BRITISH STANDARD

BS 2655-1: 1970

Incorporating Amendment Nos. 1, 2, 3, 4, 5 and 6

Specification for

Lifts, escalators, passenger conveyors and paternosters —

Part 1: General requirements for electric, hydraulic and hand-powered lifts

UDC 621.876

Co-operating organizations

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

Associated Offices' Technical Committee*
Association of Consulting Engineers
Association of Mining Electrical and Mechanical Engineers
Board of Trade
British Chemical Plant Manufacturers' Association
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The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

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

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Contents

Foreword

This standard makes reference to the following British Standard:

BS 476, *Fire tests on building materials and structures.*

BS 476-7, *Surface spread of flame tests for materials.*

This British Standard, prepared under the authority of the Mechanical Engineering Industry Standards Committee, is a revision of and supersedes the previous edition of BS 2655, which was entitled "*Electric lifts*".

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

Part 1: General requirements for electric, hydraulic and hand-powered lifts.

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

Part 2: Single-speed polyphase induction motors for driving lifts.

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

Part 3: Arrangements of standard electric lifts.

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

Part 4: General requirements for escalators and passenger conveyors.

This part specifies engineering and safety requirements for escalators and passenger conveyors. The latter may be described as machines in which the passenger carrying surface remains parallel to the direction of motion and is uninterrupted.

Part 5: General requirements for paternosters.

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

Part 6: Building construction requirements.

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

Part 7: Testing and inspection.

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

Part 8: Modernization or reconstruction of lifts, escalators and paternosters.

This part specifies engineering and safety requirements.

Part 9: Definitions.

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

Part 10: General requirements for guarding.

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

[1)] BS 2655, "Electric lifts", Part 1, "General requirements".

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

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

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

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

The British Standard covering lifts, in its main provisions, has been in use for nearly 20 years and embodies the main principles of good practice, with particular reference to safety. It is widely used in the lift manufacturing industry in this country as a basis for design and there is thus economic advantage to the user in specifying that his lift is to be in accordance with the standard.

Throughout this standard the metric and imperial systems are used together, but it is important that each contract shall use either the imperial system throughout or the metric system throughout. A mixture of the two may lead to complications. The following points should be noted.

1) Whereas it has been customary for those countries using the imperial system to rate one person as weighing 150 lb, those countries using the metric system rate one person as weighing 75 kg, i.e. a 10.2 % increase. Both these ratings have been retained in this standard for their respective systems.

2) The relationship of contract load to effective car area has been retained irrespective of the system used. Therefore, for a given car size, although the contract load will be the same in imperial or metric units, there may be a relatively small variation in the "number of persons" specified on the load plate. This will be in the direction of less persons for the metric system.

3) In the matter of customary usage for designating speeds the imperial and metric systems are very close, since 100 ft/min = 0.508 m/s and 1.00 m/s = 196.85 ft/min. British equipment has naturally been designed to suit speeds given in rounded imperial units. When rounded metric units are used in contracts a variation of 1.6 % therefore occurs when checking the speed in service in the metric system. This particularly applies for systems driven by a.c. motors. This very small difference will apply to governor tripping speeds as well as car speeds.

4) Generally, units have been converted from imperial to the metric system and then rounded off by increasing or reducing after taking into account the practical problems involved and current Continental practice.

This Part 1 applies to the engineering and safety requirements for electrically, hydraulically or hand-powered new lifts for passengers, goods and service. For hand-powered lifts the standard is restricted to goods lifts, hoists and service lifts. Though basically a revision of the 1958 edition of BS 2655-1[3)], it incorporates the following broad changes:

1) The definitions and test requirements, as well as all structural requirements, now appear under separate cover (see above).

2) Information on hydraulically and hand-powered lifts is now included.

3) The requirements for safety-gears, buffers and clearances have been extensively revised.

[3)] BS 2655, "*Electric lifts*", Part 1, "*General requirements*".

4) In certain circumstances fire resistance requirements for lift cars are now specified and car and landing openings must now be provided with doors, not gates, for all lifts other than service lifts. Because of the implications of this change, for the purpose of this standard the requirements, which exclude the use of close-picket collapsible gates for certain cars intended for the carriage of goods only, will become mandatory after a period of five years from the date of publication of this revision of the standard (see **2.6.1**). Emergency openings in lift cars must now be provided only in the roof and be openable only from the outside. Emergency stop switches for passenger operation are now not permitted.

5) The requirements for car doors and landing doors have now been combined in three clauses dealing respectively with construction, automatic closing and power controlled closing. Car closing force and kinetic energy limitations are now specified.

6) Limiting stress requirements for springs are now introduced.

7) Lift car suspension requirements now cater for the use of steel plate link chains.

8) A control station is now required on top of all lift cars which are capable of carrying persons.

9) The requirements for firemen's lifts are revised and incorporated in the body of the standard.

10) The minimum contract load requirements for goods lifts have been changed.

11) Counterweights shall not be used on drum drive machines.

This Part of this standard is rendered obsolescent concurrently with the publication of BS 5655 "*Lifts and service lifts*" — Part 1:1979 "*Safety rules for the construction and installation of electric lifts*" — Part 2:1988 "*Safety rules for the construction and installation of hydraulic lifts*" — Part 3:1989 "*Specification for electric service lifts*" and Part 14:1995 "*Specification for hand-powered service lifts and platform hoists*".

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

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 26, an inside back cover and a back cover.

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

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1 General

1.1 Scope

This Part of this British Standard applies to electric, hydraulic and hand-powered passenger lifts, goods lifts and service lifts suspended by ropes or chains or supported by direct acting ram and employing a guided lift car installed in a situation where the structural requirements of Part 6 are carried out.

The requirements for passenger and goods lifts are combined in this standard, on the basis that goods lifts are capable of carrying persons and should thus be subject to the same safety requirements applicable to lifts intended for passenger operation.

The requirements for hand-powered lifts apply only to goods lifts, hoists and service lifts.

The standard does not apply to lifting platforms and road vehicle lifting machines having a vertical travel not exceeding 2.00 m or 6 ft 6 in, amusement devices, skip hoists, builders' hoists, conveyors or similar apparatus used for raising, piling or tiering.

1.2 Factors of safety

Unless stated otherwise in this Part of the standard, there shall be a factor of safety of not less than 5 for all parts of the lift.

EXCEPTION. This does not include the conventional type of compression, tension, torsion or leaf spring, which substantially maintains original form and does not include any reverse stresses during its working stroke.

2 Specific requirements for electric passenger and goods lifts

This section is rendered obsolescent under the conditions stated in the foreword (see Amendment No. 5).

2.1 Guides and fixings

2.1.1 Rigid guides shall be used for guiding lift cars and counterweights through their travel.

2.1.2 Guides shall be of sufficient length to prevent any of the car or counterweight shoes from running off the guides, irrespective of whether or not there are any gaps beyond the upper or lower end of the guides and the nearest obstruction, such as the pit floor or the top of the well.

2.1.3 Guides shall be of steel except where the nature of the processes carried on in the building renders such material unsuitable. For goods lifts having a contract speed exceeding 0.50 m/s (100 ft/min) and for all passenger lifts, the guides shall have working surfaces that are bright, smooth and straight.

2.1.4 Guides shall be so jointed and fixed to their brackets that they do not deflect by more than 3.0 mm or ⅛ in under normal operation.

2.1.5 Guides of "T" section shall be held to their fastenings by through bolts or by clips of such design that any rotary movement of the clip will not release the guide.

2.1.6 Guide brackets shall be fixed to walls, metal inserts or stairstringers by bolts, or bolted to the building or structure steel work. Wood or fibre blocks or plugs shall not be used for securing guide brackets. Any shims shall be of metal. Suitably designed guide brackets may be built into the load bearing walls.

2.1.7 Guides and their fixings shall withstand the application of the safety-gear without permanent deformation when stopping a fully laden car or the counterweight.

2.2 Buffers

2.2.1 Installation. Buffers shall be installed under all cars and counterweights in accordance with the following requirements:

1) Buffers of timber or rubber shall not be used with lifts having a contract speed exceeding 0.40 m/s (75 ft/min) or where there is an accessible space below the pit.

2) Spring buffers shall not be used with lifts having a contract speed exceeding 1.00 m/s (200 ft/min).

3) Oil buffers shall be used with lifts having a contract speed exceeding 1.00 m/s (200 ft/min).

EXCEPTION. Where a buffer type safety-gear is used (see **2.12.5**) the buffer under the car can be of the timber or rubber type.

2.2.2 Oil buffers. The minimum total stroke of an oil buffer shall be based on an average retardation of 9.81 m/s^2 (32.2 ft/s^2), based on 115 % contract speed.

The maximum rate of retardation of oil buffers based on 115 % contract speed shall be 24.5 m/s^2 (80.5 ft/s^2), excluding any transient decelerations having a duration not exceeding 0.04 seconds.

Where there is an accessible space below the pit, the total stroke and the specified maximum rate of retardation shall relate to the maximum permitted governor tripping speed (see **2.13.2**) instead of 115 % contract speed.

Means shall be provided for ascertaining that there is a correct amount of oil in the buffer and the construction shall ensure that any oil displaced during the operation is contained within the buffer.

Each buffer shall be permanently and legibly marked to indicate the type and quantity of oil to be used within the buffer.

Oil buffers shall be self-resetting.

When lift speeds are 5.00 m/s (1 000 ft/min) or more, the buffer stroke can be reduced to not less than 50 % of the above required stroke provided positive means are used to reduce the speed of the car and counterweight to that suitable for the reduced buffer stroke before the buffer is struck.

When a reduced stroke buffer is used, the positive means of reducing car or counterweight speed shall operate independently of the normal terminal stopping device, should this device fail to slow down the car at the terminal as intended, and shall provide a retardation not in excess of 9.81 m/s^2 or 32.2 ft/s^2 without applying the car safety-gear.

EXCEPTION. In an installation with "lock down" compensating rope idler tension pulleys, the buffers must be designed to decelerate the entire moving system and the buffer supports should be designed accordingly.

2.2.3 Spring buffers. The spring buffers shall be of helical form or otherwise designed to have a spring rate which is constant throughout the full compression. The minimum stroke of a spring buffer shall be as follows:

Lift speed		Stroke	
m/s	ft/min	mm	in
Up to 0.50	Up to 100	40	1½
0.51 – 0.75	101 – 150	65	2½
0.76 – 1.00	151 – 200	100	4

Twice the static load to be supported by the buffer shall not fully compress it, but three times this load shall fully compress it.

EXCEPTION. When there is an accessible space below the pit bottom the spring buffers shall be so designed that they will not be fully compressed when struck by the loaded car or by the counterweight at safety-gear operating speeds.

2.2.4 Calculation of buffer loads. For the purpose of design of the buffer supports the maximum reaction force shall be taken as

For car buffers	For counterweight buffers
4 times (the weight of the unladen car plus contract load).	4 times the weight of the counterweight.

EXCEPTION. For systems with lock down compensator pulleys the factor of 4 may need to be increased.

2.3 Top and bottom clearances and runbys

2.3.1 Car bottom clearance. The car bottom clearance shall be such that when the car rests on the completely compressed buffers the distance between the underside of the car (guide shoes or rollers, safety gear, toe guards and other equipment round the perimeter of the car excluded) and the bottom of the pit shall be at least 600 mm or 24 in.

2.3.2 Bottom runby for lifts with counterweights. The minimum bottom runby or distance between car or counterweight buffer plate and the uncompressed buffer shall be:

1) for oil buffers, 150 mm or 6 in,

2) for spring buffers:

with generator field control, 150 mm or 6 in;

with a.c. or rheostatic control —

Speed		Runby	
m/s	ft/min	mm	in
0.15	25	75	3
0.25	50	150	6
0.50	100	230	9
1.00	200	300	12

2.3.3 Bottom runby for lifts without counterweights. The bottom runby of lifts without counterweights shall not be less than the following:

1) 75 mm or 3 in for rated speed not exceeding 0.15 m/s or 25 ft/min,

2) 150 mm or 6 in for rated speeds exceeding 0.15 m/s or 25 ft/min.

2.3.4 Maximum bottom runby. The maximum bottom runby shall not exceed:

1) for cars, 600 mm or 24 in,

2) for counterweights, 900 mm or 36 in.

2.3.5 Car top clearance for lifts with counterweights. The top clearance shall not be less than the sum of the following dimensions:

1) the bottom counterweight runby,

2) the stroke of the counterweight buffer,

3) the greater of the following two dimensions:

a. 600 mm or 24 in above the car roof,

b. 75 mm or 3 in above the projection of any part of the car or its equipment above the car roof, and

4) one half the counterweight buffer stroke.

EXCEPTION. 4) may be omitted if provision is made to prevent the jump of the car at counterweight-buffer engagement.

2.3.6 Car top clearance for lifts without counterweights. The car top clearance of lifts without counterweights shall not be less than either of the following:

1) 0.75 m or 2 ft 6 ins from the car roof,

2) The projection of any part of the car or its equipment above the car roof + 150 mm or 6 in.

2.3.7 Counterweight top clearance. The counterweight top clearance shall not be less than the sum of the following dimensions:

1) the bottom car runby,

2) the stroke of the car buffer,

3) 150 mm or 6 in, and

4) one half of the car buffer stroke.

EXCEPTION. 4) may be omitted if provision is made to prevent the jump of the counterweight at car-buffer engagement.

2.3.8 Guide gaps. Where gaps are arranged beyond the upper or lower ends of the guides the top and bottom clearances for car and counterweight shall be checked to ensure that, if car or counterweight actually travels the distance of the top or bottom clearances as calculated above, the requirements of **2.1.2** for length of guides are still valid.

2.4 Car frames

Every passenger and goods car body shall be carried in a steel car frame sufficiently rigid to withstand the operation of the safety-gear without permanent deformation of the car frame.

The deflection of the members carrying the platform shall not exceed 1/1 000 of their span under static conditions with the contract load evenly distributed over the platform.

At least four renewable guide shoes, or guide shoes with renewable linings, or sets of guide rollers shall be provided, two at the top and two at the bottom of the car frame.

2.5 Car enclosure

2.5.1 Lift cars, excluding linings, shall be constructed of non-combustible materials.

EXCEPTION. Slow burning materials may be used if all outside surfaces facing into the lift well of such material forming part of the car enclosure and platform are covered with sheet steel not less than 0.50 mm or 0.018 in. All lining surfaces within the car enclosure shall have a surface spread of flame not inferior to Class 2 of BS 476-7[4)].

2.5.2 Lift cars shall be provided with roofs, car enclosures and doors. Enclosures of passenger lift cars and of goods lift cars intended to carry persons shall not be less than 2.000 m (6 ft 6 in) in height, with no openwork panels, except ventilating panels, within a height of 1.800 m (6 ft) from the car floor. The diameter or width of any opening in a panel shall not exceed 13 mm (½ in) unless a baffle is provided on the outer side of the panel. The aperture in any open work in the car roof of a goods lift shall reject a 25 mm (1 in) diameter rod.

2.5.3 The car enclosure shall withstand without permanent deformation a thrust of 340 N (35 kgf) or 75 lbf which is applied normally at any part by a rigid square flat face of 50 mm or 2 in side, whose edges are rounded to a radius of 4.0 mm or ⅛ in. The car enclosure shall be so secured to the car floor and car frame that it cannot work loose or become displaced in ordinary service.

2.5.4 Where the lift car has walls, roof and doors without openings, provision shall be made for adequate ventilation.

2.5.5 Any glass used for, or in conjunction with, the car enclosure shall be of the safety type.

2.5.6 The car platform shall be provided with an apron 750 mm minimum deep extending across the full width under the car entrance to prevent an object being trapped between the underside of the car platform and the landing threshold, and to afford greater safety when passengers are being released from the car, when the car is not at landing level. The apron shall conform to the requirements of **2.5.3**.

2.5.7 Car platforms shall be of framed construction. Platforms for passenger cars shall be designed on the basis of contract load, this being evenly distributed. Platforms for goods cars shall be designed to suit the particular conditions of loading. The minimum factors of safety shall be 5 for steel and 8 for timber.

2.5.8 The lift car shall be adequately illuminated by a minimum of two electric lamps during the whole time the lift is available for use.

NOTE This requirement is made in the interests of safety. It is recommended that the car light switch, if provided, be so located that it is accessible only to authorized persons.

2.5.9 A 3 pin socket outlet shall be fitted on top of the lift car. A permanent light, suitably protected and separately switched, shall also be fitted on top of the lift car.

[4)] BS 476, "*Fire tests on building materials and structures*", Part 7, "*Surface spread of flame tests for materials*".

2.6 Car and landing entrance construction

NOTE The provisions of this clause relate to both vertical and horizontal moving doors.

2.6.1 Each car entrance shall be provided with a car door which shall extend the full height and width of the car opening. The top track of the door shall not obstruct the car entrance.

A vertically sliding car door may be used with vertically biparting landing doors, in which case the former shall be of close mesh construction so that the closing action of the landing doors can be seen from the car (see **2.6.6**).

For a period of five years only from the date of publication of this revision of BS 2655-1, close-picket collapsible gates may be used instead of doors at the entrances of cars intended for conveying goods only, provided that the entrances are manually operated, the lift speed does not exceed 0.75 m/s or 150 ft/min and an emergency stop device is fitted in the car.

2.6.2 All landing openings in lift well enclosures shall be protected by doors which shall extend the full height and width of the landing opening. The top track of a landing door shall not obstruct the entrance to the lift car.

2.6.3 All car and landing doors and their tracks shall be capable of withstanding a thrust of 340 N (35 kgf) or 75 lbf applied normally at any point, excepting any vision panel, without causing permanent deformation and without the doors being sprung from their guides. The thrust of 340 N (35 kgf) or 75 lbf shall be applied by a rigid square flat face of 50 mm or 2 in side, whose edges are rounded to a radius of 4.0 mm or ⅛ in.

2.6.4 Vision panels shall be fitted in manually operated doors and may be fitted in automatically operated doors. They shall be of safety-wired glass and shall not exceed a total area of 0.1 m^2 or 1 ft^2.

2.6.5 Any projections on or recesses (including vision panels) in the exposed parts of the car doors or landing doors shall be kept to a minimum in order to avoid finger trapping between sliding parts of the door and any fixed part of the car or landing entrance.

2.6.6 Openings in doors and entrances of cars and landings when the doors are fully extended shall be sufficiently small to reject a 5.0 mm or $^3/_{16}$ in diameter rod.

EXCEPTION. The holes in the mesh of a vertically sliding car door shall not exceed 32 mm or 1¼ in measured normal to any of the boundary edges.

Under the waiver given at the end of **2.6.1** any close-picket gate shall have no openings exceeding 65 mm or 2½ in in width between the vertical members of the gate when it is fully extended.

2.6.7 Sliding car and landing doors shall be guided on two parallel edges of the door. Guide block(s) shall be fitted at the bottom of each door panel to prevent twisting of the door panel, even after wear. These guide blocks shall be easily renewable from the well side of the door panel without the door having to be lifted or removed. Each guide block unit shall incorporate a robust safety flange extending downwards into the bottom track such that, in the event of the collapse or breaking adrift of the normal rubbing surfaces of the guide block, the safety flange will prevent the bottom of the door panel from being pushed into the lift well (see **2.6.3**).

2.6.8 Hangers and tracks, together with their fixings for car and landing doors, shall be of adequate strength and rigidity, and means shall be provided to prevent the hangers from jumping the tracks and jamming. Suitable stops shall be provided to prevent the hanger carriage from leaving the end of the track.

2.6.9 The distance between the lift well side of the car door and the lift well side of the landing door shall not exceed 140 mm or 5½ in. Where the car door or landing door consists of two or more panels the 140 mm or 5½ in dimension shall apply to the door panel nearest to the sill edge.

2.6.10 The distance between the lift well side of the landing door and the lift well edge of the landing threshold shall not exceed 100 mm or 4 in for hinged doors or 70 mm or 2¾ in for sliding doors. Where the landing door consists of two or more panels the 70 mm or 2¾ in dimension shall apply to the door panel nearest to the lift well edge of the landing threshold.

2.6.11 The distance between the car and landing sills shall not exceed 30 mm or 1¼ in.

2.6.12 The clear height of all entrances on car and landings shall not be less than 2 m or 6 ft 6 in.

2.6.13 The landing threshold shall be provided with a substantial apron to prevent an object being trapped between the underside of the landing threshold and the car sill. The depth of the apron shall be equal to the car levelling zone.

2.7 Automatic power operation of entrances

2.7.1 Car and landing doors which are both opened and closed automatically, i.e. other than by a continuous pressure button, shall be horizontally sliding and shall be coupled together so that they open and close simultaneously, and the horizontal distance between the car and the landing door panel leading faces shall not exceed 50 mm or 2 ins.

2.7.2 Car and landing doors which are automatically operated shall have their operating mechanisms so designed as to limit their combined kinetic energy and the force to prevent the doors from closing, as follows:

1) Providing a protective device is fitted to the doors the combined kinetic energy shall be limited to 9.8 J (1.0 kgf m) or 7 ft 1 lbf and the force to prevent the doors from closing shall not be more than 147 N (15 kgf) or 33 lbf.

2) If a protective device is not fitted to the doors the combined kinetic energy shall be limited to 3.4 J (0.35 kgf m) or 2½ft lbf and the force to prevent the doors from closing shall not be more than 49 N (5 kgf) or 11 lbf.

In addition a bell or buzzer shall be sounded at the time closing is commenced.

3) If a protective device is not fitted to the doors and a bell or buzzer is not sounded at the time closing is commenced, the combined kinetic energy shall be limited to 1.8 J (0.18 kgf m) or 1¼ft lbf and the force to prevent the doors from closing shall not be more than 29 N (3 kgf) or 6.6 lbf.

2.7.3 The maximum kinetic energy specified in **2.7.2** shall be computed for the average closing speed by timing the closing doors as follows:

1) With single speed and two speed doors determine the time required for the leading edge of the door to travel from a point 50 mm or 2 in away from the open jamb to a point 50 mm or 2 in away from the opposite jamb.

2) With centre opening or two speed centre opening doors determine the time required for the leading edge of the door to travel from a point 25 mm or 1 in away from the open jamb to a point 25 mm or 1 in away from the centre meeting point of the doors.

2.7.4 The maximum closing force specified in **2.7.2** shall be the measured force required to prevent the doors restarting from rest at approximately the mid travel position of the door panel.

2.7.5 The protective device (see **2.7.2**), when used, shall comply with the following:

1) It shall be fitted to the leading edge of each face, made up of a car and landing door panel, which moves across the clear entrance, and shall be considered as part of the door panel when measuring the distance between car and landing door faces.

2) It shall extend from not more than 25 mm or 1 in above the sill (measured to the extended position of the protective device) to a minimum height of 1.80 m or 6 ft above the sill.

When devices are employed which do not give protection extending as required above, they shall be fitted only as an addition to, and not in place of, the specified device.

3) It shall be operated by a force of not more than 14.7 N (1.5 kgf) or 3 lbf to stop, reverse and fully re-open the leading edge of each face in the event that the protective device is obstructed while closing.

4) It shall be so designed and installed that for centre opening doors the obstruction of either leading edge when closing will cause it to function.

2.7.6 When the car door only is automatically operated and the landing door is manually or spring closed then the car door shall comply with the following:

1) It shall be horizontally sliding and the horizontal distance between the car door panel leading face and the landing door panel shall not exceed 50 mm or 2 in.

2) It shall be used only in conjunction with a landing door which has a smooth face on the lift well side so that there are no projections or recesses forming finger traps between the car and landing doors.

3) It shall comply with **2.7.2** on the assumption that the kinetic energy and force to prevent the door closing do not exceed those given in **2.7.2** for the combined car and landing doors.

4) It shall not start to close until the landing door is in the closed position.

5) It shall be in the opened position before it is possible to open the landing door.

2.8 Controlled power closing of entrances

2.8.1 Power operated car and landing doors which are not automatically operated shall be closed by a continuous pressure button which shall be mounted in a conspicuous position such that the car and landing doors are in direct sight of the attendant or the user during the closing operation. The release of the button at any time before the doors have reached the fully closed position shall cause the doors to stop and reopen, thus causing the whole of the power closing operation to be controlled.

2.8.2 Every lift with continuous pressure door closing buttons shall be provided with door opening buttons adjacent to the closing buttons. The opening buttons can be of the momentary pressure or continuous pressure type. The operation of the opening buttons shall be effective only when the car is in a landing zone.

2.8.3 The closing and opening buttons shall be located in the car and/or on the landings.

2.8.4 A bell or buzzer shall be sounded at the time closing is commenced.

2.8.5 Where the lift with continuous pressure door closing buttons serves more than one entrance at any landing level the lift car shall be provided with separate door operating buttons for each car door and its adjacent landing door. Any door opening buttons at a landing shall control only the landing door and its adjacent car door for the entrance where such buttons are provided.

2.8.6 The actuating mechanism of controlled power closing entrances shall be designed to limit the force applied to the door to the minimum required to close that door.

2.8.7 If the car and landing doors are arranged to close in synchronism they shall have their operating mechanism so designed as to limit their combined kinetic energy to 9.8 J (1.00 kgf m) or 7 ft lbf and the force to prevent the doors from closing shall not be more than 147 N (15 kgf) or 30 lbf.

2.8.8 If the car and landing doors are arranged to close in sequence, i.e. one after the other, then the car doors shall have their operating mechanism so designed as to limit their kinetic energy to 9.8 J (1.00 kgf m) or 7 ft lbf and the force to prevent the car doors from closing shall not be more than 147 N (15 kgf) or 30 lbf. The same limitations shall apply to the landing doors.

The above figures shall not be increased by the addition of a safety edge. It is difficult to design safety edges for heavy doors which combine reliability of operation with effective reduction of door speed and reasonable freedom from accidental damage.

2.8.9 The above kinetic energy and closing force shall be computed and measured as in **2.7.3** and **2.7.4**.

2.8.10 Sequencing of operation for controlled power closing of entrances shall be applied as follows:

1) Whenever power operated vertically sliding car doors are used with power operated vertically biparting landing doors sequencing is required and the car doors shall close before the landing doors start to close and open after the landing doors have opened.

2) Whenever power operated horizontally sliding doors for car and landing are of different types, i.e. one centre opening and the other side opening, sequencing is required for closing, and the door nearer the operated closing button shall only start to close after the other door, which is farther away, has closed.

3) When power operated sliding doors for car and landing are of similar type, i.e. both centre opening, side opening or vertically rising and it is required that they shall not close in synchronism, then the closing sequence shall be as in 2) above.

2.8.11 The leading edges of doors closed by continuous pressure buttons shall be provided with a cushion designed to reduce the impact force when meeting an obstruction. The cushion shall be of fire resisting material where it is necessary to preserve the fire resisting construction of the entrance. The cushion shall be applied as follows:

1) to the lower edge of the upper panel of a vertically biparting door,

2) to the lower edge of a vertically sliding door,

3) to the leading edge of a side opening horizontally sliding door and

4) to both leading edges of centre opening horizontally sliding doors.

2.9 Locking devices and switches for car and landing entrances

2.9.1 Every car door shall be provided with an electrical switch which will prevent the lift car from being started or kept in motion unless all car doors are closed.

It shall not be possible to open a car door whilst the car is completing a journey.

EXCEPTION. Slow speed levelling of the car is permitted from a position 250 mm (10 ins) above or below the landing level with the car door/doors open or opening.

The practice of short-circuiting the car door switch(es) by means of a switch actuated by a movable car floor in order that the unoccupied car of an automatically operated lift may be called to a landing, is not permitted.

2.9.2 Every landing door shall be provided with an effective locking device so that it shall not normally be possible to open the door from the landing side unless the lift car is in that particular landing zone. Provision shall be made for the opening of every landing door by an authorized person by means of an emergency key, irrespective of the position of the lift car.

2.9.3 It shall not be possible under normal operation to start the lift car or keep it in motion unless all landing doors are in the closed position and locked.

EXCEPTION. Slow speed levelling of the lift car is permitted with the car and landing doors open provided that provision is made to ensure that the distance of slow speed travelling with door open is limited to 250 mm or 10 in above or below floor level and that protective toe guard aprons are provided below all landings.

2.9.4 The electrical and mechanical parts of all door locking devices shall be of good mechanical construction and adequate strength. Such devices shall be so designed that reasonable wear shall not create an unsafe condition or permit of interference with the operation of the lift by movement of the door or its fittings.

2.9.5 All door locking devices and door switches, together with any associated actuating rods, levers or contacts, shall be so situated or protected as to be reasonably inaccessible from the landing or the car.

Door locking devices and door switches shall be designed so that they cannot readily be made inoperative by unauthorized interference with their mechanisms.

2.9.6 Every electromechanical lock shall be encased and the removal of any detachable cover fitted to such casing shall not disturb any part of the lock mechanism.

2.9.7 Where springs are used in locking devices they shall be in compression and adequately supported.

2.9.8 The failure of a spring shall not render the lock unsafe.

2.9.9 The contacts of door locking devices and door switches shall be opened positively, independently of gravity or springs.

2.9.10 Locking devices used with multiple panel doors shall lock all panels of the doors and may be applied to only one panel provided that the interconnecting mechanism of door panels is so arranged that the locking of one panel will prevent the opening of all panels.

Where a door locking device is used on one panel of a vertically biparting landing door, reliance shall not be placed on gravity to keep the other panel closed.

2.10 Emergency devices and openings for cars

2.10.1 Every lift car shall be provided either with an emergency signal that is operative from the lift car and audible outside the lift well or with a telephone.

Emergency stop devices shall not be available for passenger operation, except as covered by **2.6.1**.

2.10.2 For gearless lifts only, an emergency exit with a cover shall be provided in the roof of each lift car and shall conform to the following requirements:

1) The exit opening shall have an area of not less than 0.25 m^2 and shall measure not less than 400 mm on any side.

2) The exit shall be so located as to provide a clear passage way unobstructed by fixed lift equipment located in or on top of the car.

3) The exit cover shall open outward and shall be hinged or otherwise attached to the car top and so arranged that the cover can be opened from the top of the car only.

4) The exit shall be provided with an electrical switch which will prevent operation of the lift when the cover is open and which will restore operation of the lift only when the fastening has been manually restored.

2.11 Car capacity and loading

The contract load of a passenger lift shall not be less than the amount given in Figure 1a, Figure 1b, Figure 1c or Figure 1d corresponding to the net inside car floor area, measured as shown in Figure 2.

To avoid the possibility of serious overloading of bed lifts in hospitals, such lifts shall be treated as passenger lifts.

The minimum contract load for goods lifts shall be based on a load of not less than that for a passenger lift of the same net inside floor area.

When the load in a goods lift consists of pallets or similar single piece loads, loaded by means of a power truck, it is necessary during loading and unloading to take into account the total load on the car platform (which should in no case exceed 150 % of contract load), the capacity of the brake and the resistance to slipping of the ropes on the sheave of a traction machine. Similarly, the guides, guide fixings, car frame and platform shall be designed to withstand the horizontal thrust imposed by power trucks, motor vehicles and the like.

2.12 Safety-gear

2.12.1 General. Every passenger and goods lift shall be provided with a safety-gear attached to the car frame and placed beneath the car platform. Safety-gear shall also be provided on the counterweight where there is an accessible space beneath the travel of the counterweight.

Safety-gears shall comply with the following general requirements:

1) It shall be possible to release car safety-gears by raising the car, and counterweight safety-gears by raising the counterweight.

2) Each car safety-gear shall be operated by means of either a governor or a safety rope. All sheaves or pulleys in contact with any part of this rope, which is normally in motion at the same time as the car, shall have diameters at least 30 times the diameter of the rope.

3) The safety-gear shall operate to stop and sustain the lift car with contract load in the event of failure of all suspension ropes or chains or their attachments, or in the event of the lift car exceeding a predetermined speed in the downward direction, when the safety-gear is operated by an overspeed governor.

4) A car safety-gear shall not operate to stop an ascending lift car. if an ascending lift car is to be stopped on account of overspeed then a safety-gear shall be fitted to the counterweight for this purpose.

Where an overspeed governor is used it shall cause the motor-control and brake-control circuits to be opened in the event of overspeed in the upward direction.

5) The application of the safety-gear shall not cause the car platform to slope at more than 1 in 25 to the horizontal.

6) The motor-control and brake-control circuits shall be opened by a switch on the car safety-gear before or at the time the safety-gear is applied.

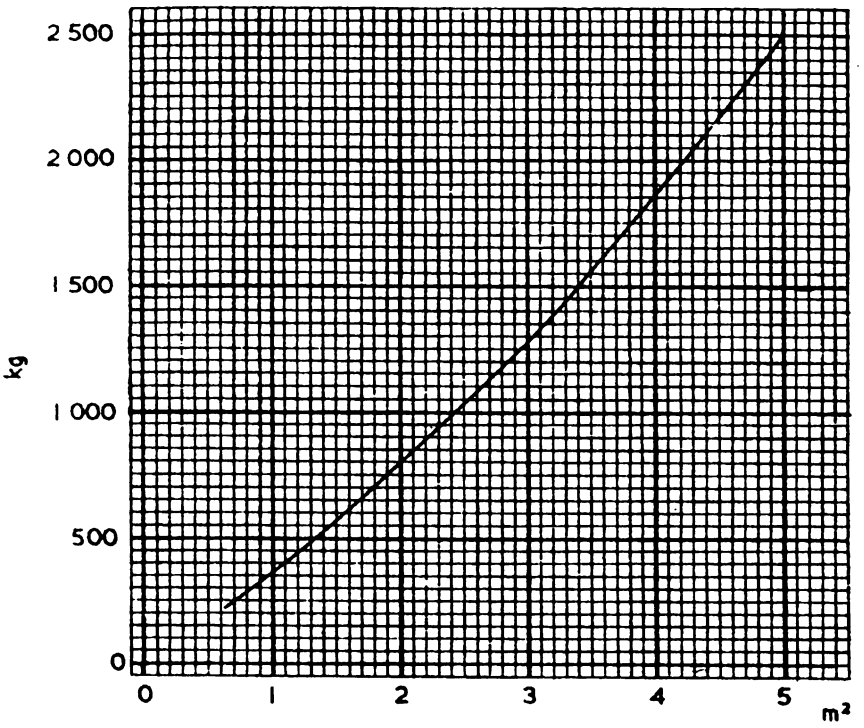

Figure 1a — Contract load for passenger lifts in relation to net inside floor area (metric units)

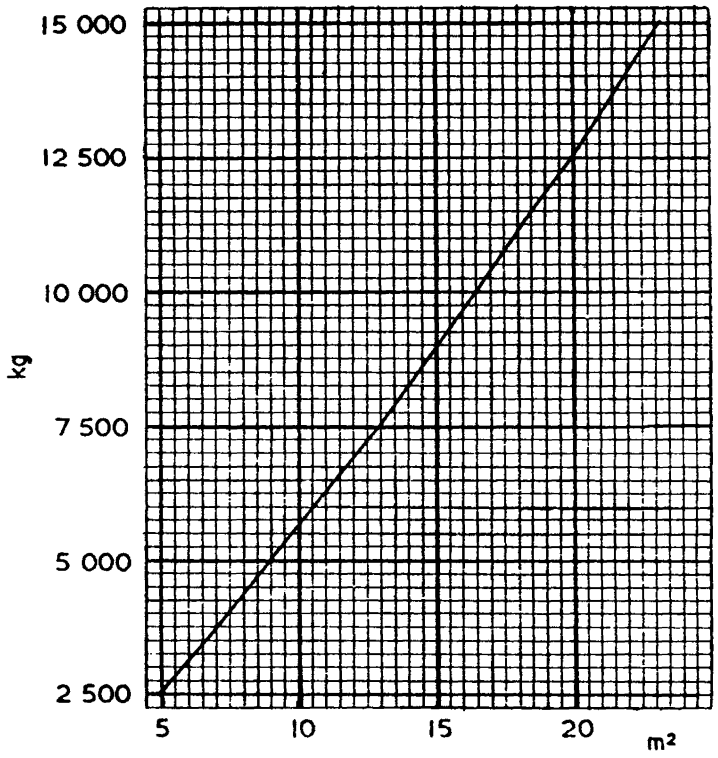

Figure 1b — Contract load for passenger lifts in relation to net inside floor area (metric units)

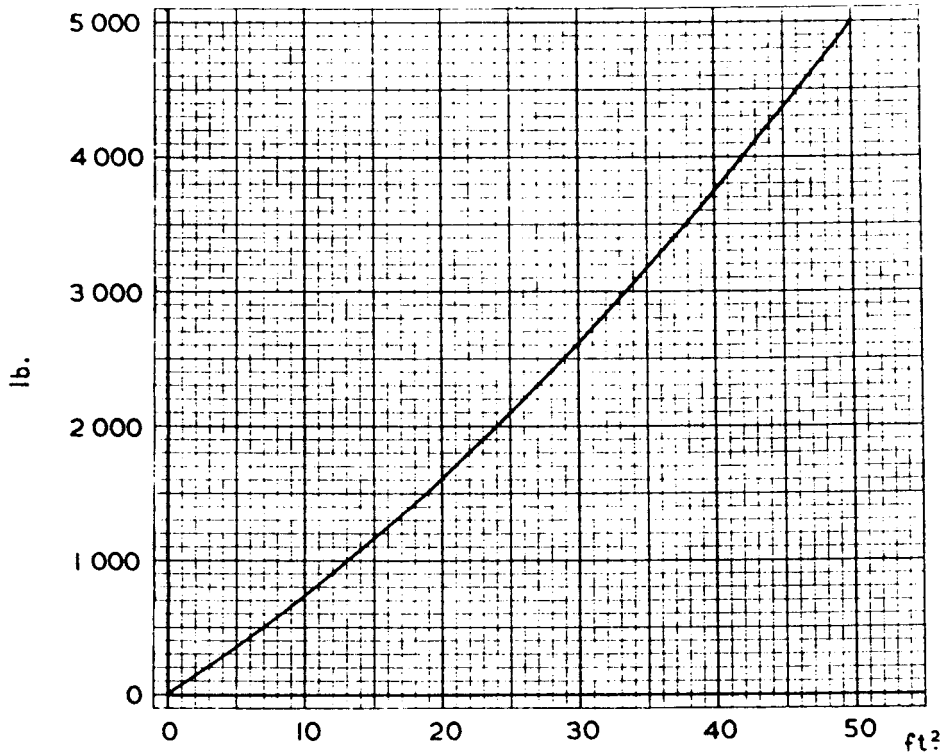

Figure 1c — Contract load for passenger lifts in relation to net inside floor area (imperial units)

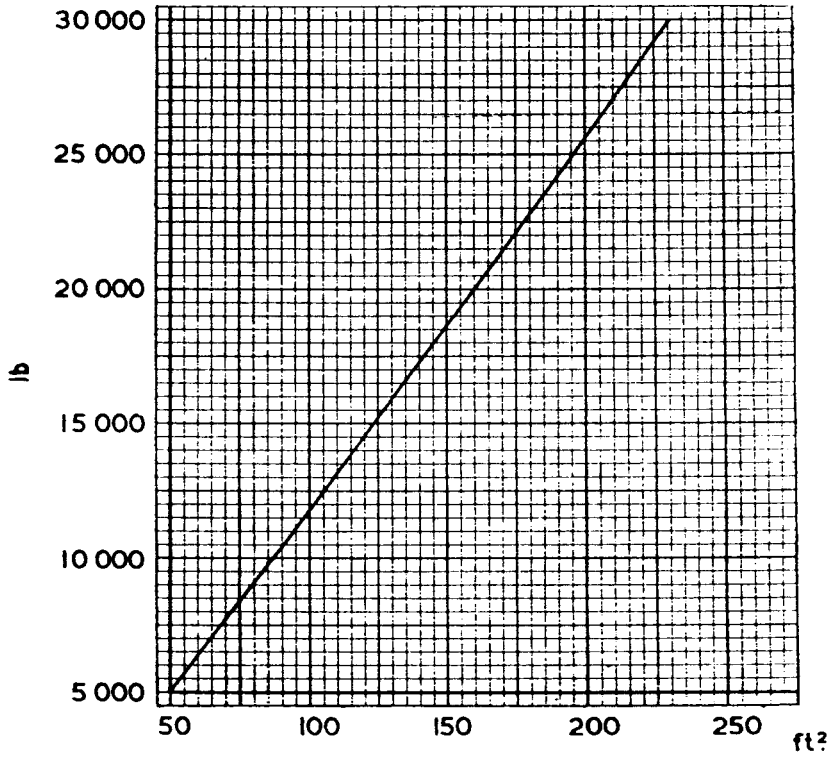

Figure 1d — Contract load for passenger lifts in relation to net inside floor area (imperial units)

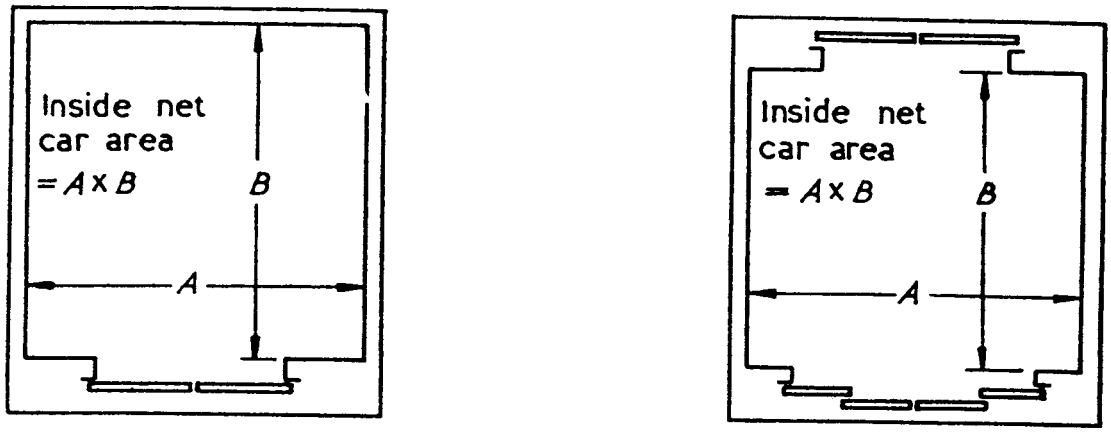

Figure 2 — Net inside floor areas for passenger lifts

7) When the car safety-gear is applied, no decrease in the tension of any rope used for applying the safety-gear, or motion of the lift car in the downward direction shall release the car safety-gear.

8) It shall not be possible for vibration of the car frame to cause a safety-gear to be applied.

9) No safety-gear shall depend for its operation upon completing or maintaining an electric circuit.

10) The gripping surfaces of a safety-gear shall be held clear of the guides during normal operation of the lift.

11) Any levers or cams operated by shafts shall be fixed to such shafts by means of welding, sunk keys or by equivalent positive connection.

12) Safety-gears shall be designed to grip each guide and to operate on the guides simultaneously.

13) Any shaft, jaw, wedge or support which forms part of a safety-gear and which is stressed during its operation shall be made of steel or other ductile material.

14) The drive to a car governor rope shall be effected from the car frame.

15) Any connecting device between a governor rope and car frame (or counterweight) that is intended to be released when the safety-gear is applied shall be retained in its normal position by a spring loaded device.

16) A pawl and ratchet shall not be used as a safety-gear.

2.12.2 Safety rope. The use of a safety rope for operating a car safety-gear shall be restricted to lifts with a speed not exceeding 0.50 m/s or 100 ft/min with a.c. induction motor or hydraulic operation.

Pulleys used for carrying safety ropes shall be mounted independently of any shaft or casting that carries the suspension ropes or chains. Provision shall be made to ensure retention of the safety rope in its pulleys.

Safety ropes shall be not less than 8.0 mm or $^{5}/_{16}$ in in diameter and shall be of steel or phosphor bronze.

2.12.3 Instantaneous safety-gears. Safety-gears of the instantaneous type may be used for lift cars having a contract speed not exceeding 0.75 m/s or 150 ft/min.

The tripping speed of a governor used with an instantaneous type safety-gear on a car shall not exceed 1.00 m/s or 200 ft/min.

Safety-gears of the instantaneous type may be used on counterweights having a contract speed not exceeding 1.50 m/s or 300 ft/min and such safety-gears can be operated without a governor.

2.12.4 Progressive safety-gears. Safety-gears of the progressive type shall stop the lift car with contract load or the counterweight from governor tripping speed within the range of stopping distances shown in Table 1. The stopping distance is the actual slide as observed from the markings on the guides made by the safety-gear.

Springs of various types may be used for limiting the force between jaws of the safety-gear and the guide. Where a spring is used and where it is partially loaded prior to the safety-gear operation, the loading on the spring shall not produce a fibre stress exceeding one half of the elastic limit of the material. During operation of the safety-gear the fibre stress shall not exceed 85 % of the elastic limit of the material. Where springs of the helical type are used they shall be in compression.

Table 1 — Governor tripping speeds and stopping distances

Contract speed	Governor tripping speed (see 2.13.2)	Stopping distances		Contract speed	Governor tripping speed (see 2.13.2)	Stopping distances	
		Minimum	Maximum			Minimum	Maximum
m/s	m/s	m	m	ft/min	ft/min	ft—in	ft—in
0 – 0.62	0.88	0.15	0.38	0 – 125	175	0 – 6	1 – 3
0.75	1.05	0.15	0.41	150	210	0 – 6	1 – 4
1.00	1.40	0.23	0.56	200	280	0 – 9	1 – 10
1.25	1.69	0.28	0.69	250	337	0 – 11	2 – 3
1.50	1.98	0.33	0.84	300	395	1 – 1	2 – 9
1.75	2.26	0.38	1.02	350	452	1 – 3	3 – 4
2.00	2.55	0.46	1.22	400	510	1 – 6	4 – 0
2.25	2.84	0.54	1.48	450	568	1 – 9	4 – 10
2.50	3.13	0.64	1.73	500	625	2 – 1	5 – 8
3.00	3.70	0.84	2.32	600	740	2 – 9	7 – 7
3.50	4.28	1.10	3.01	700	855	3 – 7	9 – 10
4.00	4.85	1.37	3.82	800	970	4 – 6	12 – 6
4.50	5.42	1.65	4.65	900	1 085	5 – 5	15 – 3
5.00	6.00	2.03	5.64	1 000	1 200	6 – 8	18 – 6
6.00	7.20	2.85	8.03	1 200	1 440	9 – 4	26 – 4

2.12.5 Oil buffer safety-gear. Safety-gears of the buffer type shall comply with the following conditions:

1) The contract speed shall not be more than 1.5 m/s or 300 ft/min.

2) The oil buffers shall conform to all requirements specified in **2.2.2** except that the stroke shall be based on governor tripping speed.

3) After the buffer stroke as defined in 2) has been completed, provision shall be made for an additional travel of the plunger or piston of not less than 10 % of the buffer stroke to prevent excessive impact on the buffer parts and the safety-gear frame.

4) Buffers shall be located in line with and symmetrically between guides. Where the distance between guides exceeds 2.5 m or 8 ft there shall be 2 identical buffers.

5) When the safety-gear is operated it shall not cause the safety-gear frame to slope at more than 1 in 25 to the horizontal.

6) An electrical switch shall prevent normal operation of the lift if a buffer is compressed more than 10 % of its stroke.

2.13 Governors

2.13.1 Governors shall be placed where they cannot be struck by the lift car or counterweight in the event of overrun.

2.13.2 Governors for safety-gears shall be adjusted to actuate the safety-gear at not less than 115 % of contract speed and at not more than the tripping speed listed opposite the applicable contract speed in Table 1.

No governor shall be required to operate the safety-gear at less than 0.70 m/s or 140 ft/min.

2.13.3 Any governor for a counterweight safety-gear shall be adjusted to trip at a speed greater than, but not more than 10 % above, the tripping speed of the car governor.

2.13.4 Each governor shall be marked with its tripping speed in terms of car speed in m/s or ft/min.

2.13.5 The motor-control and brake-control circuits shall be opened before or at the time the governor trips [see second paragraph of **2.12.1** 4)].

2.13.6 Governor ropes shall not be less than 8.0 mm or $^{5}/_{16}$ in diameter and shall be of steel or phosphorbronze and of suitable construction.

2.13.7 Governor ropes shall run clear of the governor jaws during normal operation of the lift.

2.13.8 The arc of contact made by the governor rope and the governor sheave shall, in conjunction with the rope tension device, provide sufficient tractive effort to cause proper operation of the governor.

2.13.9 Governor jaws and their mountings shall be so designed that any cutting, tearing or deformation of the rope resulting from their application shall not prevent proper operation of the safety-gear.

2.14 Suspension

2.14.1 Methods of suspension. Lift car suspension shall be by means of round strand steel wire ropes, or by means of steel plate link chains. **2.14.2** or **2.14.3**, as appropriate to the type of suspension, shall also be complied with.

2.14.2 Rope suspension. The ratio of the minimum breaking load of the rope to the working load shall not be less than the following:

Rope speed	Minimum ratio of breaking load to working load
Not exceeding 2.0 m/s or 400 ft/min	10 : 1
Not exceeding 3.5 m/s or 700 ft/min	11 : 1
Not exceeding 7.0 m/s or 1 400 ft/min	12 : 1

The above ratio is obtained from the expression

$$\frac{F \times n \times K,}{W}$$

where F = minimum breaking load of rope,

n = number of separate suspension ropes,

K = roping factor, i.e. 1 for 1 : 1 roping,
2 for 2 : 1 roping,
3 for 3 : 1 roping,

W = maximum static load imposed on the car ropes with the car and its rated load at any position in the lift well.

Not less than two ropes independent of one another shall be used for suspension.

No car or counterweight rope shall be spliced other than for the purpose of attachment to the car, counterweight or anchorage.

The ends of car ropes attached to a winding drum shall be secured by clamps or other suitable attachments on the inside of the drum.

The attachment of suspension ropes to car frames or counterweights, or to fixed anchorages where multiple roping is used, shall be effected by means of spliced return loops, gripped return loops or metalled sockets. Loops shall not bear directly on their fixings but shall be lined with thimbles.

Each end of each suspension rope shall have its own independent attachment.

No rope shall be reeved round a pulley or pin in place of using two ropes.

2.14.3 Chain suspension. Chains used for lift car suspension shall be steel plate link chains and shall be of bushed solid bearing pin construction, incorporating rollers.

Chain speeds shall not exceed 0.50 m/s or 100 ft/min and shall not be used where lift travel exceeds 12.00 m or 40 ft.

The factor of safety, determined as for suspension ropes, shall not be less than 10. Connecting links shall have a strength at least equal to that of the chain to which they are attached.

Not less than two chains independent of one another shall be used for suspension.

Chains shall be so installed that any one chain lies in one plane throughout its length.

In the event of the breakage or excessive stretch of one or more suspension chains, a switch shall open to cause the motor-control and brake-control circuits to be opened.

2.14.4 Pulleys, sheaves, drums for suspension

2.14.4.1 *General.* Drums, pulleys and sheaves shall be of cast iron or steel. They shall have machined grooves which shall be smoothly finished and have rounded edges. The grooving shall comply with the requirements of **2.14.4.3** 1), 2) or 3) as appropriate. Adequate provision shall be made to prevent ropes from leaving drums, pulleys or sheaves.

Multiplying pulleys, when fitted to the top of the car, shall have effective guards for the protection of maintenance and inspection personnel, and the guards shall be provided with effective handholds.

2.14.4.2 *Minimum diameters.* The diameters of drums, pulleys and sheaves shall not be less than the values shown in Table 2.

2.14.4.3 *Pulley, sheave and drum grooves.* All pulleys, sheaves and drums shall have machined grooves which shall be smoothly finished and have rounded edges.

1) *Pulleys.* The rope groove shall be a circular arc having a radius 5 % larger than the nominal radius of the rope. The depth of the rope groove shall not be less than one third of the nominal diameter of the rope.

2) *Sheaves.* The sheave rim should be of sufficient thickness to allow the wearing surface of rope grooves to be re-machined.

Sheaves shall have rope grooves of one of the following forms:

a. Round grooves and undercut round grooves. The form of the round portion of the groove for the rope seating shall be the same as that for a pulley.

b. "V" grooves. These grooves are basically straight sided grooves. They can have plain undercuts and also undercuts with a partial round seating. The included angle of the straight portion of the "V" groove shall neither exceed 40° nor be less than 35°.

3) *Drums.* The rope groove shall be a circular arc having a radius 5 % larger than the nominal radius of the rope.

The grooves on the drum shall be pitched so that there is clearance between neighbouring turns of rope on the drum, and also clearance between the part of the rope leading on to or leaving the drum and the adjacent coil.

The clearance between neighbouring turns of rope shall not be less than 1.5 mm or $^{1}/_{16}$ in for ropes up to and including 13.0 mm or ½ in diameter, or 2.5 mm or $^{3}/_{32}$ in for ropes above 13.0 mm or ½ in diameter.

Allowance shall be made for lead angle of the rope on to the drum.

Table 2 — Minimum diameters of drums, pulleys and sheaves

Class of rope	Diameter of drum, pulley or sheave
6 × 19 (9/9/1)	$d\ (44 + 3S_1)$ $d\ (44 + 0.015\ S_2)$ } with a minimum of $47d$
6 × 19 (12/6 + 6 F/1) 8 × 19 (9/9/1)	$d\ (37 + 3\ S_1)$ $d\ (37 + 0.015\ S_2)$ } with a minimum of $40d$
NOTE d = diameter of rope in same units as drum diameter; S_1 = rope speed in m/s; S_2 = rope speed in ft/min.	

2.14.5 Chainwheels. Chain pulleys shall not be used. Chainwheels shall be of cast iron or steel and shall have machine cut teeth.

They shall have a minimum of 25 teeth and the minimum engagement of chain when passing over a chainwheel shall be 6 teeth.

For all chainwheels means shall be provided to prevent the chain from leaving the chainwheel or riding over the teeth.

2.14.6 Shafts and axles. Stress concentrations shall be minimized by forming fillets where shafts and axles are shouldered. Pulleys or sprockets and their shafts shall be so supported and retained as to prevent them from becoming displaced.

2.14.7 Keys and keyways. Keys shall be effectively secured against movement.

2.15 Lift machines

2.15.1 General. The factor of safety used in the design of lift machines for passenger and goods lifts shall be based on the static load with contract load in the lift car and shall not be less than 8 for wrought steel and 10 for cast iron, cast steel or other materials.

No friction gearing, i.e. gearing dependent on the friction between faces of adjacent pulleys, or friction clutch mechanism shall be used for connecting the main driving gear to the sheave or drum.

Shafts shall be provided with adequate fillets where shouldered.

Any separate sheave, rope drum, spur gear, worm wheel or brake drum shall be fixed to its shaft or other driving unit by one of the following methods:

1) sunk keys,

2) splines,

3) secured by means of machined fitting bolts to a flange forming an integral part of the shaft or driving unit.

Protection shall be provided to prevent objects falling between the ropes and any sheave which is in the well.

Machines with winding drums shall be used only for travels not exceeding 12.00 m or 40 ft and for rated speeds not exceeding 0.25 m/s or 50 ft/min. Lifts using winding drums shall not be provided with counterweights.

2.15.2 Bearings. Bearings shall be of the ball, roller, sleeve or other replaceable type.

Ball and roller bearings shall be arranged in dustproof housings and shall be adequately lubricated.

Sleeve bearings having ring or chain lubrication shall have ample reservoirs provided with drain plugs and means to ascertain and limit the height of the oil in the reservoir.

Gear cases shall be provided with journal and thrust bearings suitable for the application.

2.15.3 Hand winding. Provision shall be made on geared lift machines only for passenger and goods, whereby the lift can be raised or lowered in an emergency by manual operation. The direction of winding corresponding to the raising and lowering of the lift car shall be clearly indicated.

Manual operation shall be by a smooth-rimmed, spokeless wheel which may be fitted to the shaft.

The hand winding apparatus, where detachable, shall be mounted in an accessible position in the machine room.

A prominent notice shall be displayed stating that hand winding shall be undertaken only by authorized persons and the notice shall detail step by step the procedure to move the lift in an emergency.

2.15.4 Brakes. Every lift machine shall be provided with a brake that is mechanically applied and electrically held off. The brake shall be capable of bringing the car to rest smoothly, under maximum conditions of load and speed, and of sustaining a static load of 125 % of the contract load.

No toggle, or other device depending upon impact, shall be used to hold off the brake. No brake shall be released in normal operation unless power is applied to the lift motor.

When springs are used to apply the brake shoes such springs shall be in compression and adequately supported.

Brakes of passenger and goods lifts shall have at least two brake shoes.

Brake linings shall be of incombustible material and shall be so secured to the brake shoes that normal wear will not weaken their fastenings.

No earth fault, short circuit or residual magnetism shall prevent the brake from being applied when the power supply to the lift motor is interrupted.

Means of releasing the brake in emergency shall be provided and ensure the immediate re-application of the brake as soon as hand pressure is released.

2.15.5 Alignment. The brake, motor, gear case and any bearing shall be mounted and assembled so that proper alignment of these parts is maintained under all conditions.

2.16 Counterweights

2.16.1 All counterweights shall be of metal and shall travel between rigid guides.

2.16.2 Counterweights shall withstand the effect of buffer impact.

2.16.3 Counterweights shall be constructed from multiple sections contained and secured within a steel frame.

2.16.4 Four guide shoes, capable of being easily renewed or having renewable linings, shall be provided on the counterweight.

2.16.5 When multiplying pulleys are used, the pulley on the counterweight shall comply with the requirements of **2.14.4**.

2.16.6 Counterweights shall be guarded by means of a rigid screen extending from a position 0.30 m or 1 ft above the lift pit floor to a position at least 2.10 m or 7 ft above the lift pit floor. Where oil buffers are fitted in the pit or when compensating ropes or chains are used, screens giving adequate protection consistent with the correct maintenance of the equipment shall be provided.

2.17 Load plates

NOTE Attention is drawn in the Foreword to the importance, for any one contract, of using either the metric system or the imperial system throughout, the values being based on the content of this standard.

Whereas it has been customary, for those countries using the imperial system, to rate one person as weighing 150 lb, those countries using the metric system rate one person as weighing 75 kg, i.e. a 10.2 % increase. Both ratings have been retained in this standard and the one which should be used is that whose units are of the same system as the remainder of the contract.

2.17.1 A load plate giving the contract load of the lift shall be fitted in each lift car in a conspicuous position.

2.17.1.1 For passenger lifts the contract load shall be given in persons and kilogrammes or persons and pounds.

When the contract load for passenger lifts is given in kilogrammes then a person is regarded as weighing 75 kg.

When the contract load for passenger lifts is given in pounds then a person is regarded as weighing 150 lb.

2.17.1.2 For goods lifts the contract load shall be given in kilogrammes (other convenient units such as tonnes can be included) and also in persons, or in pounds (other convenient units such as hundredweights and tons can be included) and also in persons.

When the contract load for goods lifts is given in kilogrammes then the number of persons corresponds to the effective floor area of the car for passenger lift rating, or to the contract load in kilogrammes, whichever gives the lesser number. A person is regarded as weighing 75 kg.

When the contract load for goods lifts is given in pounds then the number of persons corresponds to the effective floor area of the car for passenger lift rating, or to the contract load in pounds, whichever gives the lesser number. A person is regarded as weighing 150 lb.

Additionally, where appropriate, the maximum wheel or point loading on the platforms of goods lifts shall also be stated on the load plate.

Typical examples of the legends on goods lift load plates are as follows.

a) *Goods lifts (general purpose)*

Rated load: xxxx persons, yyyy kg evenly distributed.

Wheel or point load on platform not to exceed zzzz kg at any time.

b) *Motor vehicle lift*

Rated load yyyy kg, xxxx persons.

This lift is designed mainly for carrying motor vehicles.

c) *Goods lifts (heavy concentrated loading)*

Rated load yyyy kg, xxxx persons.

Wheel or point load on platform not to exceed zzzz kg at any time.

d) *Heavy duty goods lifts (static loading, including loading vehicle)*

Rated load yyyy kg, xxxx persons.

Wheel or point load on platform not to exceed zzzz kg at any time.

2.17.2 A data plate shall be attached to the car crosshead in a conspicuous place, giving the following information:

1) The maximum static load on the ropes in kilogrammes or pounds. This shall be understood as the maximum static load imposed on the car ropes with the car and its contract load at any position in the lift well.

2) The contract load and speed in kilogrammes and metres per second or pounds and feet per minute.

2.18 Controllers

2.18.1 General. Controllers shall comply with the following general requirements:

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

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

3) Fusible cut-outs shall be so placed and constructed that the blowing of a fuse shall not cause a short circuit between adjacent conductors.

4) Main and auxiliary resistors shall be adequately supported and ventilated.

5) Control circuits shall be protected by fuses or equivalent means independently of the protection for the main circuits.

6) In an automatically controlled lift the opening of the circuit to stop the lift at the terminal floors shall not be dependent upon the direct operation of a spring or upon the completion of another electrical circuit.

7) No control system shall depend upon the completion or maintenance of an electrical circuit for the interruption of the power supply to the lift motor and the application of the machine brake to stop the lift car:

a. at the terminal floors, or

b. when an emergency stop switch or other safety device is operated.

NOTE This requirement does not apply to dynamic braking or to speed control.

8) Lifts connected to polyphase a.c. power supplies shall incorporate means to prevent the motor from being energized against phase failure and/or phase reversal.

NOTE This does not apply to a.c motors used in motor generator sets incorporating a rotary exciter of the shunt self-excited type.

9) Control circuits shall be so arranged that an earth fault or open circuit, or the discharge or failure of a capacitor, does not set up an unsafe condition.

10) Contactors for reversing direction of travel shall be mechanically and electrically interlocked.

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

12) Where a floor selector is driven from the lift car and/or counterweight by a chain, tape, wire or similar means, a switch shall be provided to stop the lift machine in the event of the chain, tape or wire becoming slack or breaking.

13) Control circuits at normal mains voltage shall be connected between phase and neutral or, on d.c. systems, between one outer and the mid-point and not across phases or outer conductors. When control circuits are supplied through a transformer it shall be a double wound type with earth screen between primary and secondary windings. Where a rectifier is used, one pole of such a circuit shall be earthed and no single pole switch, fuse or device other than a link for testing purposes shall be placed in that pole of the circuit. Removal of any link shall prevent operation of the lift.

14) All control circuits shall be designed to fail to safety.

2.18.2 Relays and contactors. Both fixed and moving contacts shall be readily replaceable.

Where contactors having metal to metal contacts are employed to open a circuit to stop a lift machine, such a circuit shall have at least two independent contactors.

Where a pivoted joint of a contactor or relay forms part of a circuit, provision shall be made to by-pass such joint with a durable flexible connection of sufficient current carrying capacity.

Contactors having main contacts of opposite polarity or in different phase lines in juxtaposition shall be provided with arc shields.

2.18.3 Wiring. The insulation of controller wiring shall be of a flame-retardant type. All wires shall be terminated by soldering or clamping in such a way that the wires are not damaged.

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

2.19 Operation and operating devices

2.19.1 Automatically controlled lifts shall comply with the following requirements:

1) While a lift car is travelling to a given landing it shall not be possible to interfere with its journey by pressing any landing button, except that with collective forms of control it is permissible to stop the lift car at any intermediate landing for the reception or discharge of passengers.

2) Provision shall be made for a reasonable time lag between the stopping of the lift car and its being restarted.

2.19.2 Every lift having a drum drive or using chain suspension shall be provided with a slack-rope/chain switch which will cause the motor-control and brake-control to be opened should the lift car or counterweight be obstructed in its descent.
Slack-rope/chain switches shall be so constructed that they will not automatically reset when the slack in the rope or chain is removed.

2.19.3 The handle of every car operating device shall be arranged to return to the "**STOP**" position when released.

2.19.4 Electrical operating devices, whether mounted in or on the lift car or in the lift well, shall be enclosed.

2.19.5 No push button or manually operated switch that is intended to render the landing lock circuit ineffective shall be installed.

2.19.6 A control station shall be fitted on top of the car and shall incorporate the following features:

1) A permanent light; suitably protected with its separate switch.

2) A three pin socket outlet (BS 1363).

NOTE A common supply shall be provided for items 1) and 2).

3) A robust emergency stop switch with "RUN" and "STOP" positions legibly marked. When the switch is in the "STOP" position it shall not be possible to move the car from any control station.

4) "UP" and "DOWN" push buttons legibly marked.

5) A robust "TEST SWITCH" with the "TEST" and "NORMAL" positions legibly marked. When the switch is in the "NORMAL" position the lift will respond normally to the landing and car push buttons. When the switch is in the "TEST" position the "UP" and "DOWN" push buttons on this car top control station shall become operative, subject to the following conditions:

i) it will not be possible to control the car from any other position

ii) the car will travel at a speed of not exceeding 0.50 m/s (100 ft/min)

iii) the car will not move until all safety devices are in, and remain in, the safe position

iv) the car will move only while the movement button is subjected to continuous pressure

v) a terminal stop limit switch associated with this control will, when the car is moving in the upward direction, stop the car with its roof not less than 1.8 m (6 ft) from the top of the well.

6) The control station shall be placed or designed so as to prevent it being operated accidentally.

2.19.7 Where lift equipment is housed in any compartment separate from the motor room or lift well, a switch shall be provided in that compartment which, when placed in the "STOP" position, will cause the lift to stop and prevent its being started until placed in the "RUN" position.

2.19.8 A switch as specified in **2.19.7** shall be provided in each lift pit.

2.20 Suppression of radio and television interference

Interference suppression components shall not be used in any part of the circuit where their failure might cause an unsafe condition.

2.21 Terminal stopping and final limit switches

2.21.1 General. Each lift shall be provided with terminal stopping switches and final limit switches complying with the following requirements:

1) The terminal stopping and final limit switches shall control at least two separate and independent contactors, two of which shall be closed to complete the motor and brake circuits for each direction of travel, unless the final limit switch opens the motor and brake circuits and its contacts are directly opened mechanically.

2) Switches for terminal and final stopping, when fixed on the car frame or in the lift well, shall be securely mounted in such a manner that the movement of the switch levers to open the contacts is positive and not affected by normal "float" of the car.

Any cam used for operating these switches shall be of stable material of sufficient length and so arranged that the switch is held in the open position when either the lift car or the counterweight is resting on the fully compressed buffers.

3) The contacts of all terminal stopping and final limit switches shall be opened by positive mechanical means. Arrangements in which a spring or gravity or both open the contacts by the withdrawal of a cam or similar device shall not be used.

4) Terminal stopping and final limit switches, whether mounted on the car frame or in the lift well, shall be enclosed.

2.21.2 Terminal stopping switches. Terminal stopping switches shall be arranged to stop the lift car automatically from any speed attained in normal operation within the top runby and bottom runby, independently of the operating device, the final limit switch and the buffers.

A lift having a traction drive shall have its terminal stopping switch(es) mounted on the car frame or in the lift well and operated directly by the movement of the lift car, or in the machine room provided that the stopping contacts are operated by a device mechanically connected to and driven by the lift car without dependence upon friction as a driving means. An automatic safety switch shall be provided which will stop the machine in the event of a failure of the tape, chain, rope or other similar device mechanically connecting the stopping device to the lift car.

NOTE When the floor controller, floor switch or selector of an automatically operated lift is driven in accordance with this requirement, the floor stopping contacts for the terminal floors may serve as the terminal stopping switch.

A lift having a drum machine or chain suspension shall have its terminal stopping switch(es) mounted either on the car frame or in the lift well and operated directly by the movement of the car.

2.21.3 Final limit switches. Final limit switches shall be arranged to cause the power to be removed from the lift motor and apply the brake independently of all other switches.

Final limit switches shall be arranged to operate with the lift car as close to the terminal floors as practicable without interfering with the normal operation of the lift, and shall be operated directly by the movement of the car. When spring buffers are employed the final limit switches shall be arranged to open their contacts before the buffer is engaged.

A lift using chain suspension or employing other than traction drive shall have a further stopping switch in the machine room, operated by the machine.

The opening of a final limit switch shall prevent further movement under power of the lift car in both directions of travel.

A lift having variable voltage motor control shall be provided with final limit switches either of which shall, on being opened, cause the lift motor to exert its full dynamic braking effort with the lift motor field winding energized and with motor generator running.

2.22 Main switches and wiring

2.22.1 Circuit breaker or main switch. The incoming supply mains in the machine room shall terminate either in a non self-resetting circuit breaker with over-current release or in a main switch with fuses. Where a main switch with fuses is provided, the lift controller shall be equipped with over-current protection. For a single lift this circuit breaker or switch shall be fixed adjacent to the machine room entrance. In a machine room common to more than one lift each circuit breaker or switch shall be conveniently situated with respect to the lift machine it controls and shall be suitably marked for identification purposes.

The opening of the circuit breaker or main switch while the lift car is in motion shall cause the machine brake to be applied.

NOTE Where this feature is not inherent in the class or design of the equipment the circuit breaker or main switch can be provided with additional contacts by which the object of this requirement may be secured.

2.22.2 Wiring. All cables, trunking, conduit and conduit fittings necessary for lift circuits (including power, lighting and indicator circuits) shall be installed in accordance with the latest issue of the IEE Regulations for the Electrical Equipment of Buildings.

Travelling cables between the lift well and lift car terminal boxes shall be suspended by looping over reels or by suitable clamps. The connections in the terminal boxes shall be marked for identification purposes.

All exposed metalwork liable to become electrically charged, other than conductors, shall be efficiently bonded and earthed.

All wiring installed in the lift well, other than travelling cables, should preferably be enclosed in steel conduit or trunking. Where this method of protection is not adopted, appropriately protected cables may be used, provided that they are fixed to the structure at fixing centres not exceeding 1.0 m (3 ft) apart.

3 Specific requirements for electric service lifts

3.1 Lift cars

3.1.1 Service lift cars shall be of rigid construction and totally enclosed except for service openings.

Two pairs of renewable guide shoes shall be fitted.

3.1.2 Any removable shelves shall be so retained that they are not displaced by movement of the car.

3.1.3 Cars with openings in the front only need not be provided with car entrance protection. Cars constructed with openings on opposite sides shall be provided with some form of protection to prevent goods projecting outside the car. Where gates are used they may have pickets spaced at a maximum of 130 mm (5 in) centres.

3.2 Lift machines

The design of machines for electric service lifts shall comply with **2.15.1**, except that the factor of safety shall be based on the static load with contract load in the car and shall not be less than 6 for wrought steel and 9 for cast iron and other materials. The design shall also agree with **2.15.4** except that one brake shoe is permissible.

3.3 Guides

3.3.1 The requirements of **2.1.1** and **2.1.2** shall apply to service lifts.

3.3.2 Guides and their fixings shall withstand the application of the safety-gear (if provided) when stopping a fully loaded car or the counterweight.

3.3.3 One set of guides may be used for both the car and counterweight.

3.4 Buffers

Buffers shall be installed under all cars and counterweights.

Spring buffers or buffers of rubber or timber may be used.

3.5 Counterweights

Counterweights shall be of metal.

Those consisting of sections without frames shall have not less than two suspension rods extending throughout the counterweight. The nuts on the suspension rods shall be retained by split pins or equivalent positive means.

3.6 Suspension

Lift car suspension shall be by means of either round strand steel wire ropes or steel plate link chains.

The factor of safety of suspension ropes or chains shall not be less than 8, calculated by the method given in **2.14.2**. Connecting links shall have a strength at least equal to that of the chain to which they are attached.

A single rope or chain may be used for suspension.

The diameter of drums, sheaves or pulleys shall not be less than 30 times the rope diameter.

For chainwheels the requirements of **2.14.5** apply, except that the minimum number of teeth shall be 15. No car or counterweight rope shall be lengthened or repaired by splicing.

The ends of car ropes attached to a drum shall be secured by clamps or other suitable attachments inside the drum.

3.7 Safety-gear

A safety-gear shall be provided for the car and/or counterweight of any service lift where there is an accessible space beneath the travel of the car and/or counterweight.

When a safety-gear is fitted to a service lift it may be of the instantaneous type operated by an independent steel wire rope running over an independent pulley at the top of the lift well; governor operation and switching to cut the control circuit are not required.

3.8 Load plates

A load plate giving the contract load of the lift shall be fitted in each lift car in a suitable position.

3.9 Landing doors, shutters or gates

All landing openings in lift well enclosures of service lifts shall be protected by doors, shutters or close-picket type collapsible gates.

Every landing door, shutter or gate shall be equipped with an electrical switch which will prevent the lift being operated whilst any landing door, shutter or gate is open, Where the serving level is less than 0.85 m or 2 ft 9 in above the floor, the landing door, shutter or gate shall, in addition, be mechanically locked, unless the car is at that opening.

3.10 Terminal stops

Service lifts shall be provided with means to stop the car automatically at or near the terminal service levels.

3.11 Slack-rope switch

Every lift having a drum machine or chain suspension shall be provided with a slack-rope/chain switch which will cause the motor-control and brake-control to be opened should the lift car be obstructed in its descent. Such switches shall be so constructed that they will not automatically reset when the slack in the rope or chain is removed.

3.12 Main switches and wiring

The requirements of **2.22** shall apply to service lifts.

3.13 Suppression of radio and television interference

The requirements of **2.20** shall apply to service lifts.

4 Firemen's lifts

This section is rendered obsolescent under the conditions stated in the foreword (see Amendment No. 5).

4.1 Location

Firemen's lifts may be required by the Fire Authority and their positioning is the subject of agreement between this Authority and the architect.

4.2 Capacity

The lift shall have an effective platform area not less than 1.45 m^2 or 15½ ft^2 and be capable of carrying a load not less than 550 kg or 1 200 lb.

4.3 Doors

The lift shall have power operated doors giving a minimum clear opening width of 0.80 m or 2 ft 9 in and arranged to remain open whilst the lift car is at a floor when under "fire control" conditions.

4.4 Speed

The speed of the lift shall be such that it will run its full travel in not more than one minute.

4.5 Fire switch

4.5.1 Location. A switch, in a box clearly marked "FIRE CONTROL", shall be sited adjacent to the lift opening at fire control floor level so that firemen can obtain immediate control of the fire lift without interference from the ordinary call-points. Where two or more lifts are installed together the position selected for the switch should, if possible, be such that there is no doubt which lift it controls. Otherwise a suitable notice or directing arrow shall be provided adjacent to the switch to indicate which lift it controls. Where two adjacent lifts are adapted as fire lifts a notice, "FIRE CONTROL FOR BOTH LIFTS", shall be provided. In blocks of dwellings where the fire switch may be subjected to unauthorized interference the switch and box shall be fitted at high level.

4.5.2 Type. Only one fire switch shall be provided. The switch shall be of a type which does not require a key for operation, e.g. a switch with two press buttons, or a tumbler switch marked "FIRE CONTROL", "ON" and "OFF". Where a two button switch is used the operated button shall remain depressed to indicate which button is in operation.

4.5.3 Operation. The operation of the fire switch shall be such that all safety devices remain operative, including maintenance switches. Arrangements shall be made for the operation of the fire switch to bring the firemen's lift car to the fire control level without delay and with doors parked open.

A service switch, as defined in Part 9, shall not overrride the fire control switch.

Whilst under "fire control" all landing call-points and control switches shall be rendered inoperative and sole control vested in the car control station, ensuring that any collective control becomes inoperative.

4.6 Electricity supply

The electrical supply to the lift shall be connected to a sub-main circuit exclusive to the lift and independent of any other main or sub-main circuit. The cables supplying current to the lift installations should be located on a route of negligible fire risk and where possible within the lift well.

When a fire lift is one of a battery of lifts the other lifts may be fed from the same supply, provided it is adequate for this purpose and that arrangements are such that a fault occurring in any other lift of the battery will not affect in any way the operation of the fire lift.

5 Specific requirements for hydraulic lifts

This section is rendered obsolescent under the conditions stated in the foreword (see Amendment No. 5).

5.1 Guides and fixings

The requirements of **2.1** or **3.3** apply, with the exception that for hydraulic lifts round-section guides shall not be used to guide the car or platform of direct acting lifts.

5.2 Buffers

All the requirements of **2.2** or **3.4** apply, except that where hydraulic buffering is incorporated in the design of the lifting cylinder, solid buffers are acceptable to meet the requirements of **5.13**.

5.3 Top and bottom clearances and runbys

5.3.1 Car bottom clearance. The car bottom clearance shall be as in **2.3.1**.

5.3.2 Bottom car runby. The bottom runby for the car shall not be less than:

1) 75 mm or 3 in for rated speeds not exceeding 0.50 m/s or 100 ft/min;

2) 150 mm or 6 in for rated speeds exceeding 0.5 m/s or 100 ft/min.

5.3.3 Maximum top and bottom runby for car. The top and bottom runby for the car shall not exceed 600 m or 24 in.

5.3.4 Car top clearance. The top clearance for the car shall not be less than the sum of the two following dimensions:

1) the distance the car can travel above its top terminal landing until the ram reaches its extreme limit of travel, and

2) the greater of the two following items:

a. 600 mm or 24 in above the car roof, or

b. 75 mm or 3 in above the projection of any part of the car or its equipment above the car roof.

5.3.5 Top clearance and bottom runby of counterweights. Where a counterweight is provided, the top clearance and bottom runby of the counterweight shall conform with the following:

1) The top clearance shall not be less than the sum of the three following items:

a. the car bottom runby,

b. the stroke of the car buffers, and

c. 150 mm or 6 in.

2) The bottom runby shall not be less than the sum of the two following items:

a. the distance the car can travel above its top terminal landing until the plunger strikes its top mechanical stop, and

b. 150 mm or 6 in.

The minimum runby specified shall not be reduced by rope stretch.

5.4 Car frames

The requirements of **2.4** apply to passenger and goods lifts, and the following additional requirements shall also be met for all hydraulic lifts.

The platform frame shall be so designed and constructed that all eccentric loads are transferred to the guides and not to the ram attachments.

The car or platform shall not open flaps during its travel.

5.5 Car enclosure

The requirements of **2.5** or **3.1.1** and **3.1.2** apply.

5.6 Car and landing entrance construction

The requirements of **2.6** or **3.1.3** and the first paragraph of **3.9** apply.

5.7 Automatic power operation of entrances

For passenger and goods lifts the requirements of **2.7** apply.

5.8 Controlled power closing of entrances

For passenger and goods lifts the requirements of **2.8** apply.

5.9 Locking devices and switches

The requirements of **2.9** or the second paragraph of **3.9** apply.

5.10 Emergency devices and openings for cars

For passenger and goods lifts the requirements of **2.10.1** apply.

5.11 Car capacity and loading

The requirements of **2.11** or **3.8** apply.

5.12 Safety-gear

5.12.1 Direct acting lifts

All direct acting lifts capable of carrying passengers shall be provided with and either:

1) governor operated safety gears complying with the requirements specified in **2.12**; or

2) a rupture valve(s).

Instantaneous safety gear shall not be fitted to direct acting lifts. Other forms of safety gear shall be made to absorb any impact loading at the cross head due to inertia of the ram and attachments.

5.12.2 Indirect acting lifts

All indirect acting lifts shall be provided with safety gears complying with the requirements specified in **2.12**.

The safety gear shall be operated by either:

1) an overspeed governor; or

2) a safety rope in conjunction with a rupture valve, on lifts with a rated speed not exceeding 1.0 m/s.

The rupture valve shall be capable of stopping and holding the car with its rated load, in the event of it overspeeding in the down direction. It shall be fitted, integral with, or flange bolted to, the hydraulic cylinder.

5.13 Ram stops

Hydraulic lifts shall be so constructed or reeved that the cars are prevented, by means of permanent stops on the cylinders, from moving into any dangerous position.

5.14 Suspension

Where the raising of the lift is achieved by the use of ropes or chains interposed between the ram and the car, the requirements of **2.14** or **3.6** shall apply. As an alternative to the types of chains referred to in **2.14** and **3.6**, balance chains may be used. For balance chains the pulleys shall have machined square bottom grooves and shall have flanges not less than ⅓ chain depth.

Where chains are used, a chain speed of up to 0.63 m/s and a travel of up to 25 m are permitted.

The minimum thickness of the car roof when chains are used for suspension shall be 1.5 mm steel or 15 mm timber.

5.15 Hoisting machinery

5.15.1 General. All openings in hydraulic equipment shall be sealed prior to dispatch.

Adequate precautions shall be taken to prevent corrosion during transit.

Hydraulic equipment and piping shall be accessible and shall be mounted in a position that will not interfere with equipment adjustment or maintenance.

All pressure and volume controls shall be so constructed that they are not adjustable outside the safe working range of the system of which they form part.

5.15.2 Emergency lowering. Provision shall be made on hydraulic lifts for the emergency lowering of the car by manual operation. Any such device must automatically reset when hand pressure is removed.

The seating of any valve used for such a purpose shall be maintained by the pressure within the lifting cylinder. Springs or weights shall be used only to assist initial movement of valve mechanism to the seated position.

A prominent notice shall be displayed stating that hand lowering shall be undertaken only by experienced persons and only after the driving motor has been disconnected from the main supply.

5.15.3 Anti-creep device

NOTE An anti-creep device is a device used to limit automatically a change in car level caused by leakage in the hydraulic system.

All hydraulic lifts, other than service lifts, shall be provided with an anti-creep device conforming to the following requirements:

1) It shall automatically limit the car movement within 75 mm or 3 in of the landing from any point within the interlocked zone irrespective of the hoistway door or doors.

The device will operate only in the landing level interlocked zone.

2) For electro-hydraulic lifts it shall be required to operate the car in the “up” direction only.

3) For maintained-pressure hydraulic lifts it shall be required to operate the car in both directions.

The operation may depend on the availability of the electrical power supply provided that:

1) the disconnect switch is kept in the closed position at all times except during maintenance, repairs and inspection, and

2) the electrical protective devices shall not cause the electrical power to be removed from the anti-creep mechanism except when such a device operates in consequence of driving motor failure.

5.15.4 Rams. Rams shall have smooth cylindrical external surfaces and, if hollow, should be of approximately uniform thickness.

Grey cast iron or other brittle material shall not be used for rams or connecting links. Grey cast iron, where used in other parts of the ram assembly, shall have a safety factor of not less than 10.

Direct acting rams shall be attached to the car platform with fastenings of sufficient strength to support the weight of the ram with a safety factor of not less than 4.

Rams shall not be subjected to bending stresses or eccentric loading. Eccentric loading shall be taken by the car frame and guiding shoes.

Rams shall be provided with solid metal stops at the limit of stroke, or with other means to prevent the ram from travelling beyond the limits of the cylinder. Stops shall be so designed and constructed as to stop the ram from maximum speed at maximum operating pressure in the out direction without damaging the hydraulic system. For rated speeds exceeding 0.50 m/s or 100 ft/min where a solid metal stop is provided, means other than normal stopping devices shall be provided to retard the car to 0.50 m/s or 100 ft/min before striking the stop with a retardation not in excess of 9.81 m/s^2 or 32.2 ft/sec^2. Rams shall be so constructed that a normal working stress of $^1/_5$ ultimate is not exceeded.

The maximum load of a ram should be based on the maximum pressure obtainable from the supply and calculated for the condition of a fully extended ram.

1) For rams with positively guided heads:

$$P_e = \frac{4EI}{L^2}$$

where: P_c = MAXIMUM LOAD,
E = modulus of elasticity,
I = moment of inertia of cylinder ram,
L = maximum exposed length of cylinder ram.

2) For rams without positively guided heads:

$$P_e = \frac{EI}{2L^2}$$

For non-guided rams, the length of the ram bearing in the cylinder shall be not less than two times the cylinder ram diameter.

3) For two-stage telescopic cylinders having rams with positively guided heads:

P_c is based on the lesser of $\frac{E_1 I_1}{{L_1}^2}$ and $\frac{E_2 I_2}{{L_2}^2}$

For telescopic cylinders, the length of the bearing at each of the intermediate sections shall be not less than twice the diameter of the mating cylinder ram.

Means shall be provided to limit positively the cylinder ram strokes in each section of a telescopic cylinder other than by limiting fluid transfer between sections.

NOTE The subscripts 1 and 2 used in the above formulae correspond to the first and second sections respectively of the telescopic assembly.

5.15.5 Check, relief and other auxiliary valves. A check valve shall be provided and shall be so installed that it will hold the lift car or platform with the contract load at any point when the pump stops or the mains pressure drops below the minimum operating pressure.

Check, relief and other auxiliary valves shall be designed to withstand a static pressure equal to twice the normal operating pressure without permanent deformation.

The relief valves shall be located between the pumps and the check valve and shall be of such a type and so installed in a by-pass connection that the valve cannot be shut off from the hydraulic pump. The return from the valve shall be passed directly to the tank and not to the suction side of the pump.

The relief valve shall be pre-set to open at a pressure not greater than 125 % of the working pressure of the pump.

The size of the relief valve and by-pass shall be sufficient to pass the maximum rated capacity of the pumps without raising the pressure more than 20 % above that at which the valve opens. Two or more relief valves may be used to obtain the required capacity.

Relief valves having exposed pressure adjustments shall have their means of adjustment sealed.

5.15.6 Controlling valves. The main controlling valves shall be so constructed that they will remain closed to the supply when pressure is shut off.

Valve spindles or plungers shall be positively restrained against their being forced from the valve casing.

Electrically controlled valves shall be so designed and installed that they fail to safety in the event of power-failure.

5.15.7 Cylinders, valves and pipes shall be so arranged that they can be completely vented with efficient air cocks.

Cylinders, pipes and valves using water based fluid and exposed to the action of frost shall be protected against freezing of their contents.

Effective measures shall be taken to prevent the syphoning of fluid from cylinders.

Means shall be provided to collect drainage from the cylinder gland.

It shall be ensured that when the car is resting on its fully compressed buffer there is sufficient clearance to prevent the bottom of the ram striking the bottom of the cylinder. Cylinders shall be installed in a waterproof surround and be so positioned that the sides and bottom shall at all points (other than necessary supports) be surrounded by an air space.

5.15.8 Pumps. Each pump or group of pumps shall be equipped with a relief valve complying with the requirements of **5.15.5**.

The following information shall be permanently displayed on each hydraulic pump and/or motor:

1) manufacturer's name, and

2) manufacturer's part, model and/or serial number.

If this information is not readily visible duplicate information shall be provided adjacent to the pump or motor where it can be easily read.

The original nameplate shall not be removed from the pump motor.

The direction of rotation of each pump shall be clearly indicated on the pump where it can be readily seen.

All pumps shall be clearly marked to indicate inlet and outlet, related to a specified direction of rotation.

5.15.9 Design pressure. All cylinders, rams, pipes, valves and fittings shall be designed to withstand a static pressure equal to twice the maximum operating pressure without permanent deformation.

5.15.10 Pipes and pipe supports. Piping shall be so supported that undue stresses are eliminated at joints, bends and fittings, particularly at any section of the system subject to vibration.

Cross-sectional areas of piping shall be sufficient to prevent cavitation and starvation and not to induce turbulence or temperature rise.

5.15.11 Oil storage tanks (atmospheric and discharge type). All tanks shall have sufficient capacity to provide for an adequate oil reserve to prevent the entrance of air or other gas into the system.

They shall be of rigid construction so as to prevent distortion due to the weight of oil and shall be so designed and constructed that when completely filled a factor of safety of at least 4, based on the ultimate strength of the material, is obtained.

All sides of the tank shall be fully visible for examination and protected by a substance unaffected by the working fluid.

Tanks and feed pipe connections shall be of fluid-tight construction.

Means for checking the fluid level shall be provided and the minimum permissible fluid level shall be clearly indicated. Such means shall be accessible without the removal of any cover or other parts of the equipment.

A removable cover to the tank, as well as a suitable vent to atmosphere, fitted with a breather, shall be provided.

The system shall incorporate a continuous full flow removable oil filter.

The tank shall be of adequate depth to permit settling of the fluid.

Means for draining the tank shall be provided.

5.16 Counterweights

The requirements of **2.16** or **3.5** apply.

5.17 Load plates

The requirements of **2.17** or **3.8** apply.

5.18 Control and controllers

Rope or rod operated devices actuated directly by hand, or rope operated devices actuated by wheels, levers or cranks shall not be used.

The requirements of **2.18**, except 7); **2.19** and **2.20** apply for passenger and goods lifts.

5.19 Main circuit breaker or main switch, and wiring

The electrical power supply to the installation shall not be disconnected except for purposes of maintenance, repair or inspection. The requirements of **2.22** also apply, excluding the second paragraph of **2.22.1**.

5.20 Terminal stopping switches

Those requirements of **2.21** which relate to terminal stopping switches apply to all hydraulic lift installations, apart from **2.21.3** which does not apply.

6 Specific requirements for hand-powered lifts

6.1 General

The requirements of this section relate only to lifts carrying goods and service lifts and are not considered adequate for hand-powered lifts intended for carrying persons.

6.2 Lift cars

The requirements of **3.1** apply.

6.3 Lift machines

The factor of safety shall be based on the static load to be used in the design of the machine and driving sheaves and shall not be less than 6 for wrought steel and 9 for cast iron and other materials.

The maximum allowable effort for one person shall be 147 N (15 kgf) or 30 lbf.

When the sheave is provided with a traction "V" groove the angle of the groove shall not be less than 35° and not more than 40°.

6.4 Guides

Car and counterweight guides shall be of steel or straight grained seasoned wood, free from knots, shakes or other imperfections. All joints in the guides shall be smooth, flush and parallel.

The guides shall be securely fastened and of such strength and fixing spacing that they will not suffer permanent deformation under normal working conditions.

Guides shall be of rigid construction and ropes shall not be used for guiding either cage, platforms or counterweight. Where safety-gears are provided, the guides shall withstand the application of the safety-gear and full contract load conditions without permanent deformation. The guides should extend the full length of the lift well and be so designed that the shoes cannot come out of the guides.

6.5 Buffers

The requirements of **3.4** apply.

6.6 Counterweights

The requirements of **3.5** apply.

6.7 Suspension

The top car or balance weight clearance shall be such that any part of the anchorage (including the splice) shall not be less than 50 mm or 2 in from the contact between the suspension rope and the sheave or drum.

The factor of safety of suspension ropes or chains shall not be less than 8, calculated by the method given in **2.14.2**. Connecting links shall have a strength at least equal to that of the chain to which they are attached.

The suspension shall have not less than two steel wire ropes or chains, except for a service lift where a single rope may be used. Drum ends of suspension ropes shall be secured by a clamp or splice, and where the anchorage is insufficient to withstand the working tension of the rope at least one complete turn of suspension rope round the winding drum shall be provided when the car or counterweight (when fitted) is resting on the buffer.

6.8 Hauling rope

The hauling rope shall be at least 40 mm or 1½ in in diameter and shall be situated outside the landing doors.

6.9 Brakes and sustaining devices

Driving machines shall be provided with a brake or sustaining device which will operate in either direction of motion of the car and be capable of stopping and holding the car under full load conditions. When the brake or sustaining device is applied it shall remain in the "ON" position until released by an operator.

6.10 Safety-gear

Each car having a travel of more than 4.50 m or 15 ft shall be provided with a safety-gear.

This requirement does not apply to service lifts, except where a service lift is working over an accessible space where the pit cannot support the impact load of the freely falling loaded car and counterweight. In such a case a safety-gear shall be provided for car and/or counterweight.

The safety-gear need not be operated by a speed governor and may be instantaneously operated as a result of the breaking or slackening of the rope or chain.

Where the travel exceeds 12 m or 40 ft, driving machines having hand operated brakes shall be equipped with an automatic speed brake.

6.11 Load plates

The requirements of **3.8** apply.

6.12 Landing doors

Where a lift serves below 0.85 m or 2 ft 9 in above the floor level and has an opening in excess of 1.20 m or 4 ft 0 in in height, a mechanical lock shall be provided. This shall engage the doors when they are closed and the lift moved from the landing level. The lock shall be released only by the car being within the landing zone.

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