioned in A1.4.1 *(b)* and the total area of the openings mentioned in A1.4.1 *(c)* should be at least equal to the area required for ventilation openings.

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[1] For example, the following areas have been recommended in some national provisions:

(a) the area of the ventilation openings should be at least equal to 2.5 per cent of the well plan area with a minimum of 110sq. in. (700cm²) per lift;

(b) not more than two-thirds of the required ventilation area may be closed by ordinary glass less than $^1/_8$in. (3mm) thick. When these openings are not vertical, they should be protected on the outside and on the inside by wire mesh (or expanded metal) with mesh rejecting a ball of 1in. (25mm) in diameter.

A1.5. Ventilation of the well

A1.5.1. The well should be adequately ventilated.

A1.5.2. The well should not be used for the ventilation of any area unconnected with the maintenance or operation of lifts, or for the ventilation of the machine room if the latter is not located above the well.

A1.6. Materials forming the walls of the well

A1.6.1. The walls of the well should have adequate strength and rigidity.

A1.6.2. Lift wells should comply with the fire prevention and protection rules in the country where the lifts are installed, and should at least satisfy the following minimum requirements:

(a) when the well can be expected to act as a chimney *, the walls should be in fire-resistant material;

(b) when the well is not likely to act as a chimney its enclosure should, in case of fire, retain its strength as long as required and should not consist of materials apt to become dangerous on account of their high flammability or as a result of the nature and quantity of the fumes which they would produce in the event of a fire.

A1.7. Construction of the walls of lift wells and of the surfaces of landing doors facing car entrances [1]

A1.7.1. The following requirements relating to walls or part of walls and to the surfaces of landing doors facing a car entrance should apply to the full height of the well.

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[1] For clearances between moving parts and walls of lift wells see A7.1 and A7.2.

A1.7.2. Any wall or part of a wall together with the landing doors facing a car entrance should form a continuous surface over the full width of the car entrance.

A1.7.3. (1) For lifts without car doors:

(a) the wall and landing doors referred to in A1.7.2 should together form a smooth and hard vertical surface composed, for example, of metal or stainless components, smooth hard cement covered with oil paint, or some other material having the same properties with regard to friction. In particular soft plastered walls should be prohibited;

(b) any projection should be less than $^{3}/_{16}$in. (5mm). The top as well as the bottom edge of projections of more than 1mm should be chamfered at an angle of at least 75° to the horizontal.

(2) For lifts with car doors:

(a) below the threshold of each landing door, over a vertical distance of not less than half the unlocking zone of the landing door plus 2in. (5cm), the wall of the lift well should comply with the requirements of A1.7.3 (1). At the lower end, this part of the wall should join the unfinished wall of the well by means of hard smooth chamfer at an angle of not less than 60°—preferably 75°—to the horizontal;

(b) at other points the distance between the car sill and the wall of the well should not exceed 4¾in. (12cm).

Exception

However, A1.7.3 (2) (b) *need not be applied in either of the following two cases:*

(a) *if the car has a door that is locked automatically before departure. It should not be possible to open this door (or any of the panels in the case of a multi-panel door) until the car has stopped or is about to stop behind a landing door. Movement of the car should not be possible until the car door is locked. In the case of several mechanically interconnected panels the lock-*

ing of only one panel is permissible, provided that all the other panels are thus prevented from opening;

(b) *if the car is provided with a door sufficiently heavy to prevent it from being opened manually from inside.*

A1.8. Protection against fall of the counterweight

A1.8.1. A lift well should not be located above a space accessible to persons unless:

(a) a pillar of sufficient strength extending down to the foundations or any other device affording sufficient safeguards is installed below the counterweight buffers; or

(b) the counterweight is fitted with safety gear.

A1.9. Well enclosing cars or counterweights belonging to two or more passenger, goods or service lifts

A1.9.1. There should be a dividing screen extending from the bottom of the pit to a height of not less than 8ft 3in. (2.50m) between the moving parts (cars or counterweights) of different passenger, goods or service lifts.

A1.9.2. Further to the provisions of A1.9.1, when the distance between the edge of the car roof of a passenger or goods lift and a moving part (car or counterweight) of an adjacent passenger, goods or service lift is less than 1ft (30cm), the dividing screen provided for in A1.9.1 should extend over the full height of the well.

A1.10. Top clearance for traction drive lifts*

A1.10.1. Both of the following two requirements should be met:

(a) when the counterweight rests on its fully compressed buffers, the remaining travel of the car in the upward direction should

at least be equal to two-thirds of the gravity stopping distance corresponding to the contract speed of the lift (0.035 v^2, the travel being expressed in metres and the speed in metres per second), and not be less than 10in. (25cm); and

(b) when the counterweight rests on its fully compressed buffers, the free height above the car roof should be at least 3ft 4in. (1m) plus two-thirds of the gravity stopping distance corresponding to the contract speed of the lift (0.035 v^2, the travel being expressed in metres and the speed in metres per second).

A1.10.2. Further to the provisions of A1.10.1, when the car rests on its fully compressed buffers the remaining travel of the counterweight in the upward direction should be at least equal to two-thirds of the gravity stopping distance corresponding to the contract speed of the lift (0.035 v^2, the travel being expressed in metres and the speed in metres per second).

A1.11. Top clearance for drum drive lifts*

A1.11.1. Both of the following two requirements should be met:

(a) when the car is level with the top floor, the remaining travel of the car in the upward direction should at least be equal to 6¼in. (16cm) plus thirteen times the gravity stopping distance corresponding to the contract speed of the lift (0.65 v^2, the travel being expressed in metres and the speed in metres per second), and not be less than 10in. (25cm); and

(b) when the car is in contact with the fully compressed overhead buffers, the free height above the car roof should be at least 3ft 4in. (1m).

A1.11.2. In addition to the requirements laid down in A1.11.1, if a counterweight is used and when the car is resting on its fully compressed buffers, the remaining travel of the counterweight in the upward direction should be at least equal to 6¼in. (16cm) plus

thirteen times the gravity stopping distance corresponding to the contract speed of the lift (0.65 v^2, the travel being expressed in metres and the speed in metres per second).

A1.12. Pit

A1.12.1. The bottom of the well should form a waterproof pit.

A1.12.2. (1) If there is a special access door to the pit other than the landing door, it should meet the requirements of A1.3.2, A1.3.3 and A1.3.4.

(2) If no such entrance exists and if the depth of the pit exceeds 4ft 3in. (1.3m), a means of access out of the way of the moving parts of the lift should be provided to enable maintenance personnel to reach the pit floor safely.

A1.12.3. (1) When the car rests on its fully compressed buffers the distance between the lowest part of the car (guide shoes, roller guides, safety gear and toe guard excluded) and the bottom of the pit should not be less than 1ft 8in. (50cm), and should be such that a person can remain in the free space below the car.

(2) Maintenance personnel working in the pit should be able to stop the lift by means of a switch located in the pit. Re-starting should be possible only as a result of the deliberate action of such personnel.

A1.13. Exclusive use of the lift well

A1.13.1. The well should not serve any purposes, and should contain no tubing or other parts, that are not connected with the maintenance and operation of the lift. (It is permissible for the well to contain equipment for its own heating.)

A1.14. Lighting of the well

A1.14.1. The well should be equipped with fixed artificial lighting ensuring sufficient light during repair and maintenance work with all landing doors closed.

A1.15. Special counterweight wells

A1.15.1. Separate counterweight wells should comply with the requirements for the construction of lift wells and inspection doors. Counterweight wells need not have lighting.

A2. Machine and pulley rooms

A2.1. General

A2.1.1. Normally machines, their control gear and pulleys should be accessible only to maintenance personnel.

A2.1.2. Machines, their control gear and pulleys should be in special rooms.

Exceptions

1. *However, in the case of lifts in industrial establishments, machines, their control gear and pulleys may be located in rooms that are also used for other purposes and are in parts of the building accessible only to personnel of the establishment. In that case machines, their control gear and pulleys should be separated from the remaining part of those rooms by:*

(a) *covers locked by key; or*

(b) *enclosures with access doors locked by key.*

2. *There need be no floor under the pulleys; in that case the top of the well is to be regarded as constituting a pulley room.*

A2.1.3. (1) In no circumstances should machine and pulley rooms be used for purposes other than those relating to lifts: they should contain no tubing or other parts that are not connected with the maintenance and operation of lifts. (It is permissible for these rooms to contain equipment for their own heating.)

(2) The same requirements should apply to the covers and enclosures mentioned in A2.1.2 (1).

A2.1.4. A machine room should preferably be above the well.

A2.2. Accessibility

A2.2.1. Access from the street to the interior of the premises housing the machines, their control gear or the pulleys should be

easy and perfectly safe even in bad weather. In particular such access should conform to the recommendations issued on this subject in the *Model Code of Safety Regulations for Industrial Establishments* published by the International Labour Office, and to national laws and regulations relating to occupational safety.

A2.2.2. (1) The access of personnel to machine rooms should preferably be entirely by way of stairs.

(2) If that is impossible, ladders may be used which satisfy the following conditions:

(a) they should not be apt either to slip or to turn over;

(b) if they are not fixed, their slope in position of use should not exceed 60° to the horizontal;

(c) they should be used exclusively for the purpose in question and should always be kept available nearby. The necessary arrangements (e.g. padlocking) should be made to ensure this;

(d) they should be fitted with one or two handholds within reach at the top.

A2.2.3. Easy, safe and convenient means of access, separate from stairways, should be provided in the building to allow handling of heavy equipment on erection and the subsequent removal and replacement of any that is defective.

A2.3. Design and equipment of machine rooms

A2.3.1. Machine rooms should be designed to withstand the stresses to which they will normally be subjected.

A2.3.2. The floors, walls and ceilings of machine rooms, as well as the access doors and trapdoors, should in case of fire retain their strength as long as required. They should not consist of materials apt to become dangerous on account of their high flammability or as a result of the nature and quantity of the fumes which they would produce in the event of a fire.

A2.3.3. The floors of machine rooms should not be slippery.

A2.3.4. (1) The dimensions of machine rooms should be sufficient to allow easy and perfectly safe access by maintenance personnel to all parts of the machines, especially the electrical connections. In particular there should be a horizontal distance of at least 2ft 6in. (75cm) in front of the control panels to allow access to the components.

(2) In no case should the height of machine rooms be less than 5ft 11in. (1.80m).[1]

A2.3.5. (1) Doors giving access to machine rooms should have a height of not less than 5ft 11in. (1.80m).

(2) Trapdoors giving access to machine rooms should when closed be capable of supporting the weight of persons who may stand on them.

(3) When a trapdoor is in an open position the opening should be adequately guarded to prevent persons from falling through it.

(4) A door or trapdoor for the access of personnel to a machine room should be provided with a lock and key. When the door or trapdoor is locked, opening from the inside should be possible without a key. A trapdoor for the purpose of handling equipment only should be locked from the inside.

A2.3.6. In order to prevent objects from falling through them, openings in machine foundations and in the machine room floor should be as small as possible and sleeves projecting 2in. (5cm) above the floor or foundations should be used.

A2.3.7. (1) Arrangements should be made to ensure adequate lighting of the machine room. The lighting should be independent of the supply to the machine, and the current should either be

[1] In this case the term "height" refers to the height between the floor of the room (not the machine foundation) and the ceiling, irrespective of any girders, beams, etc. below the ceiling.

supplied from a separate circuit or be taken from the machine circuit before the main switch of the lift.

(2) A switch located inside the machine room (near the lock jamb side of the door, if any) and at normal height should enable the light in the machine room to be controlled from the entrance. One or more socket outlets should be provided.

A2.3.8. Machine rooms should be ventilated so that motors, control gear and electric conduits will be protected as far as possible against dust, noxious gases and humidity.[1]

A2.3.9. When not otherwise agreed between the customer and the lift manufacturer, the ambient temperature should be kept between 40 and 105 °F (5 and 40 °C).

A2.3.10. Waste material such as used cleaning rags should be deposited in an incombustible receptacle provided with a lid.

A2.3.11. One or more metal beams or hooks, as required, should be fixed to the ceiling of the machine room to allow handling of heavy equipment on erection and the subsequent removal and replacement of any defective part.

A2.4. Design and equipment of pulley rooms

A2.4.1. Pulley rooms should be designed to withstand the stresses to which they will normally be subjected.

A2.4.2. The floors, walls and ceilings of pulley rooms, as well as the access doors and trapdoors, should in case of fire retain their strength as long as required. They should not consist of materials apt to become dangerous on account of their high flammability or as a result of the nature and quantity of the fumes which they would produce in the event of a fire.

A2.4.3. (1) The floors of pulley rooms should not be slippery.

[1] Ventilation openings may assist the discharge of gases and smoke in the event of fire (see A1.4.1*(c)*).

(2) When there is no floor (see A2.1.2 (2)), one or more inspection panels (without electric contacts) should be installed in suitable positions to enable observation to be made of the moving parts when the lift is in operation; the necessary precautions should be taken to prevent falls into the well.

A2.4.4. (1) The dimensions of pulley rooms should be such that maintenance personnel have easy and perfectly safe access to all the parts.

(2) The ceiling of a pulley room should be at a height of not less than 4ft (1.20m).

A2.4.5. (1) Doors giving access to pulley rooms should have a height of not less than 4ft (1.20m).

(2) Trapdoors giving access to pulley rooms should when closed be capable of supporting the weight of persons who may stand on them.

(3) When a trapdoor giving access to a pulley room is in an open position the opening should be adequately guarded to prevent falls.

(4) A door or trapdoor for the access of personnel to a pulley room should be provided with a lock and key. When locked, opening from the inside should be possible without a key. Trapdoors for the purpose of handling equipment only should be locked from the inside.

A2.4.6. In order to prevent objects from falling through them, openings in pulley foundations and in the pulley room floor should be as small as possible, and sleeves projecting 2in. (5cm) above the floor or foundations should be used.

A2.4.7. (1) Arrangements should be made to ensure adequate lighting of the pulley room.

(2) A switch located inside the pulley room (near the lock jamb side of the door, if any) and at the normal height should

enable the light in the pulley room to be controlled from the entrance. One or more socket outlets should be provided.

A2.4.8. In the pulley room a switch should be installed for stopping the lift. Re-starting should be possible only by the use of that switch.

A2.5. Enclosures and covers

A2.5.1. Machine or pulley enclosures or covers, if any, should meet the following requirements:

(a) the enclosure doors of the covers should be locked by key;

(b) the rooms containing the enclosures or covers should meet the requirements of A2.3.1 to A2.3.11, except that the switch provided for in A2.3.7 (2) should be located either inside the enclosure near the lock jamb side of the door or near the cover.

A3. Landing doors

A3.1. General

A3.1.1. The openings in the well giving access to the lift car should be fitted with imperforate doors. When closed those doors should completely cover the openings, subject to the necessary clearance, which should be as small as possible and in any case less than ¼in. (6mm).[1]

A3.2. Strength of landing doors and their frames

A3.2.1. (1) Doors and their frames should be so constructed that the doors will not become deformed in the course of time. It is recommended that metal doors should be used in all cases.

(2) The use of glass, even wired glass, or of plastic material should be allowed only for the vision panels referred to in A3.6.2*(a)*.

A3.2.2. Landing doors should comply with the fire prevention and protection rules in the country where the lift is installed. In addition, without necessarily being as fire-resistant as the walls of the well onto which they open, landing doors should afford a degree of protection against fire corresponding to that required for those walls.

A3.2.3. Doors and their locks should have adequate strength and rigidity.[2]

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[1] For the requirements respecting the car side of landing doors see A1.7.1.

[2] In this respect the following criteria could be adopted:

(a) locked landing doors should withstand without permanent deformation a horizontal force of 66lbf (30kgf or 30daN) applied at any point on either side of a door panel, this force to be evenly distributed over an area of 4sq.in. (25cm²) in a round or square section. After this the doors should function normally;

A3.3. Height and width of doors

A3.3.1. Landing doors should have a clear height of not less than 6ft 5in. (1.95m).

A.3.3.2. The clear width of landing doors should not exceed the width of the car entrance by more than 4in. (10cm).

A3.4. Sills

A3.4.1. Each landing opening should have a sill, clad or otherwise reinforced if need be, and strong enough to withstand the passage of the loads into the lift. The sill should line up accurately with the landing floor in the horizontal plane and with the wall of the well in the vertical plane.

A3.5. Protection of persons

A3.5.1. The design of the doors and of the surrounding parts of the structure should be such as to reduce to a minimum the harm that may ensue if a part of the body or an article of clothing or some other object is caught in or between them.

A3.5.2. Power-operated doors should be designed to ensure that no injury will result if a person happens to be hit by a door panel.

A3.6. Local lighting and waiting signal

A3.6.1. Natural or artificial lighting of landings in the vicinity of the doors should be such that on opening a landing door to enter the car, a user can see what is in front of him, even in the event of failure of the car light.

(b) in the case of lifts not provided with car doors, the landing doors should have a maximum permitted elastic deformation not exceeding $^{3}/_{16}$in. (5mm) when a force of 66lbf is applied as mentioned above.

A3.6.2. In the case of a landing door designed to be opened by hand, the user should know before opening the door whether the car is behind the door or not. For this purpose there could be provided:

(a) preferably one or more transparent vision panels. The strength of such panels should be that specified in A3.2.3, and one of their dimensions should not exceed 6in. (15cm); or

(b) a waiting signal which should light up only when the car is about to stop or has stopped at the landing in question. This light should remain on throughout the time when the car is stationary.

A3.7. Safeguards to prevent persons from falling into the lift well

A3.7.1. It should not normally be possible to open a landing door (or any of the panels in the case of a multi-panel door) unless the lift car is stationary or about to stop in the unlocking zone of that door.

A3.7.2. The unlocking zone should not exceed 8in. (20cm) above and below floor level. For power-operated doors this distance may be increased to 1ft (30cm).

A3.8. Protection against shearing

A3.8.1. It should not be possible to operate the lift or to keep it in motion if a landing door (or any of the panels in the case of a multi-panel door) is open, except during levelling * or re-levelling * in the unlocking zone of that door.

A3.8.2. When the lift operates with any landing door open during levelling or re-levelling, one of the two following requirements should be met:

(a) stopping should be achieved by opening contacts that are in conformity with A3.11.1, and are operated either directly by the movement of the car itself, or by the selector; or

(b) stopping should be ensured by other means. In that case, the normal stopping device should be supplemented by an independent device which causes the car to stop as soon as it has left the unlocking zone.

A3.8.3. A rope, chain or tape used to connect a selector to the car for one of the devices mentioned in A3.8.2. should be free of friction throughout its length, and its breaking should cause the lift to stop.

A3.9. Emergency locking and unlocking devices

A3.9.1. Each landing door should be fitted with a special lock meeting the requirements of A3.7.1 and A3.7.2.

A3.9.2. Locking of the landing door should precede the start of the movement of the car. This locking should be controlled electrically. It should be possible for the lift to move only if the locking mechanism is properly engaged.

Exception

*However, for a lift whose contract speed * does not exceed 100ft per minute (0.50m/s), the top and bottom landing doors may be provided with locks the locking of which is effective and electrically controlled only from the moment when the car leaves the unlocking zone. The contacts permitting the operation of the lift in that zone with a non-locked door should meet the requirements of A3.11.1(1) and (2).*

A3.9.3. It should be possible to unlock any landing door from the outside by means of a special key. This key should be handed only to the persons in charge of the lift, together with written instructions listing the essential precautions to be taken to prevent accidents which could result if a door is unlocked and not properly locked again. A triangular key may be used similar to that used for bolting flameproof electrical switchgear.

A3.9.4. Locking and unlocking devices should be protected against misuse.

A3.10. Requirements for switches for landing entrances

A3.10.1. Each landing door should be fitted with an electrical switch controlling the closed position to meet the requirements of A3.8. The switch may be part of the locking device.

A3.11. Requirements for door locking devices and switches

A3.11.1. (1) Door locking devices and door switches should be so designed that the contacts will be opened by positive mechanical action even if they are accidentally welded together.

(2) Every precaution should be taken in the construction of such locks and switches to prevent accidental short-circuiting of the contact.

A3.11.2. It should be impossible, by any single action not being part of the normal operating procedure, to start the lift while the door is open or not locked.[1]

A3.12. Multi-panel landing doors

A3.12.1. When a landing door consists of several mechanically interconnected panels it is permissible, in order to meet the requirements of A3.7 to A3.11:

(a) to lock only one panel, provided that all the other panels are thus prevented from opening; and

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[1] Operation of the lift with an open or non-locked door might, for example, call for one of the following two combinations of actions:

(a) simultaneous shorting of two electric contacts; or

(b) shorting of one electric contact and simultaneous deliberate manipulation of a mechanical part of the locking device.

(b) to fit the electric door switch to one panel only.

A3.12.2. When the panels of a landing door are interconnected by such means as a rope, belt or chain, the connection should be designed to withstand the stresses to which it will normally be subjected. It should be made with the utmost care and be checked at regular intervals.

A4. Car and counterweight

A4.1. Car height

A4.1.1. The internal height of the car should not be less than 6ft 7in. (2m).

A4.1.2. The height of the entrance (or entrances) for the normal access of users should be at least equal to the height of the lowest door at any landing.

A4.2. Car floor area

A4.2.1. In order to prevent the number of persons in the car from exceeding the contract load, the net car floor area * of a lift other than those covered by A4.2.2 and A4.2.3 should be limited. For that purpose the relationship between the contract load and the maximum net floor area of the car may be determined in accordance with the following table.

Contract load		Maximum number of persons	Maximum net car floor area	
lb	kg		sq. ft	m^2
220 [1]	100 [1]	1	4.3	0.40
395 [1]	180 [1]	2	5.4	0.50
495	225	3	7.5	0.70
660	300	4	9.7	0.90
825	375	5	11.8	1.10
990	450	6	14.0	1.30
1 155	525	7	15.6	1.45
1 320	600	8	17.2	1.60
1 485	675	9	18.8	1.75
1 650	750	10	20.5	1.90

[1] In practice these loads are used only in exceptional cases.

Contract load		Maximum number of persons	Maximum net car floor area	
lb	kg		sq. ft	m²
1 815	825	11	22.1	2.05
1 980	900	12	23.7	2.20
2 145	975	13	25.3	2.35
2 310	1 050	14	26.9	2.50
2 475	1 125	15	28.5	2.65
2 640	1 200	16	30.1	2.80
2 805	1 275	17	31.8	2.95
2 970	1 350	18	33.4	3.10
3 135	1 425	19	35.0	3.25
3 300	1 500	20	36.6	3.40
For each person in excess of 20 add:				
165	75		1.3	0.12

A4.2.2. In the case of a lift (other than a bed lift *) designated for the exclusive use of authorised and instructed users *, the requirements laid down in A4.2.1 need not be complied with if the person responsible for the lift ensures that the number of persons or the load allowed to be carried in the lift car is within the prescribed rating. It is, however, inadvisable to exceed greatly the net areas specified in the table for the loads indicated.[1]

A4.2.3. In the case of a bed lift for a contract load of 1,320, 1,650 or 1,980 lb (600, 750 or 900 kg) the requirements laid down in A4.2.1 need not be complied with if all of the following requirements are met:

(a) a responsible person ensures that the load to be carried in the lift car is within the prescribed limits;

[1] Experience has shown that for the transport of most goods it is not necessary to increase the maximum net areas, as specified above, by more than 25 per cent.

(b) the lift is equipped with a device to prevent it from starting when overloaded;

(c) the users are warned by an acoustic and visual signal that this device is actuated; and

(d) the net car floor areas do not exceed those specified in the following table:

Contract load of bed lift		Maximum net car floor area	
lb	kg	sq. ft	m^2
1 320	600	26.9	2.50
1 650	750	29.6	2.75
1 980	900	32.3	3.00

A4.3. Car walls, floors and roofs

A4.3.1. Cars should be completely closed by imperforate walls, floors and roofs, the only openings permissible being the following:

(a) openings for the normal access of users;

(b) emergency or inspection doors and trapdoors; and

(c) ventilation openings.

A4.3.2. Car walls [1], floors and roofs:

(a) should be sufficiently strong (see A4.3.3); and

(b) should, in case of fire, retain their strength as long as required, and should not consist of materials apt to become dangerous owing to their high flammability or as a result of the nature and quantity of the fumes which they would produce in the event of a fire.

[1] This refers not to the panelling but to the structure of the car walls.

A4.3.3. (1) The walls, floor and roof of a car should as a whole be sufficiently strong to withstand the stresses to which the car is subjected during normal operation of the lift, or when the safety gear operates or the car strikes the buffers.

(2) Car walls should be only of metal, or of material of equivalent strength.

(3) Car walls should withstand without permanent deformation a horizontal force of 66lbf (30kgf or 30daN) applied at any point and evenly distributed over an area of 4sq.in. (25cm²) in a round or square section.

A4.4. Toe guard

A4.4.1. Each car sill should be provided with a vertical apron extending over the full width of the landing doors facing it. The height of the apron should not be less than half the unlocking zone plus 2in. (5cm).

Exception

However, in the case referred to in the exception to A3.9.2, the above-mentioned dimension of 2in. should be increased to 6in. (15cm).

A4.5. Closing of car entrances for the normal access of users

A4.5.1. Car entrances for the normal access of users should be fitted with car doors.[1]

A4.5.2. Although it is preferable that there should be car doors in all cases, permission may be given [2], in the case of lifts specially made for the transport of goods, for one or several car

[1] See also A4.7.

[2] It should be noted that certain national regulations do not allow this.

entrances not to be provided with doors if both of the following requirements are met:

(a) the contract speed of the lift does not exceed 170ft per minute (0.85m/s); and

(b) the lift does not transport persons other than authorised and instructed users.

A4.6. Car doors

A4.6.1. No openings should be allowed in car doors.

Exception

However, on lifts with car attendants which are used for the transport of goods, vertical-sliding car doors made of wire mesh may be used if the horizontal dimension of the mesh does not exceed $^{3}/_{8}$in. (1cm) and the vertical dimension $2^{3}/_{8}$in. (6cm).

A4.6.2. But for the required clearances, car doors should when closed have the same dimensions as the corresponding car entrances.

Exception

However, in the case of high cars, the height of the car doors could be limited to 6ft 7in. (2m) on lifts having a speed not exceeding 170ft per minute (0.85m/s) if the lifts are designated for the exclusive use of authorised and instructed users.

A4.6.3. (1) The doors and the surrounding parts of the structure should be so designed as to ensure that users are not exposed to an accident risk as a result of being caught in them.

(2) Power-operated doors should be so designed as not to harm persons struck by them.

A4.7. Safety devices on car entrances without doors

A4.7.1. When a car entrance has no door, precautions should be taken to reduce to a minimum the risk of accidents involving jamming and crushing between the car sill and the wall of the well.

A4.7.2. At the present stage of development of lift engineering the use of the following devices is permissible:

(a) a movable sill allowing the clearance between sill and wall to increase to between 2 and 3¼in. (5-8cm), the movement of the sill causing the lift to stop by means of electric contacts meeting the requirements of A3.11.1;

(b) a photo-electric or similar device, fitted in such a manner that actuation of the device automatically puts the lift out of service.

A4.7.3. Special provision should be made to ensure that the load will be kept at a safe distance from the wall of the well at all times.

A4.8. Car door contacts

A4.8.1. It should not be possible to operate the lift, or to keep it in motion, if a car door (or any panel in the case of a multi-panel door) is open, except during levelling or re-levelling at a landing.

A4.8.2. These contacts should meet the requirements of A3.11.1.

A4.9. Opening of the car door in case of breakdown

A4.9.1. In order to enable persons who are in the car to be released in case of breakdown, it should always be possible to open the car door manually from a landing. This requirement is particularly important:

(a) if the power supply fails; and

(b) if the car door is locked.

A4.10. Multi-panel car doors

A4.10.1. When a car door consists of several mechanically interconnected panels it is permissible, in order to meet the requirements of A4.8.1, to fit the electric door contact to one panel only.

A4.10.2. When the panels of a car door are interconnected by such means as a rope, belt or chain, the connection should be designed to withstand the stresses to which it will normally be subjected. It should be made with the utmost care and be checked at regular intervals.

A4.11. Aid to persons trapped in the car

A4.11.1. Aid to persons in the car should always be given from the outside, by using the emergency device mentioned in A8.5.

A4.11.2. (1) Provision of an emergency trapdoor in the car roof should be recommended.

(2) Provision of such a trapdoor should be compulsory if it is essential for the rapid release of passengers.

A4.11.3. The installation of emergency doors may be provided for in the case mentioned in the qualification to A1.3.1.

A4.12. Requirements for emergency or inspection trapdoors and doors

A4.12.1. (1) Emergency or inspection trapdoors and doors should be lockable but not self-locking.

(2) Emergency or inspection trapdoors and doors should be provided with electric contacts meeting the requirements of A3.11.1(1) and (2). The contacts should control the locking required above and cause the lift to stop as soon as the locking

is no longer effective; re-starting should be possible only by the deliberate action of a person supervising or maintaining the lift.

A4.12.2. (1) Trapdoors should open from the outside without a key; when it is also possible to open them from the inside of the car, that act should require the use of a key.

(2) Trapdoors should not open towards the interior of the car.

A4.12.3. (1) Emergency doors should not open outwards. It should be possible to open them:

(a) from outside the lift car without a key; and

(b) from inside the lift car with the key provided for in A3.9.3.

(2) Emergency doors should not face the path of a counterweight.

A4.13. Car roof

A4.13.1. In addition to the requirements contained in A4.3.3, the car roof should be designed to support without permanent deformation the weight of two adults.

A4.13.2. The roof should be fitted with the following equipment:

(a) a stopping device (see A10.3);

(b) a socket outlet (see A4.15.2); and

(c) a data plate on the frame cross-head (see A11.5.1).

A4.14. Car ventilation

A4.14.1. The car should be effectively ventilated, due allowance being made for the time needed to carry out repairs in case of breakdown.

A4.15. Car lighting; socket outlet

A4.15.1. The car should be adequately lit by electric light

throughout the time when the lift is in service. The switch controlling the light should not be in the car.

A4.15.2. A socket outlet should be installed on the car roof.

A4.16. Counterweight

A4.16.1. If a counterweight consists of multiple sections, it should be designed to prevent displacement of the sections. Designs suitable for that purpose are:

(a) a frame securing the sections; or

(b) at least two tie rods passing through the sections.

The latter design should not be permitted in the case of concrete sections.

A4.16.2. The counterweight should be made in such a manner as to meet the requirements of A1.10.2 and A1.11.2.

A5. Suspension and safety gear

A5.1. Type of suspension; number of ropes or chains

A5.1.1. Cars and counterweights should be suspended by round strand steel wire ropes, the wires of a strand to be wound in parallel lay (linear contact between wires).

A5.1.2. For traction drive machines the number of ropes should not be less than two. The ropes should be independent of one another.

A5.1.3. For drum drive machines the number of ropes should not be less than two for the car and two for the counterweight, if any. The ropes should be independent of one another.

A5.1.4. Where reeving is used (e.g. 2 to 1 or more roping) the number of independent ropes should not be less than two.

Exception

The use of roller chains may be permitted for chain speeds not exceeding 100ft per minute (0.50m/s).
In that case the number of chains should not be less than two. The chains should be independent of one another.

A5.2. Ratio between pulley or sheave diameter and rope diameter; safety factor for ropes or chains

A5.2.1. The pulley or sheave diameter should not be less than 40 times the diameter of the suspension rope, whatever the number of strands in each rope.

A5.2.2. When three or more suspension ropes are used allowance should be made for a safety factor [1] of not less than 12.

[1] The safety factor is the ratio between the breaking load of the suspension system (obtained by multiplying the number of ropes—or of legs in the case

When two suspension ropes are used the safety factor should be not less than 16.

A5.2.3. If chains are used the safety factor[1] should not be less than 6.

A5.3. Rope traction (for traction drive lifts)

A5.3.1. It should not be possible to raise the car by starting the machine in the "Up" direction when the counterweight is resting on the buffers.

A5.3.2. It should not be possible to raise the counterweight by starting the machine in the "Down" direction when the car is resting on the buffers.

A5.3.3. The ropes should not slip, or should slip only over a short length, when the machine is stopped by the car's arriving at any floor after it has been travelling at contract speed in the downward direction carrying an overload of 25 per cent.

A5.4. Coiling of ropes (for drum drive lifts)

A5.4.1. When the car or the counterweight rests on its buffers, not less than one-and-a-half turns of rope should remain on the drum.

A5.4.2. There should be only one layer of rope wound on the drum.

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of reeving—by the guaranteed breaking load* of one rope) and the total suspended static load of the lift (i.e. the contract load, the weight of the car, the weight of the ropes over the length of travel, and the possible additional load of compensation gear, if any).

[1] This factor is defined in a way similar to that indicated for ropes.

A5.5. Equalisation of the load between ropes or chains

A5.5.1. A device should be installed to equalise the load between the ropes or chains. In the case of suspension by two ropes or chains, an electric contact should be provided to stop the lift in case of excessive stretch of one rope or chain in relation to the other.

A5.6. Protection of the suspension system

A5.6.1. The necessary arrangements should be made to:

(a) retain the ropes in the grooves; and

(b) prevent foreign matter from becoming wedged between the grooves and the ropes (or between the teeth and the chains).

A5.7. Safety gear

A5.7.1. The car should be fitted with a safety gear applied evenly to both guides and capable of stopping and holding a fully loaded car travelling in the downward direction. The counterweight should also be fitted with a safety gear, acting only in the downward direction, when required in the circumstances described in A1.8.1 *(b)*.

A5.7.2. Car and counterweight safety gear should be of the gradual * type if the contract speed of the lift exceeds 170ft per minute (0.85m/s); for lower speeds it may be of the instantaneous * type.

A5.7.3. Car and counterweight safety gear should be actuated by a speed governor.*

Exception

However, counterweight safety gear may be of the type actuated by the failure of the suspension gear if the contract speed is less than 300ft per minute (1.50m/s).

A5.7.4. For gradual safety gear the maximum deceleration in downward motion with a load of 220lb (100kg) in the car should be less than 2.5*g* (where *g* is the acceleration due to gravity).

A5.7.5. The release of car or counterweight safety gear should normally be obtained by raising the car or the counterweight, as the case may be.

A5.8. Speed governors

A5.8.1. (1) The safety gear should be actuated by the speed governor not later than when the ratio between overspeed of the car and contract speed reaches the values indicated below.

Contract speed				Maximum ratio between overspeed and contract speed (percentage)
Feet per minute		Metres per second		
Above	Up to (inclusive)	Above	Up to (inclusive)	
—	140	—	0.70	50
140	300	0.70	1.50	40
300	400	1.50	2.00	35
400	—	2.00	—	30

(2) However, unless specially designed for low-speed lifts carrying very heavy loads, no speed governor should be set to operate at a speed of less than 170ft per minute (0.85m/s).

A5.8.2. The tripping speed of a speed governor actuating the counterweight safety gear should be up to 20 per cent higher than that of a speed governor actuating the car safety gear.

A5.8.3. A speed governor should be driven by a very flexible rope protected against oxydation. The breaking load of the rope should correspond to the stress to which the rope may be subjected, with a minimum safety factor of 5.

A5.8.4. The time that elapses until a speed governor makes the safety gear grip should be sufficiently short to ensure that the speed reached at the moment of operation of the safety gear is not at a dangerous level.

A5.9. Electrical protective devices

A5.9.1. When the safety gear operates, a device should cause the motor and brake control circuits to open shortly before or at the moment of operation. The opening of the circuits should be achieved through separation of the contacts by positive mechanical action even if the contacts are accidentally welded together.

A5.9.2. When the speed of an ascending car exceeds the contract speed by the percentage indicated in the table in A5.8.1(1), the speed governor or another device should cause the motor and brake control circuits to open.

A6. Guides, buffers and stopping devices

A6.1. General requirements for guides

A6.1.1. The strength of guides, their brackets and joints should be sufficient to withstand the stresses imposed by the operation of the safety gear, as well as by deflection caused by uneven distribution of the load in the car. Such deflection should be limited to a level that will not affect the normal operation of the lift.

A6.1.2. The guides should be fixed to their brackets and to the wall in such a manner as to permit compensation, either automatically or by simple adjustment without any additional work, of effects due to normal settlement of the building or shrinking of the concrete.

A6.2. Guiding of the car

A6.2.1. The car should be guided by rigid metal guides.

A6.3. Guiding of the counterweight

A6.3.1. The counterweight should be guided either by rigid metal guides or, if the distance between rigid attachments does not exceed 100ft (30m), by means of ropes or steel wire guides.

A6.3.2. When the counterweight is guided by ropes or steel wire guides, they should be at least four in number; the arrangement should be such that all contact between the counterweight and the car or the wall of the well is prevented (see A7.2 and A7.3). Each rope or wire guide should be kept taut.

A6.4. Car and counterweight buffers

A6.4.1. A lift should be provided with buffers at the bottom limit of the travel of the car and of the counterweight.

A6.4.2. A drum drive lift * should have buffers also at the top limit of the travel of the car.

A6.4.3. A lift having a contract speed exceeding 300ft per minute (1.50m/s) should be provided with hydraulic buffers.

A6.5. Buffers other than hydraulic buffers

A6.5.1. The possible full stroke of buffers other than hydraulic buffers should be at least equal to twice the gravity stopping distance corresponding to the contract speed of the lift ($0.10\ v^2$, the stroke being expressed in metres and the speed in metres per second).

A6.5.2. The buffers should be so designed as to be fully compressed by a static load between two and three times the weight either of the car (with contract load) or of the counterweight.

A6.6. Hydraulic buffers

A6.6.1. The possible full stroke of hydraulic buffers should be at least equal to the gravity stopping distance corresponding to the contract speed ($0.05\ v^2$, the stroke being expressed in metres and the speed in metres per second).

A6.6.2. The distance indicated in A6.6.1 above could be reduced by half if the slowing down of the lift is positively controlled.

A6.6.3. The maximum deceleration of the car with a load of 220lb (100kg) should be less than $2.5\ g$.

A6.6.4. Normal operation of the lift should not be possible unless the buffer pistons have returned to their normal working position.

A6.6.5. The buffers should be provided with a device for checking the fluid level.

A6.7. Terminal stopping switches

A6.7.1. The car should normally stop automatically at terminal landings.

A6.7.2. (1) In the case of single-speed lifts, normal stopping should be brought about by the opening of contacts located in the well or on the selector.

(2) The contacts should be opened directly by the movement of the car itself, or by the selector, provided that the selector is linked to the car by a rope, chain or tape the breaking of which should cause the lift to stop.

A6.7.3. In the case of multi-speed lifts or lifts with continuous speed regulation, A6.7.2 applies to the slowing-down preceding a normal stop, unless the lift is brought to a stop by a failure of the slowing-down device itself.[1]

A6.8. Final limit switches

A6.8.1. In addition to the normal stopping devices mentioned in A6.7, final limit switches should be provided.

A6.8.2. The final limit switches should be set to operate after the normal stopping devices at the terminal landings and before the car or the counterweight (if any) strikes the buffers.

A6.8.3. (1) In the case of drum drive lifts * the final limit switches should interrupt directly the electric supply to motor and brake. Back feed from the motor to the brake coil should be prevented.

(2) In the case of single-speed or two-speed traction drive lifts *, the final limit switches should directly:

(a) interrupt the electric supply to motor and brake; or

(b) cause two series contactors in the supply circuit of the motor and the brake to open.

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[1] The purpose of these requirements is to reduce the risk of the car's hitting the buffers at full speed (see also A6.6.2).

(3) In the case of variable voltage lifts or lifts with continuous speed regulation, the final limit switches should cause the machine to stop with full dynamic braking.

A6.8.4. After a final limit switch has operated, only a competent person should be able to re-start the lift.

A6.9. Safety device to operate if the descent of the car or counterweight is prevented by some object in the lift well

A6.9.1. In the case of drum drive lifts, there should be a slack rope or slack chain device cutting off the current and causing the lift machine to stop if the descent of the car or counterweight is prevented by some object in the lift well.

A6.9.2. In the case of traction drive lifts, there should be a device causing the lift machine to stop in sufficient time to avoid damage to the ropes and the traction sheave if free movement of the car or counterweight is obstructed.

A7. Running clearances

A7.1. Clearance between car and front of well

A7.1.1. In the case of lifts without car doors, the following provisions should be applied:

(a) the clearance between the car sill and the facing wall of the well should not exceed ¾in. (2cm);

(b) the clearance between the sides of the car entrance and the facing wall of the well should not exceed ¾in. (2cm); and

(c) when the clear height of the car entrance is less than 8ft 3in. (2.50m), the clearance between the top of the car entrance and the facing wall of the well should be between 2¾ and 4¾in. (7-12cm). (It is to be noted in this respect that the use of a hinged flap at this point should be prohibited.)

A7.1.2. In the case of lifts with car doors, the following provisions should be applied:

(a) the clearance between the car sill and the facing wall of the well should not exceed 4¾in. (12cm).

Exception

However, the above-mentioned distance may be varied if the requirements of the exception to A1.7.3 (2) (b) *are met.*

(b) the clearance between the car sill and a landing sill should not exceed ¾in. (2cm). However, in the case of power-operated car and landing doors the clearance may be increased to meet design requirements, provided that the clearance does not then exceed 1¼in. (35mm);

(c) the distance between the car door and a closed landing door should be sufficiently small to prevent a person from being trapped between the two. This requirement may be considered

to be met if a person cannot obtain access to a space where the distance between two such closed doors (or door panels) exceeds 4¾in. (12cm).

A7.2. Clearance between counterweight and well

A7.2.1. (1) When the counterweight is guided by ropes or steel wires, the clearance between the counterweight and the wall of the well, measured at the closest point, should not be less than 2in. (5cm).

(2) To meet the above requirement it will be necessary to provide, at the general layout stage, for a clearance exceeding 2in. by an amount proportionate to the distance between the brackets.

A7.3. Clearance between moving parts of a single lift [1]

A7.3.1. When the counterweight is guided by ropes or steel wires, the clearance between moving parts of a single lift, measured at the closest point, should not be less than 2¾in. (7cm).

A7.3.2. To meet the above requirement it will be necessary to provide, at the general layout stage, for a clearance exceeding 2¾in. by an amount proportionate to the distance between the brackets.

[1] For the case of multiple lifts in a single well see A1.9.

A8. Lift machine

A8.1. Methods of driving the car and the counterweight

A8.1.1. The two following driving methods may be used:

(a) by traction (use of sheaves and ropes);

(b) by fixed attachment (use of a winding drum and ropes, or chain drive wheels and chains).

A8.2. Use of belts to drive the machine

A8.2.1. Belts may be used to couple the motor or motors to the rotating part subjected to the mechanical brake action, provided that the belts are of the "V" or toothed type; that there is at least one more than the minimum number determined by calculation; and that in any case there are never less than three.

A8.3. Use of overhung sheaves or pulleys

A8.3.1. When overhung sheaves or pulleys are used, arrangements should be made to prevent the ropes from leaving the sheave or pulley grooves.

A8.4. Brake system

A8.4.1. The lift should be fitted with a brake system which must include a mechanical brake; additional means of deceleration may be provided, for example dynamic braking.

A8.4.2. The brake system should act automatically in case of failure of the electric supply to the machine or the controls.

A8.4.3. The brake system should be capable of stopping a descending car travelling at contract speed with its contract load increased by 25 per cent.

A8.4.4. The mechanical brake should meet the following requirements:

(a) it should be capable of holding the machine stationary when the car is carrying its contract load increased by 25 per cent;

(b) the part subjected to the braking action should be coupled to the traction sheave, drum or chain drive wheel by direct mechanical means;

(c) in normal operation the brake should be held off by continuous action of an electric current. When the lift motor can act as a generator, the brake coils or servo motors for applying the brake should be connected in such a manner that in no circumstances can they be energised by the hoisting motor. Braking should be effective as soon as the brake circuit is opened; and

(d) it should be possible to release the brake by hand. Such release should require permanent application of manual force.

A8.5. Emergency winding

A8.5.1. (1) The lift should be provided with an emergency winding device making it possible, even in case of failure of the electric supply, to raise or lower the fully loaded car to one of the nearest landings.

(2) The device should be a smooth hand wheel without spokes or holes. It should be accessible only to persons who have received the necessary instructions.

(3) The direction of movement of the car should be clearly indicated on the machine.

A8.6. Speed

A8.6.1. The speed of the lift in the downward direction measured at half contract load in the mid-travel position (acceleration and deceleration periods being excluded) should not exceed the contract speed by more than 5 per cent.

A8.7. Machines driven by variable voltage systems

A8.7.1. When the lift machine used is driven by a variable voltage system, controls should be provided to:

(a) maintain the machine at rest and counteract any possible effects of residual magnetism;

(b) allow starting only when the field excitation of the motor is at safe working level and when the main circuit is closed (in the case of motor-generator sets);

(c) bring the car quickly to rest in case of failure of the supply to the motor-generator set, or in case of absence or insufficiency of motor excitation; and

(d) stop the machine automatically in the event of overspeed in the upward or downward direction before the speed governor actuates the safety gear.

A8.8. Other high-speed machines

A8.8.1. In the case of lifts with a contract speed exceeding 300ft per minute (1.50m/s) that are driven by machines other than variable voltage machines, equipment should be provided to achieve at least the same degree of safety as is achieved with machines driven by variable voltage systems.

A8.9. Guarding of machinery

A8.9.1. Keys and other similar projecting parts, as well as journal ends and exposed gears and belts, should be provided with suitable guards.

A9. Electrical wiring and switchgear

A9.1. General

A9.1.1. In view of its importance from the point of view of safety, electrical wiring associated with lifts should be designed and installed with the utmost care. The wiring should be in conformity with the rules in force in the country where the lift is installed.

A9.1.2. (1) Every precaution should be taken to prevent incidents and accidents that could result from accidental contact with conductors or from insulation faults to earth or between conductors.

(2) In particular, one or more insulation faults to earth should neither cause the lift to start nor render the safety devices ineffective.

A9.2. Protection of motors

A9.2.1. Lift motors should be protected against overloading and short circuits.

A9.2.2. Every measure should be taken to prevent damage to equipment in case of failure of a single phase of the electricity supply.

A9.3. Contactors and relays

A9.3.1. In view of the fundamental role which contactors and relays play with regard to safety, such equipment should be selected with the utmost care. It should be of sound design and construction, and its specifications should correspond to the operating conditions.

A9.4. Voltage for control and safety circuits

A9.4.1. The r.m.s. voltage between conductors in control and safety circuits should not exceed 250 volts.

A9.5. Multi-pole disconnection of the power supply line

A9.5.1. The power supply line to the machine room should have a multi-pole main switch or circuit-breaker adjacent to the access door or trapdoor. The main switch or circuit-breaker should disconnect the supply to the machine on all phases, without disconnecting the supply to the car and machine room lighting circuits and the emergency signalling circuit.

A9.6. Lighting supply

A9.6.1. The electric lighting of the car and of the machine room should be independent of the supply to the machine, and should be taken either from a separate supply or from the supply to the machine before the main switch referred to in A9.5.1. The socket outlet on the car roof (see A4.15.2) should be connected to the same lighting circuit.

A9.7. Supply to the emergency signalling device

A9.7.1. The emergency signalling device should operate even in case of failure of the main supply to the machine.[1]

[1] The emergency signalling device could be supplied from the same source as the car lighting if the latter is independent of the main supply to the machine.

A10. Controls; priorities

A10.1. Control of movement

A10.1.1. The movement of the car should be controlled electrically.

A10.1.2. (1) In general the controls should take the form of push buttons. The buttons should be encased so that no live part is accessible.

(2) The use of a manually operated car control may be permitted if all three of the following requirements are met:

(a) movement of the lift car is possible only when a key is inserted in a lock within the car, this key to be in the possession of a person who has received the necessary instructions;

(b) the direction of movement of the car is clearly indicated; and

(c) the car control returns to the neutral position automatically.

(3) In some cases (e.g. for passenger lifts) the controls are entirely automatic. In such a case an acoustic signal should draw the users' attention to the closing of the doors.

A10.1.3. To facilitate inspection and maintenance the installation of a control device on the car roof should be recommended. All of the following five requirements should be met:

(a) it should be possible to operate the device only after all normal controls have been isolated;

(b) the movement of the car should be conditional on the application of continuous pressure on a button protected against any involuntary action;

(c) it should not be possible for the car to move at a speed exceeding 170ft per minute (0.85m/s);

(d) all safety devices should remain effective; and

(e) the movement of the car in the upward direction should be limited in such a manner that a person on the car roof cannot hit either the ceiling of the well or a part of the lift installation located at the top of the well.

A10.2. Stopping device in the car

A10.2.1. In cars that have doors on all entrances and that move with open doors during levelling * or re-levelling *, users should have at their disposal near each car entrance a push button or a switch that will cause the lift to stop in an emergency; the stop button or switch should be inoperative when the car door is completely closed. The button or switch should be red in colour. Only a person in the car should be able to re-start the lift.

A10.2.2. In cars that have doors on all entrances and that do not move with open doors during levelling or re-levelling, there should be no stop button or switch in the car.

A10.2.3. In a car having an entrance without a door, users should have at their disposal near the entrance a push button or switch that will cause the lift to stop in an emergency. The button or switch should be red in colour. Only a person in the car should be able to re-start the lift.

A10.3. Other stopping devices [1]

A10.3.1. Switches for stopping the lift and keeping it stationary should also be installed on the car roof and in the pulley room, if any. The operation of these switches should render the car and landing calls inoperative and cancel all registered calls.

A10.4. Emergency signalling device

A10.4.1. In order to obtain help from the outside when necessary, persons in the car should have at their disposal an easily recognisable and accessible device enabling them to summon help.

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[1] As regards the stopping device to be provided for work in the pit, see A1.12.3(2)

A10.4.2. The emergency signalling device should operate even in case of failure of the main supply to the machine.

A10.4.3. The device should consist of either a bell or, preferably, a telephone.

A10.4.4. When there is no service in the building available to answer emergency calls from the lift round the clock, the car should be provided with a telephone that communicates with such a service outside the building. Failing this, use may be made of a device actuating an acoustic signal in the street near the main entrance of the building, where the necessary instructions concerning action to be taken should be posted up.

A10.5. Priorities

A10.5.1. In order to allow sufficient time for users to open a landing door, a timing device should prevent departure of the car until not less than two seconds have elapsed after arrival at a landing.

Exception

However, it is permissible for departure not to be delayed when calls originate from within the car and are not registered.

A10.5.2. After a user has entered the car the landing call buttons should remain inoperative for at least two seconds after the landing door has closed.

Exception

However, it is permissible not to apply the above-mentioned requirement to collective control systems, provided that a light signal, clearly visible to users entering the car, indicates the direction in which the car is about to travel. If the car is available for travel in either direction, priority of control should be ensured as indicated above.

A10.5.3. If a landing door is provided with a lock and key (which is inadvisable), special precautions should be taken to prevent the car from starting when the key is inserted in the lock on the car side. There should preferably be a car door on the corresponding car entrance.

A11. Notices and operating instructions

A11.1. General

A11.1.1. All plates and notices, including those bearing operating instructions, should be untearable, of durable material, placed in a conspicuous position and inscribed in easily legible lettering in the language of the country where the lift is installed (or in several languages if the national regulations so require).

A11.2. Inside the car

A11.2.1. (1) An indication of the contract load of the lift (in units of mass) and of the maximum number of persons should be affixed to the inside of the car.

(2) For lifts available for use without attendants, the latter number should be calculated as a function of the car floor area in accordance with the table in A4.2.1.

(3) The corresponding notice should be worded as follows: "Maximum load: ... lb" (or "... kg").
"Number of persons: ...".

A11.2.2. Operating and safety instructions should be affixed to the inside of the car whenever this appears useful. In particular, in the case of lifts without car doors, it should be indicated that persons and goods should be kept clear of the wall of the well.

A11.3. In machine and pulley rooms

A11.3.1. On doors or trapdoors giving access to machine and pulley rooms, notices should be affixed reading: "**Lift Machinery—Danger—No Admittance to Unauthorised Persons**".

A11.3.2. Instructions to be followed in the event of a breakdown should be affixed in machine rooms or inside enclosures or covers.

A11.4. On the outside of the well enclosure

A11.4.1. Near the well inspection doors, notices should be affixed reading: **"Danger—Lift Well"**.

A11.4.2. When landing doors cannot be identified as lift doors they should carry the indication: **"Lift"**.

A11.4.3. On the outside of landing doors of lifts designated for the exclusive use of authorised or instructed users, a notice should be displayed reading: **"Lift Not to Be Used by Unauthorised Persons"**.

A11.5. On the car frame cross-head

A11.5.1. Near the suspension a plate should be affixed indicating:

(a) the name of the lift manufacturer;

(b) the year of installation;

(c) the contract load; and

(d) the number of ropes, their diameter and their individual breaking load or, in the case of chain suspension, the number of chains and their type and specifications (single, double, etc.; pitch; breaking load per chain).

A11.6. On the speed governor

A11.6.1. On the speed governor a plate should be affixed indicating:

(a) the diameter, type and material of the governor rope; and

(b) the tripping speed of the governor.

A11.7. Component identification plates

A11.7.1. The main components of the lift (motor, contactors, etc.) should have identification plates affixed to them.

A11.8. Floor designation

Clearly marked indications, or signal lights, should enable persons in the car to know at which floor the car is.

A12. Lift maintenance and inspection

A12.1. Maintenance

A12.1.1. Lifts should be regularly maintained by competent personnel.

A12.2. Inspection

A12.2.1. (1) Lifts should be inspected before being put into service, and at regular intervals thereafter.

(2) These inspections, if not carried out by a public authority, should be carried out by a body or person licensed by the public authorities (when such licensing exists in the country concerned), such body or person to be as far as possible independent of the manufacturer and of the organisation in charge of the maintenance.

A12.3. Register

A12.3.1. The specifications of the lift should be entered in a register to which should be appended the layout drawings and the electric wiring diagrams.

A12.3.2. The dates and findings of the inspections mentioned in A12.2 should be entered in the register.

A12.3.3. The register should be in the keeping of the organisation in charge of the maintenance.

A12.3.4. A copy of the register or part thereof should be given to the owner of the lift on request.

B Service lifts*

B1. Lift well

B1.1. General

B1.1.1. This section applies to wells containing one or more lift cars.

B1.1.2. The counterweight of a lift should preferably be in the same well as the car.

B1.2. Enclosure of the well

B1.2.1. (1) Each well should be totally enclosed by imperforate walls, as defined in B1.4.

(2) The only permissible openings should be:

(a) landing doors (see B3);

(b) inspection doors giving access to the well (B1.3);

(c) ventilation openings (if any); and

(d) permanent openings between the well and the machine or pulley space.

Exception

However, if no special precautions against fire risk are required, the imperforate enclosure could terminate at a height of not less

* It will be recalled that the meaning attached to words or expressions followed by an asterisk is defined under 2.0.1 above.

than 8ft 3in. (2.50m) above the landing level or the nose of steps (if any) and be completed in a perforated form or by wire netting. The dimensions of the perforations or mesh should not exceed 3in. (75mm) measured either horizontally or vertically.

B1.3. Inspection doors

B1.3.1. Inspection doors should be provided only if they are necessary for inspection and maintenance.

B1.3.2. Inspection doors should not open into the well.

B1.3.3. (1) Inspection doors should be provided with suitable locks. Operation of the lift should be automatically dependent on the maintenance of those doors in the closed position.

(2) Moreover, if the bottom of an inspection door is less than 2ft (60cm) from the floor, operation of the lift should be possible only when the door is also locked.

(3) The breaking of the contacts should be by positive mechanical action even if they are accidentally welded together.

B1.3.4. Inspection doors should be imperforate, and as strong and as fire-resistant as landing doors.

B1.4. Materials forming the walls of the well

B1.4.1. The walls of the well should have adequate strength and rigidity.

B1.4.2. Lift wells should comply with the fire prevention and protection rules in the country where the lifts are installed.

B1.5. Protection against fall of suspended parts

B1.5.1. A lift well should not be located above a space accessible to persons unless:

(a) a pillar of sufficient strength extending down to the foundations or any other device affording sufficient safeguards is installed below the buffers (or other arresting devices) of the car, or the car is provided with safety gear; and

(b) a pillar of sufficient strength extending down to the foundations or any other device affording sufficient safeguards is installed below the buffers (or other arresting devices) of the counterweight, or the counterweight is provided with safety gear.

B1.6. Well enclosing cars or counterweights belonging to two or more service lifts [1]

B1.6.1. There should be a dividing screen extending from the bottom of the pit to a height of not less than 8ft 3in. (2.50m) between the moving parts (cars or counterweights) of different service lifts.

B1.6.2. Further to the provisions of B1.6.1, if a person can obtain access to the roof of the car of one of the lifts—which should not be permitted unless the car is resting on its buffers—the dividing screen mentioned in B1.6.1 should extend to a height of not less than 11ft 6in. (3.50m).

B1.7. Top clearance for traction drive lifts*

B1.7.1. When the counterweight rests on its fully compressed buffers (or other arresting devices), the remaining travel of the car in the upward direction should at least be equal to two-thirds of the gravity stopping distance corresponding to the contract speed of the lift ($0.035\ v^2$, the travel being expressed in metres and the speed in metres per second) and not less than 10in. (25cm).

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[1] For wells containing moving parts belonging to two or more passenger, goods or service lifts, see A1.9.

B1.7.2. Further to the provisions of B1.7.1, when the car rests on its fully compressed buffers (or other arresting devices), the remaining travel of the counterweight in the upward direction should at least be equal to two-thirds of the gravity stopping distance corresponding to the contract speed of the lift (0.035 v^2, the travel being expressed in metres and the speed in metres per second)

B1.8. Top clearance for drum drive lifts*

B1.8.1. When the car is level with the top landing, the remaining travel of the car in the upward direction should at least be equal to $6^1/_4$in. (16cm) plus thirteen times the gravity stopping distance corresponding to the contract speed of the lift (0.65 v^2, the travel being expressed in metres and the speed in metres per second) and not less than 10in. (25cm).

B1.8.2. Further to the provisions of B1.8.1, when the car rests on its fully compressed buffers (or other arresting devices), if a counterweight is used the remaining travel of the counterweight in the upward direction should be at least equal to $6^1/_4$in. (16cm) plus thirteen times the gravity stopping distance corresponding to the contract speed of the lift (0.65 v^2, the travel being expressed in metres and the speed in metres per second).

B1.9. Pit

B1.9.1. The bottom of the well should form a waterproof pit.

B1.9.2. (1) Equipment located in the pit should be readily accessible—from the outside if the pit is small.

(2) If there is a special access door to the pit other than the landing door, it should comply with the requirements of B1.3.2, B1.3.3 and B1.3.4.

B1.10. Exclusive use of the lift well

B1.10.1. The well should not serve any purposes, and should contain no parts or tubing, that are not connected with the main-

tenance and operation of the lift. (It is permissible for the well to contain equipment for its own heating.)

B1.11. Special counterweight wells

Separate counterweight wells should comply with the requirements for the construction of lift wells and inspection doors (B1.2, B1.3 and B1.4).

B2. Machine and pulley spaces

B2.1. General

B2.1.1. With regard to machine spaces, B2.2 and B2.3 are based on the assumption that the lift machine is located inside the well or in a small compartment. When this is not the case the provisions of A2 are applicable.

B2.1.2. With regard to pulley spaces, B2.2 and B2.3 (except B2.3.1, B2.3.4, B2.3.5 and B2.3.6) are applicable on the basis of the same assumption as is made in respect of machine spaces.

B2.2. Accessibility

B2.2.1. Access from the street to the spaces where the machines and their control gear are located should be easy and perfectly safe even in bad weather. In particular such access should conform to the recommendations issued on this subject in the *Model Code of Safety Regulations for Industrial Establishments* published by the International Labour Office, and to national laws and regulations relating to occupational safety.

B2.2.2. (1) The access of personnel to the spaces where the machines and their control gear are located should preferably be entirely by way of stairs.

(2) If that is impossible, ladders may be used which meet the following requirements:

(a) they should not be apt either to slip or to turn over;

(b) if they are not fixed, their slope in position of use should not exceed 60° to the horizontal;

(c) they should be used exclusively for the purpose in question and should always be kept available nearby. The necessary arrangements (e.g. padlocking) should be made to ensure this;

(d) they should be fitted with one or two handholds within reach at the top.

B2.3. Design and equipment of machine spaces

B2.3.1. (1) The dimensions and arrangement of the spaces from which the maintenance personnel obtain access to the parts of the machine and the control gear should be such that access to all the parts is easy and perfectly safe. In particular there should be a horizontal distance of at least 2ft 6in. (75cm) in front of the control panels to allow access to the components.

(2) In no case should the height of the spaces mentioned in B2.3.1. (1) be less than 5ft 11in. (1.80m).[1]

B2.3.2. (1) Access trapdoors should when closed be capable of supporting the weight of persons standing on them.

(2) When a trapdoor is in an open position the opening should be adequately guarded to prevent persons from falling through it.

(3) A door or trapdoor for access to a lift machine should be provided with a lock and key. When it is locked, opening from the inside should be possible without a key.

B2.3.3. (1) Arrangements should be made to ensure adequate lighting.

(2) There should be a switch outside, near the access door to the machine and at normal height, to control the lighting of the compartment or of the part of the well where the machine is located. One or more socket outlets should be provided.

B2.3.4. The space containing the machine and the control gear should be ventilated so that motors, control gear and electric conduits will be protected as far as possible against dust, noxious gases and humidity.

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[1] In this case the term "height" refers to the height between the floor of the room (not the machine foundation) and the ceiling, irrespective of any girders, beams, etc., below the ceiling.

B2.3.5. When not otherwise agreed between the customer and the lift manufacturer, the ambient temperature should be kept between 40 and 105 °F (5 and 40 °C).

B2.3.6. Waste material such as used cleaning rags should be deposited in an incombustible receptacle provided with a lid.

B3. Landing doors

B3.1. General

B3.1.1. The openings in the well giving access to the lift car should be provided with imperforate doors. When closed, those doors should completely cover the openings, subject to the necessary clearance, which should be as small as possible and in any case less than ¼in. (6mm).

B3.2. Strength of landing doors and their frames

B3.2.1. (1) Doors and their frames should be so constructed that the doors will not become deformed in the course of time. It is recommended that metal doors should be used in all cases.

(2) The use of glass, even wired glass, or of plastic material should be allowed only for vision panels. The horizontal dimension of such vision panels should not be more than 6in. (15cm).

B3.2.2. Landing doors should comply with the fire prevention and protection rules in the country where the lift is installed. Without necessarily being as fire-resistant as the walls of the well onto which they open, landing doors should afford a degree of protection against fire corresponding to that required for those walls.

B3.2.3. Doors, including vision panels (if any) and locks, should have adequate strength and rigidity.[1]

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[1] In this respect the following criterion could be adopted: locked landing doors should withstand without permanent deformation a horizontal force of 66lbf (30kgf or 30daN) applied at any point on either side of a door panel, this force to be evenly distributed over an area of 4sq.in. (25cm²) in a round or square section. After this test the doors should function normally.

B3.3. Width of doors

B3.3.1. The clear width of landing doors should not exceed the width of the car entrance by more than 4in. (10cm).

B3.4. Local lighting

B3.4.1. Natural or artificial lighting of landings in the vicinity of lift doors should be such that a user can see what is in front of him.

B3.5. Safeguards to prevent persons from falling into the lift well

B3.5.1. (1) It should not normally be possible to open a landing door (or any of the panels in the case of a multi-panel door) unless the lift car is in the unlocking zone of that door.

(2) In addition, for lifts having a contract speed exceeding 170ft per minute (0.85m/s), opening should not be possible unless the car is stationary or about to stop.

B3.5.2. The unlocking zone should not exceed 8in. (20cm) above and below floor level.

B3.6. Protection against shearing

B3.6.1. It should not be possible to operate the lift or to keep it in motion if a landing door (or any of the panels in the case of a multi-panel door) is open.

B3.7. Emergency locking and unlocking devices

B3.7.1. Each landing door should be fitted with a special lock meeting the requirements of B3.5.

B3.7.2. (1) On a lift with a contract speed exceeding 170ft per minute (0.85m/s), or in which the car floor is less than 2ft

(60cm) above the level of the landing when the car has come to a rest at serving level in the course of normal operation, locking should be controlled electrically, movement of the lift outside the unlocking zone being possible only if the locking mechanism is properly engaged.

(2) For other lifts locking need not be electrically controlled.

B3.7.3. It should be possible to unlock any landing door from the outside by means of a special key. This key should be handed only to responsible persons together with written instructions listing the essential precautions to be taken to prevent accidents which could result if a door is unlocked and not properly locked again. A triangular key may be used similar to that used for bolting flameproof electrical switchgear.

B3.7.4. Locking and unlocking devices should be protected against misuse.

B3.8. Requirements for switches for landing entrances

B3.8.1. Each landing door should be fitted with an electrical switch controlling the closed position to meet the requirements of B3.6. The switch may be part of the locking device (if any).

B3.9. Requirements for door locking devices and switches

B3.9.1. (1) Door locking devices and door switches should be so designed that the contacts will be opened by positive mechanical action even if they are accidentally welded together.

(2) Every precaution should be taken in the construction of such locks and switches to prevent accidental short-circuiting of the contact.

B3.9.2. On a lift with a contract speed not exceeding 170ft per minute (0.85m/s), and in which the car floor is less than 2ft (60cm) above the level of the landing when the car has come to rest

at serving level in the course of normal operation, the requirements of B3.9.1 (1) and (2) should also apply to contacts permitting the operation of the lift in the unlocking zone with a non-locked door.

B3.9.3. It should be impossible, by any single action not being part of the normal operating procedure, to start a lift covered by B3.7.2 (2) while the door is open or not locked.[1]

B3.10. Multi-panel landing doors

B3.10.1. When a landing door consists of several mechanically interconnected panels it should be permissible, in order to meet the requirements of B3.5 to B3.9 inclusive:

(a) to lock only one panel, provided that all the other panels are thus prevented from opening; and

(b) to install the electric lock on one panel only.

B3.10.2. When the panels of a landing door are interconnected by means such as a rope, belt or chain, the connection should be designed to withstand the stresses to which it will normally be subjected. It should be made with the utmost care and be checked at regular intervals.

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[1] Operation of the lift with an open or non-locked door might, for example, call for one of the following two combinations of actions:

(a) simultaneous shorting of two electric contacts; or

(b) shorting of one electric contact and simultaneous deliberate manipulation of a mechanical part of the locking device.

B4. Car and counterweight

B4.1. Car dimensions

B4.1.1. The dimensions and the arrangement of the car should manifestly prevent the access of persons. Accordingly the horizontal dimensions of the car (width and depth) should not exceed 3ft 4in. (1m) and its height should not exceed 4ft (1.20m).

Exception

However, a height of more than 4ft is permissible if the car has several fixed compartments meeting the above-mentioned requirements.

B4.2. Car walls, floor and roof

B4.2.1. The car should be completely closed, except for the door openings, by walls, a floor and a roof.

B4.2.2. The car walls, the floor, the roof and any shelving in the compartments dividing the car:

(a) should be sufficiently strong (see B4.2.3); and

(b) should, in case of fire, keep their strength as long as required, and should not consist of materials apt to become dangerous owing to their high flammability or as a result of the nature and quantity of the fumes which they would produce in the event of a fire.

B4.2.3. The car walls, the floor, the roof and any shelving in the compartments dividing the car should be sufficiently strong to withstand the stresses to which the car is subjected during normal operation of the lift (taking into account the nature of the load carried) when it strikes the buffers (or other arresting devices) or when the safety gear operates if the car is fitted with such gear.

B4.3. Toe guard and head guard

B4.3.1. If the lift stops at a normal serving level, the height of the car should be equal to the height of the landing door increased at the top and bottom by half the unlocking zone plus 6in. (15cm).[1]

Exception

However, in the case referred to in B3.5.1 (2), the above-mentioned dimension of 6in. may be reduced to 2in. (5cm).

B4.4. Car doors

B4.4.1. The car need not be provided with a door if suitable provision has been made to prevent the load from coming into contact with the walls of the well.

B4.5. Counterweight

B4.5.1. If a counterweight consists of multiple sections, it should be designed to prevent displacement of the sections. Designs suitable for that purpose are:

(a) a frame securing the sections; or

(b) at least two tie rods passing through the sections. The latter design should not be permitted in the case of concrete sections.

B4.5.2. The counterweight should be made in such a manner as to meet the requirements of B1.7.2 and B1.8.2.

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[1] For this purpose it might be necessary to provide the car sill with a toe guard, or the car top with a head guard.

B5. Suspension and safety gear

B5.1. Type of suspension; number of ropes or chains

B5.1.1. Cars and counterweights should be suspended by:

(a) round strand steel wire ropes, the wires of a strand to be wound in parallel lay (linear contact between wires); or

(b) roller chains.[1]

B5.1.2. When the total suspended load (the weight of the car plus the contract load) exceeds 220lb (100kg), the number of ropes or chains should not be less than two. The ropes or chains should be independent of one another.

B5.2. Ratio between pulley or sheave diameter and rope diameter; safety factor for ropes or chains

B5.2.1. The pulley or sheave diameter should not be less than 40 times the diameter of the suspension rope, whatever the number of strands in each rope.

B5.2.2. When suspension ropes are used, allowance should be made for a safety factor [2] of not less than 8.

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[1] It will be recalled that as indicated in 1 (Scope), this code of practice does not apply to other types of suspension such as by rack and pinion, screw spindles, etc.

[2] The safety factor is the ratio between the breaking load of the suspension system (obtained by multiplying the number of ropes—or legs in the case of reeving—by the guaranteed breaking load * of one rope) and the total suspended static load of the lift (i.e. the contract load, the weight of the car, the weight of the ropes over the length of travel, and the possible additional load of compensation gear, if any).

B5.2.3. If chains are used the safety factor [1] should not be less than 6.

B5.3. Rope traction (for traction drive lifts)

B5.3.1. It should not be possible to raise the car by starting the machine in the "Up" direction when the counterweight is resting on the buffers.

B5.3.2. It should not be possible to raise the counterweight by starting the machine in the "Down" direction when the car is resting on the buffers.

B5.3.3. The ropes should not slip, or should slip only over a short length, when the machine is stopped by the car's arriving at any serving position after it has been travelling at contract speed in the downward direction carrying an overload of 25 per cent.

B5.4. Coiling of ropes (for drum drive lifts)

B5.4.1. When the car or the counterweight rests on its buffers (or other arresting device), not less than one-and-a-half turns of rope should remain on the drum.

B5.4.2. There should be only one layer of rope wound on the drum.

B5.5. Equalisation of the load between ropes or chains

B5.5.1. A device should be installed to equalise the load between the ropes or chains. In the case of suspension by two ropes or chains, an electric contact should be provided to stop the lift in case of excessive stretch of one rope or chain in relation to the other.

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[1] This factor is defined in a way similar to that indicated for ropes.

B5.6. Protection of the suspension system

B5.6.1. The necessary arrangements should be made to:

(a) retain the ropes in the grooves; and

(b) prevent foreign matter from becoming wedged between the grooves and the ropes (or between the teeth and the chains).

B5.7. Safety gear

B5.7.1. If a safety gear is fitted (see B1.5.1), it should meet the following requirements:

(a) car and counterweight safety gear should be of the gradual * type if the contract speed of the lift exceeds 300ft per minute (1.50m/s);

(b) car and counterweight safety gear should be actuated by a speed governor if the contract speed of the lift exceeds 300ft per minute. In that case the provisions of A5.8 should be applied.

B5.8. Electrical protective devices

B5.8.1. When the safety gear operates, a device should cause the motor and brake control circuits to open.

B6. Guides, buffers and stopping devices

B6.1. General requirements for guides

B6.1.1. The strength of guides, their brackets and joints should be sufficient to withstand the stresses imposed by the operation of the safety gear, if the car or the counterweight is provided with such gear, as well as by deflection caused by uneven distribution of the load in the car. Such deflection should be limited to a level that will not affect the normal operation of the lift.

B6.1.2. The guides should be fixed to their brackets and to the wall in such a manner as to permit compensation, either automatically or by simple adjustment without any additional work, of effects due to the normal settlement of the building or shrinking of the concrete.

B6.2. Guiding of the car

B6.2.1. The car should be guided by rigid metal guides.

B6.3. Guiding of the counterweight

B6.3.1. The counterweight should be guided either by rigid metal guides or, if the distance between rigid attachments does not exceed 100ft (30m), by means of ropes or steel wire guides.

B6.3.2. When the counterweight is guided by ropes or steel wire guides, they should be at least two in number; the arrangement should be such that all contact between the counterweight and the car or the wall of the well is prevented (see B7.2 and B7.3). Each rope or wire guide should be kept taut.

B6.4. Car and counterweight buffers

B6.4.1. A lift should be provided with buffers (or other arresting devices) at the bottom limit of the travel of the car and of the counterweight.

B6.5. Terminal stopping switches

B6.5.1. The car should normally stop automatically at terminal landings.

B6.5.2. (1) Normal stopping should be brought about by the opening of contacts located in the well or on the selector.

(2) The contacts should be opened directly by the movement of the car itself, or by the selector, provided that the selector is linked to the car by a rope, chain or tape the breaking of which should cause the lift to stop.

B6.6. Final limit switches

B6.6.1. In addition to the normal stopping devices mentioned in B6.5, final limit switches should be provided.

B6.6.2. The final limit switches should be set to operate after the normal stopping devices at the terminal landings and before the car or the counterweight (if any) strikes the buffers (or other arresting device).

B6.6.3. (1) In the case of drum drive lifts * the final limit switches should interrupt directly the electric supply to motor and brake. Back feed from the motor to the brake coil should be prevented.

(2) In the case of traction drive lifts * the final limit switches should directly:

(a) interrupt the electric supply to motor and brake; or

(b) cause two series contactors in the supply circuit of the motor and the brake to open.

B6.7. Safety device to operate if the descent of the car or counterweight is prevented by some object in the lift well

B6.7.1. In the case of drum drive lifts * there should be a slack rope or slack chain device cutting off the current and causing the lift machine to stop if the descent of the car or counterweight is prevented by some object in the lift well.

B7. Running clearances

B7.1. Clearance between car sill and edge of the serving level of an open landing door

B7.1.1. When the car is stationary at a landing the clearance between the car sill and the edge of the serving level of an open landing door should not exceed $1^1/_4$in. (35mm).

B7.2. Clearance between counterweight and well

B7.2.1 (1) When the counterweight is guided by ropes or steel wires, the clearance between the counterweight and the wall of the well, measured at the closest point, should not be less than 2in. (5cm).

(2) To meet the above requirement it will be necessary to provide, at the general layout stage, for a clearance exceeding 2in. by an amount proportionate to the distance between the brackets.

B7.3. Clearance between moving parts of a single lift [1]

B7.3.1. When the counterweight is guided by ropes or steel wires, the clearance between moving parts of a single lift, measured at the closest point, should not be less than $2^3/_4$in. (7cm).

B7.3.2. To meet the above requirement it will be necessary to provide, at the general layout stage, for a clearance exceeding $2^3/_4$in. by an amount proportionate to the distance between the brackets.

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[1] For the case of multiple lifts in a single well see B1.6.

B8. Lift machine

B8.1. Methods of driving the car and the counterweight

B8.1.1. The two following driving methods may be used:

(a) by traction (use of sheaves and ropes); or

(b) by fixed attachment (use of a winding drum and ropes, or chain drive wheels and chains).

B8.2. Use of belts to drive the machine

B8.2.1. Belts may be used to couple the motor or motors to the rotating part subjected to the mechanical brake action, provided that the belts are of the "V" or toothed type and that there is at least one more than the minimum number determined by calculation.

B8.3. Use of overhung sheaves or pulleys

B8.3.1. When overhung sheaves or pulleys are used, arrangements should be made to prevent the ropes from leaving the sheave or pulley grooves.

B8.4. Brake system

B8.4.1. The lift should be fitted with a brake system which must include a mechanical brake; additional means of deceleration may be provided, for example dynamic braking.

B8.4.2. The brake system should act automatically in case of failure of the electric supply to the machine or the controls.

B8.4.3. The brake system should be capable of stopping a descending car travelling at contract speed with its contract load increased by 25 per cent.

B8.4.4. The mechanical brake should meet the following requirements:

(a) it should be capable of holding the machine stationary when the car is carrying its contract load increased by 25 per cent;

(b) the part subjected to the braking action should be coupled to the traction sheave, drum or chain drive wheel by direct mechanical means; and

(c) in normal operation the brake should be held off by continuous action of an electric current. When the lift motor can act as a generator, the brake coils or servo motors for applying the brake should be connected in such a manner that in no circumstances can they be energised by the hoisting motor. Braking should be effective as soon as the brake circuit is opened.

B8.5. Emergency winding

B8.5.1. (1) The lift should be provided with an emergency winding device making it possible, even in case of failure of the electric supply, to raise or lower the fully loaded car to one of the nearest landings.

(2) The device should be a smooth handwheel having no spokes or holes.

B8.5.2. If the device cannot be used without releasing the brake:

(a) it should be available only to persons who have received the necessary instructions;

(b) it should require permanent application of manual force;

(c) the direction of movement of the car should be clearly indicated on the machine.

B8.6. Speed

B8.6.1. The speed of the lift in the downward direction, measured at half contract load in the mid-travel position (accelera-

tion and deceleration periods being excluded), should not exceed the contract speed by more than 5 per cent.

B8.7. Guarding of machinery

B8.7.1. Keys or other similar projecting parts, as well as journal ends and exposed gears and belts, should be provided with suitable guards.

B9. Electrical wiring and switchgear

B9.1. General

B9.1.1. In view of its importance from the point of view of safety, electrical wiring associated with lifts should be designed and installed with the utmost care. The wiring should be in conformity with the rules in force in the country where the lift is installed.

B9.1.2. Every precaution should be taken to prevent incidents and accidents that could result from accidental contact with conductors or from insulation faults to earth or between conductors. In particular, one or more insulation faults to earth should neither cause the lift to start nor render the safety devices ineffective.

B9.2. Protection of motors

B9.2.1. Lift motors should be protected against overloading and short circuits.

B9.2.2. Every measure should be taken to prevent damage to equipment in case of failure of a single phase of the electricity supply.

B9.3. Contactors and relays

B9.3.1. In view of the fundamental role which contactors and relays play with regard to safety, such equipment should be selected with the utmost care. It should be of sound design and construction, and its specifications should correspond to the operating conditions.

B9.4. Voltage for control and safety circuits

B9.4.1. The r.m.s. voltage between conductors in control and safety circuits should not exceed 250 volts.

B9.5. Multi-pole disconnection of the power supply line

B9.5.1. The power supply line to the machine should have a multi-pole main switch or circuit-breaker adjacent to the machine. The main switch or circuit-breaker should disconnect the supply to the machine on all phases, without disconnecting the supply to the machine lighting circuit.

B9.6. Lighting supply

B9.6.1. The electric lighting of the machine should be independent of the supply to the machine itself, and should be taken either from a separate circuit or from the supply to the machine before the main switch referred to in B9.5.1.

B10. Controls; priorities

B10.1. Control of movement

B10.1.1. The movement of the car should be controlled electrically.

B10.1.2. Push button controls should be encased so that no live part is accessible.

B10.2. Priorities

B10.2.1. In order to allow sufficient time for users to open a landing door, a timing device should prevent departure of the car until not less than two seconds have elapsed after arrival at a landing.

B11. Notices and operating instructions

B11.1. General

B11.1.1. All plates and notices, including those bearing operating instructions, should be untearable, of durable material, placed in a conspicuous position and inscribed in easily legible lettering in the language of the country where the lift is installed (or in several languages if the national regulations so require).

B11.2. In the car and at landings

B11.2.1. An indication of the contract load of the lift (in units of mass) should be affixed to the inside of the car and at each landing. Except for lifts of very small size, there should also be a notice reading: "**Service Lift—Not for Persons**".

B11.2.2. Operating and safety instructions should be affixed to the inside of the car or at each landing whenever this appears useful. In particular, in the case of a lift without a car door it should be indicated that the goods loaded should be kept clear of the wall of the well.

B11.3. In machine and pulley spaces

B11.3.1. On doors or trapdoors giving access to machines and pulleys, notices should be affixed reading: "**Lift Machinery—Danger—No Admittance to Unauthorised Persons**".

B11.3.2. Instructions to be followed in the event of a breakdown should be affixed in machine spaces or inside enclosures or covers.

B11.4. On the outside of the well enclosure

B11.4.1. Near the well inspection doors, notices should be affixed reading: "**Danger—Lift Well**".

B11.5. On the car frame cross-head

B11.5.1. Near the suspension a plate should be affixed indicating:

(a) the name of the lift manufacturer;

(b) the year of installation;

(c) the contract load; and

(d) the number of ropes, their diameter and their individual breaking load or, in the case of chain suspension, the number of chains and their type and specifications (single, double, etc.; pitch; breaking load per chain).

B11.5.2. Except on lifts of very small size, a notice should be affixed stating that it is forbidden to go onto the roof of the car unless the car is resting on its buffers.

B11.6. Component identification plates

B11.6.1. The main components of the lift (motor, contactors etc.) should have identification plates affixed to them.

B12. Lift maintenance and inspection

B12.1. Maintenance

B12.1.1. Lifts should be regularly maintained by competent personnel.

B12.2. Inspection

B12.2.1. (1) Lifts should be inspected before being put into service, and at regular intervals thereafter.

(2) These inspections, if not carried out by a public authority, should be carried out by a body or person licensed by the public authorities (when such licensing exists in the country concerned), such body or person to be as far as possible independent of the manufacturer and of the organisation in charge of the maintenance.

B12.3. Register

B12.3.1. The specifications of the lift should be entered in a register to which should be appended the layout drawings and the electric wiring diagrams.

B12.3.2. The dates and findings of the inspections mentioned in B12.2 should be entered in the register.

B12.3.3. The register should be in the keeping of the organisation in charge of the maintenance.

B12.3.4. A copy of the register or part thereof should be given to the owner of the lift on request.

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