

Australian Standard™

Lifts, escalators and moving walks

**Part 2: Passenger and goods lifts—
Electric**



S t a n d a r d s Australia



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This Standard was issued in draft form for comment as DR 01002.

Australian Standard™

Lifts, escalators and moving walks

Part 2: Passenger and goods lifts— Electric

Originated as part of AS CA3—1935.
Previous edition AS 1735.2—1997.
Sixth edition 2001.

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Published by Standards Australia International Ltd
GPO Box 5420, Sydney, NSW 2001, Australia

ISBN 0 7337 4239 4

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standard New Zealand Committee ME-004, Lift Installations, to supersede AS 1735.2—1997.

This Standard is the result of a consensus among Australian and New Zealand representatives on the Joint Committee to produce it as an Australian Standard.

The objective of this Standard is to provide requirements for electric lifts that carry passengers or goods, or both.

The objective of this revision is to rectify anomalies in the existing editions, and accommodate recent changes in engineering practices and advances in technology, and to harmonize the Standard with the relevant major overseas Standards (viz., EN81.1 and ANSI/ASME A17.1).

This Standard forms Part 2 of the AS 1735 series of Standards, as follows:

Lifts, escalators and moving walks

- Part 1: General requirements
- Part 3: Passenger and goods lifts—Electrohydraulic
- Part 4: Service lifts—Power-operated
- Part 5: Escalators and moving walks
- Part 7: Stairway lifts
- Part 8: Inclined lifts
- Part 9: Special purpose industrial lifts
- Part 10(Int) Tests
- Part 11: Fire-rated landing doors
- Part 12: Facilities for persons with disabilities
- Part 13: Lifts for persons with limited mobility—Manually powered
- Part 14: Low-rise platforms for passengers
- Part 15: Lifts for people with limited mobility—Restricted use—Non-automatically controlled
- Part 16: Lifts for persons with limited mobility—Restricted use—Automatically controlled
- Part 17: Lifts for persons with limited mobility—Restricted use—Water-drive

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is for information and guidance only.

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STANDARDS AUSTRALIA

Australian Standard
Lifts, escalators and moving walks

Part 2: Passenger and goods lifts—Electric

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out requirements for electric lifts for carrying passengers or goods, or both.

This Standard is complementary to AS 1735.1, but the requirements of this Standard take precedence over corresponding requirements of that Standard.

Requirements for periodic inspection and testing are given in Appendix E.

NOTES:

- 1 AS 1170.4 should be considered for seismic conditions.
- 2 Alternative requirements for electric lifts carrying passengers or goods or both are set out in AS 1735.1.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1023	Low voltage switchgear and control gear—Protection of electric motors
1023.1	Part 1: Built-in thermal detectors and associated control units
1023.3	Part 3: Inherent overheat protectors
1170	Minimum design loads on structures
1170.4	Part 4: Earthquake loads
1288	Glass in buildings—Selection and installation
1319	Safety signs for the occupational environment
1428	Design for access and mobility
1428.1	Part 1: General requirements for access—New building work
1429	Electric cables—Polymeric insulated
1429.1	Part 1: For working voltages 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV
1442	Carbon steels and carbon-manganese steels—Hot-rolled bars and semifinished products
1530	Methods for fire tests on building materials, components and structures
1530.1	Part 1: Combustibility test for materials
1654	ISO system for limits and fits
1654.1	Part 1: Bases of tolerances, deviations and fits
1654.2	Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts
1657	Fixed platforms, walkways, stairways and ladders—Design, construction and installation

AS

- 1735 Lifts, escalators and moving walks
- 1735.1 Part 1: General requirements
- 1735.10 Part 10(Int): Tests
- 1735.11 Part 11: Fire-rated landing doors
- 1735.12 Part 12: Facilities for persons with disabilities
- 1831 Iron castings—Spheroidal or nodular graphite cast iron
- 1979 Electric cables—Lifts—Flexible travelling
- 2074 Steel castings
- 2118 Automatic fire sprinkler systems
- 2118.1 Part 1: General requirements
- 2759 Steel wire rope—Application guide
- 2784 Endless wedge belt and V-belt drives
- 2938 Gears—Spur and helical—Guide to specification and rating
- 3133 Approval and test specification—Air break switches
- 3569 Steel wire ropes
- AS/NZS
- 1530 Methods for fire tests on building materials, components and structures
- 1530.3 Part 3: Simultaneous determination of ignitability, flame propagation, heat release and smoke release
- 1680 Interior lighting
- 1892 Portable ladders
- 1892.1 Part 1: Metal
- 2053 Conduits and fittings for electrical installations
- 2053.1 Part 1: General requirements
- 2053.2 Part 2: Rigid plain conduits and fittings of insulating material
- 2053.3 Part 3: Rigid plain conduits and fittings of fibre-reinforced concrete material
- 2053.4 Part 4: Flexible plain conduits and fittings of insulating material
- 2053.5 Part 5: Corrugated conduits and fittings of insulating material
- 2053.6 Part 6: Profile-wall, smooth-bore conduits and fittings of insulating material
- 2053.7 Part 7: Rigid metal conduits and fittings
- 2053.8 Part 8: Flexible conduits and fittings of metal or composite material
- 2208 Safety glazing materials in buildings (human impact considerations)
- 3000 Electrical installations—(known as the Australian/New Zealand Wiring Rules)
- 3013 Electrical installations—Classifications of the fire and mechanical performance of wiring systems
- 3187 Approval and test specifications—Mineral-insulated metal-sheathed cables
- 3678 Structural steel—Hot-rolled plates, floor-plates and slabs
- BS
- 46 Key and keyways and taper pins
- 46.1 Part 1: Keys and keyways
- 970 Specification for wrought steels for mechanical and allied engineering purposes
- ASTM
- D 97 Test methods for pour point of petroleum oils
- D 2270 Calculating viscosity index from kinematic viscosity at 40 and 100°C

1.3 DEFINITIONS

For the purpose of this Standard, the definitions in AS 1735.1 apply.

SECTION 2 COMBINED OPERATION

2.1 OPERATION UNDER BOTH ATTENDANT AND PASSENGER CONTROL

Where a lift is arranged for alternative control by either attendant or passenger, the requirements for both forms of control shall apply.

2.2 CARRYING BOTH PASSENGERS AND GOODS

Where a lift may carry both passengers and goods, the requirements for each type of loading shall apply (see Clauses 12.10, 23.13.1 and 24.4.1 for specific requirements for passenger lifts).

SECTION 3 DEFLECTIONS OF MACHINERY SHEAVE BEAMS AND THEIR SUPPORT

The deflections of machinery, sheave beams, and their immediate supports, under static load, shall be not more than $1/1666$ of the span.

SECTION 4 SUPPORTING AND OVERHEAD STRUCTURES

4.1 BEAMS AND FLOORS LOCATED DIRECTLY OVER LIFTWELL

Overhead beams, floors, and their supports shall be designed to support not less than the sum of the following loads:

- (a) The load resting on the beams and supports, which shall include the complete weight of the machine, motor generator, sheaves, controller, governor, and any other equipment together with any portion of the machine room floor supported thereon.
- (b) Twice the sum of the vertical component of static tension in all runs of wire rope passing from sheaves or drums (both sides to be counted), or connected to rope hitches supported by the beams, with the rated load in the car.

NOTE: The doubling of these tensions allows for impact forces, acceleration forces, and the like.

- (c) The load applied by the governor when it operates.

For design purposes, the stress in compression flanges of overhead steel beams for lifts shall be not more than P_c MPa, subject to a maximum of 165 MPa, where —

$$P_c = \frac{93000 \times b \times t}{l \times d}$$

where

- b = least breadth of the compression flange at which the stress is to be determined, in millimetres
- t = thickness of the compression flange at which the stress is to be determined, in millimetres
- l = maximum length of the laterally unsupported compression flange, in millimetres
- d = overall depth of section at which the stress is to be determined, in millimetres

4.2 FOUNDATIONS, BEAMS, AND FLOORS NOT LOCATED DIRECTLY OVER LIFTWELL

Where machines and sheaves are located below or at the sides of the liftwell, the foundation for the machine and sheave beams and their supports shall be designed to withstand the following relevant loads:

- (a) The foundation shall support the weight of the machine, sheaves, other equipment, and any floor.
- (b) The sheave beams and the foundation bolts shall withstand twice the sum of the vertical components of static tension in the runs of wire rope passing over the sheaves or drums on the foundation or beams, less the weight of the machine or sheaves.
- (c) The sheave beams and the foundation bolts shall withstand twice the sum of any horizontal components of static tension in the runs of wire rope passing over the sheaves or drums on the foundation or beams.
- (d) The foundation shall withstand twice the sum of any upward forces and any overturning moments developed by the static tension in the runs of wire rope passing over the sheaves or drums on the foundation or beams.

SECTION 5 MACHINERY LOCATIONS

5.1 LOCATION OF EQUIPMENT

5.1.1 General

The driving machine and control equipment, shall be housed in a machine room or in accordance with Clauses 5.1.2 or 5.1.3.

The necessary devices for emergency operation and dynamic tests (such as brake test, traction test, safety gear test, buffer tests, or test of ascending car overspeed protection) shall be arranged so they can be operated from outside the liftwell.

5.1.2 Machinery inside liftwell

Where the machinery and/or control equipment is located in the liftwell, the maintenance/inspection work on the machine and/or control equipment shall be carried out from on top of the car, and the following shall apply:

- (a) Any kind of uncontrolled or unexpected movement shall be prevented by a mechanical car locking device.
- (b) An electrical contact shall open the control circuit when the mechanical locking device is operated.
- (c) When the car is in the locked position it shall be possible to access and egress the top of car through the landing door with a minimum clear height of 1000 mm.
- (d) No equipment requiring maintenance/inspection shall be located more than 600 mm horizontally from the roof of the car.
- (e) The following sign shall be conspicuously displayed at the machine:

CAUTION—ENGAGE MECHANICAL LOCKING DEVICE PRIOR TO COMMENCING
WORK ON THE MACHINE.

Signage shall be in accordance with AS 1319.

The necessary devices for emergency operation and dynamic tests (such as brake test, traction test, safety gear test, buffer tests, or test of ascending car overspeed protection) shall be arranged so they can be operated from outside of the liftwell.

Where the machine/control equipment may be affected from the heat produced by the equipment, appropriate means shall be provided to limit this heat gain to a suitable level.

5.1.3 Machinery in enclosures alongside liftwell

Machinery and/or control equipment may be located in an enclosure alongside the liftwell. The enclosure shall be lockable. Machinery and/or control equipment shall comply with the following:

- (a) Be fully enclosed (other than the liftwell side, which shall be guarded) and when the door(s) are open, provide a clear working area in front of all equipment requiring maintenance/inspection.
- (b) When the doors are open, the clear working space shall be not less than 1980 mm high × 600 mm deep × the full width of the equipment.
- (c) When the doors are fixed in the open position, there shall be clear access to and from the working area of at least 600 mm wide × 1980 mm high.

NOTE: BCA access ways may require additional width in excess of 600 mm.

Warning signs shall be affixed to the inside of the door, which shall state the following:

DOORS TO BE KEPT CLOSED WHEN THIS EQUIPMENT IS UNATTENDED.

The necessary devices for emergency operation and dynamic tests (such as brake test, traction test, safety gear test, buffer tests, or test of ascending car overspeed protection) shall be arranged so they can be operated from outside the liftwell.

Where the machine/control equipment may be affected from the heat produced by the equipment, appropriate means shall be provided to limit this heat gain to a suitable level.

5.2 LIMITATIONS OF USE

Machine rooms shall not be used for purposes other than those connected with the lift and shall not be used as a means of gaining access to any other part of the building.

5.3 ENCLOSURE

Machine rooms shall be enclosed by walls or partitions of substantial and solid construction extending from the floor to the ceiling.

Any ventilation panels may be of wire mesh. Where below a height of 2000 mm, ventilation panels shall be protected by fixed louvres, designed to restrict the passage of a 13 mm diameter rod or protected by a firmly supported crimped wire mesh of 12 mm × 2 mm diameter or its equivalent.

Any fire-resisting enclosures shall be of non-brittle material and shall have a fire resistance rating complying with any relevant requirements of local laws and ordinances.

5.4 ENTRANCES

5.4.1 Doors and locking of machine rooms

Entrances to machine rooms shall have a clear opening, not less than 1980 mm high nor less than 600 mm wide, which shall be provided with a self-closing, self-locking door. The design and shape of the door and its frame shall not reduce this clear opening. Such doors shall be provided with a night type latch that can be opened from without only by the use of a key, and which does not require a key to open it from within the machine room.

A key for the machine room door shall be retained on site under security.

A duplicate key for the lift mechanic shall be provided and retained in a locked metal sealed receptacle immediately adjacent to the lift machine room entrance. Such receptacle shall be capable of being opened by a combination key of the respective lift contractors' series.

Where the receptacle is not located immediately adjacent to the lift machine room entrance, a sign stating its location shall be installed on the machine room door.

The following notice in prominent characters not less than 3 mm high shall be exhibited on every duplicate key receptacle for machine room access:

MACHINE ROOM EMERGENCY KEY

The door lock shall be protected to prevent manipulation from outside the machine room.

5.4.2 Restrictions to persons entering machine rooms

The entering of persons to lift machine rooms shall be restricted to lift mechanics and authorized persons.

The following notice in permanent characters shall be exhibited in a prominent position on every machine room door:

DANGER
ENTRY OF UNAUTHORIZED
PERSONS PROHIBITED

The word 'DANGER' shall be of letters not less than 25 mm high and the remainder of the notice shall be of letters not less than 10 mm high.

5.5 ACCESS

5.5.1 General

Unrestricted access shall be provided by the most direct route possible between the machine room and the nearest floor served by the lift. Stairways complying with AS 1657 shall be provided for access to every machine room.

Headroom clearances above stairs, landings, doorways and passageways shall be not less than 2000 mm. Where a beam or other fixed object is vertically above any part of a stair tread, the headroom clearance shall be measured vertically between the next tread above and the underside of such beam or other fixed object. Where such a fixed object is within 230 mm, measured horizontally, from the nosing of the lowest tread, the headroom clearance shall be measured vertically above that nosing.

5.5.2 Access across roofs

Where passage over a roof is necessary to reach the means of access to machine rooms or machinery spaces, the following requirements shall apply:

- (a) Where access is across sloping or brittle roofs, walkways complying with AS 1657 shall be provided.
- (b) Where the walkway is over any roof having an unprotected parapet, each side of the walkway shall be provided with a handrail complying with AS 1657.

5.5.3 Lighting of stairways, walkways and the like

Stairways, walkways, corridors, and any access to machine rooms shall have artificial illumination available at all times. The illumination shall be from 24-hour lighting or shall be controlled from each end by either a two-way switch or a reliable time-delay switch having an adequate time-delay.

Stairways shall be provided with illumination not less than 75 lx.

Walkways and corridors shall be provided with illumination not less than 40 lx.

5.6 HEADROOM

The height in machine rooms shall be sufficient to enable any portion of the machinery or apparatus to be raised clear for dismantling, and headroom above the machine room floor shall be not less than 2100 mm. This clearance shall extend over any area that is necessarily used for access to equipment, and shall be measured to any fixtures or projections that may be present, e.g. monorails, lighting fixtures, ducts or fire protection systems.

5.7 EQUIPMENT ACCESSIBILITY AND CLEARANCES

5.7.1 General

The size of machine rooms shall afford effective access and working space for the purpose of inspection and maintenance of any machine and equipment located therein, and for any dismantling necessary for repairs.

5.7.2 Clearance between machine and walls

Along not less than two sides of the machine, the clearance between any part of the machine and an adjacent wall shall be not less than 600 mm.

Where any part of a machine requires adjustment, maintenance, or inspection on either or both of the other two sides of the machine, a clear accessway not less than 380 mm wide shall be provided to and between any wall, column, or portion of the building structure and the item requiring adjustment. Such accessway may be attained by a decking provided at bedplate level.

NOTES:

- 1 *Accessways to equipment in machine room* A clear accessway not less than 450 mm wide should be provided from the machine room door entrance to the machine, controller, circuit-breaker, motor generator and floor controller or selector.

A clear accessway not less than 380 mm wide should be provided to any main current overtravel switch, governor, and junction box for travelling cables (see Clause 26.14).

- 2 *Clearance adjacent to equipment in machine room* Not less than the following clear spaces should be provided adjacent to the following equipment.

- (a) *Floor controller or selectors*—450 mm at the accessway thereto and 380 mm on two other sides. Where an accessway to other equipment passes beside the floor controller or selector, 450 mm at that side.
- (b) *Motor generators*—450 mm facing the commutator and 450 mm on one side, either of which may include the approach access (see also Note 3).
- (c) *Main current overtravel switch*—where the operating handle is not on top of the main current overtravel switch or does not face into the accessway, 180 mm on the handle side.

Where the only access to a governor or machine adjustment is past a current overtravel switch, 380 mm on that side of the switch.

- (d) *Junction box for travelling cable*—450 mm at the front of the junction box.

- (e) *Governors:*

- (i) *Pawl type*—380 mm at the accessway side and 180 mm at two other sides. On any face where switches or adjustments are located, 380 mm clearance is to be provided. Where the only access to a main current overtravel switch or machine adjustment is beside this type of governor, 380 mm at that side of the governor.
- (ii) *Flyball type*—450 mm facing the accessway, 380 mm on the rope grip jaws side, and 180 mm on one other side. Where the only access to a main current overtravel switch or machine adjustment is beside this type of governor, 450 mm clearance at that side of the governor.

- 3 *Access to brush gear*—Convenient access should be provided for the inspection and maintenance of brush gear. A clearance not less than 230 mm should be provided between any wall or fixed equipment and the nearest part of the brush gear of any lift machine, driving motor, or generator.

5.8 FLOORS

A metal, concrete, or timber floor shall be provided in the machine room. The floor—

- (a) shall be capable of sustaining a live load of 6 kPa over the whole area plus a concentrated load of 135 kg on any square of 50 mm side; and
- (b) shall be capable of sustaining any load that may be imposed on it during periods of normal operation and during dismantling or repair of the lift machine.

NOTE: In some States, timber flooring is prohibited in machine rooms.

5.9 EQUIPMENT REMOVAL

5.9.1 General

Hatches or doors shall be provided to enable the largest equipment components to be moved to a level served by a lift or accessible to other mechanical handling means.

Lifting points or beams shall be provided in the machine room to facilitate handling of the largest equipment components.

5.9.2 Equipment hatches

Hatches in floors shall comply with the following requirements:

- (a) Covers shall be hinged; however, where conditions render the use of hinged covers impracticable, removable panels may be used.
Loose or detachable covers of single panel or multiple panel construction, which could be dropped diagonally through the hatch opening, may be used provided that hinged metal safety guards designed to sustain a falling cover are installed immediately under such loose sections.
- (b) Lifting points on the covers shall be provided to assist with their opening.
- (c) Hatches in floors or roofs shall be flush to eliminate tripping hazards and be capable of sustaining a load of 6 kPa.
- (d) Suitable guarding shall be provided when a hatch is open.
- (e) Hatch covers, other than those of concrete, shall be secured in the closed position when not in use.

5.10 PROTECTION OF FLOOR OPENINGS

Openings, for ropes through machine room floors, secondary floors, and platforms, shall be as small as practicable and fitted with coamings of height not less than 50 mm.

5.11 DIFFERENCE IN FLOOR LEVELS

Where practicable, differences in level of machine room and machinery-space floors shall be avoided. Where there is an unavoidable difference in level, the following shall apply:

- (a) For differences in level not less than 300 mm nor more than 600 mm, a step shall be provided.
- (b) For differences in level not less than 600 mm nor more than 1500 mm, a guardrailing and a ladder or steps complying with AS 1657 shall be provided.
- (c) For differences in level not less than 1500 mm, a guardrailing and a stairway complying with AS 1657 shall be provided.

5.12 STOP SWITCH

A stop switch complying with Clause 29.14 shall be conveniently located adjacent to or on any equipment or machinery with moving parts that may cause injury to a person, such as a lift machine, motor generator, or floor selector, where such equipment is—

- (a) in a secondary floor space; or
- (b) within any space where the floor is more than 600 mm above or more than 600 mm below the floor on which a person would stand to operate the circuit-breaker.

The stop switch shall be clearly marked and connected in the control circuit of the equipment or machinery for which it is required.

Where both a control-circuit stop switch for a motor generator set is required by this Clause and the motor generator set is out of sight from the circuit-breaker, the following notice shall be mounted adjacent to the switch (see also Clause 26.2):

THIS SWITCH DOES NOT ISOLATE THE ELECTRIC SUPPLY.
SECURE CIRCUIT-BREAKER OPEN BEFORE WORKING ON THE EQUIPMENT.

5.13 LIGHTING

Not less than two luminaires shall be provided in each machine room and in each machinery space to effectively illuminate the equipment, including the front and the rear of any control panel. At floor level and at a distance of 600 mm from any major obstruction such as machines or control panels, the average maintained illumination shall be not less than 200 lx. The luminaires shall be permanently located and protected so as to prevent breakage by persons maintaining, inspecting, or installing equipment.

Where the lighting is electrically connected to the lift mains on the line side of the circuit-breaker of the lift, it shall be deemed to be part of the lift installation.

Switches for the luminaires shall be installed in the machine room or machinery space at an accessible position, convenient and adjacent to the entrance.

5.14 PROTECTION AGAINST WEATHER

Machine rooms shall be located and constructed so as to afford permanent protection against the weather.

Any louvre type openings shall prevent the ingress of driving rain.

5.15 VENTILATION

Machine rooms shall have permanent means of ventilation, sufficient to ensure that an adequate volume of fresh air is passed through the machine room in an effectively distributed manner, to ensure an acceptable working environment and to remove heat produced by the equipment to ensure a safe and reliable operation of the lift.

NOTE: Consideration of the requirements for ventilation in NOHSC 1003 is recommended.

Any doors, windows and the like, which can be closed, and any holes communicating between the machine room and the liftwell shall not be counted as ventilating means.

The ventilation shall be designed to limit the temperature in the machine room to a maximum of 34°C. If the machine room temperature exceeds 43°C, one of the following shall occur:

- (a) The sounding of an audible alarm at the main floor landing or adjacent to the building entrance. The audible alarm shall continue to sound until manually reset at a point in the machine room.
- (b) The generation of an alarm at a permanently attended location that has a system to identify the location of the machine room. The alarm shall continue until manually reset at a point in the machine room.
- (c) The lift shall stop at a landing to allow passengers to leave the car and shall not return to normal operation until the machine room temperature has decreased below 43°C.

Any mechanical ventilation shall be deemed to be part of the lift installation and electrically connected to the lift mains on the line side of the lift circuit-breaker. An overriding manually operated switch shall be connected across the thermostat, so that the mechanical ventilation may be operated by a lift mechanic.

5.16 SOCKET OUTLET

At least one socket outlet shall be conveniently located in every machine room or machinery enclosure and be protected by a 30 mA residual current device (RCD).

Where the socket outlet is electrically connected to the lift mains on the line side of the circuit-breaker of the lift, it shall be deemed to be part of the lift installation.

SECTION 6 ACCESS TO OVERHEAD EQUIPMENT

6.1 SHEAVES, DEAD-ENDS, AND OTHER EQUIPMENT ABOVE LIFTWELLS

6.1.1 Lift machine above liftwell

Where a lift machine is above a liftwell, the following requirements shall apply:

- (a) Safe and convenient access to the lubricating point of sheaves shall be available from the machine room, secondary floor, or platform, unless the lubrication point is within safe reach from and not more than 2000 mm vertically above the roof of the car or the car crosshead, as appropriate, when the platform is level with the top landing.
- (b) Safe and convenient access to the adjusting nuts of dead-end anchorages of multiple-roped lifts shall be available from the machine room, secondary floor, or platform, unless the adjusting nuts are within safe and convenient reach from and not more than 2000 mm vertically above the roof of the car or the car crosshead, as appropriate, when the counterweight is fully supported by its buffer.

NOTE: A spring buffer is not necessarily fully compressed when fully supporting the stationary counterweight.

- (c) Bond-blocks, inserts, or permanent brackets shall be provided in the liftwell for the support of any temporary staging required to afford safe access for the repair and for the replacement of sheaves, where the sheave is not within the machine room, secondary floor, or platform space, except where an overhead sheave can be safely dismantled in the machine room either for repair in the machine room or for lowering down the liftwell.
- (d) Bond-blocks, inserts or permanent brackets shall be provided in the liftwell for the support of any temporary staging required to afford safe access to dead-end anchorages for the replacement of ropes of multiple-roped lifts, except where these are wholly accessible from the machine room.

6.1.2 Lift machine not above liftwell

Diverter pulleys and dead-end rope anchorages may be installed in the headroom of the liftwell provided that they are located outside the projection of the car roof and that examinations and tests and maintenance operations can be carried out in complete safety from the car roof or from outside the liftwell.

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

6.1.3 Devices above liftwell but not in machine room

Access that is easy to use in complete safety, in all circumstances, shall be provided for governors, floor controllers, selectors and similar devices located above the liftwell but not in a machine room.

6.1.4 Governors located in liftwell

6.1.4.1 With access door

Where a speed governor is mounted in the liftwell, and where it is not accessible from a gallery, machine room or a platform, an access door to the governor shall be provided and the following conditions shall apply:

- (a) The horizontal distance between the outside of the liftwell wall and the furthest governor rope shall be not more than 800 mm.

- (b) The centre of the governor sheave shall be not more than 1500 mm above the nearest standing area.
- (c) The base of the governor shall be not less than 600 mm nor more than 1200 mm above the nearest standing area, measured at the vertical centre-line of the access door.
- (d) The bottom of the access door shall be not higher than the base of the governor.
- (e) Where it is necessary to reach across the governor to reset the jaws or the switch, the top of the access door shall be not less than 200 mm above the top of the governor.
- (f) The dimensions of the clear opening of the access door shall be not less than 600 mm by 600 mm nor more than 750 mm wide by 1000 mm high.
- (g) The access door shall be provided with a secure cylinder-type self-locking lock.
- (h) An electrical contact shall be provided in the control circuit, which—
 - (i) shall not close unless the access door is closed and locked by the lock required by (g) above; and
 - (ii) shall be positively opened whenever the access door is opened.
- (i) Where any horizontal sliding landing door moves across the access door, a mechanical interlock shall be provided to prevent the horizontal sliding landing door being opened while the access door is open.
- (j) The access door, including its frame and mounting, shall have a fire resistance rating not less than that required by local laws and regulations for liftwells.
- (k) The access door shall be provided with a notice in accordance with Clause 5.4.2.

6.1.4.2 Without access door

Governors of the jawless type may be located in the liftwell without an access door if the following three conditions are fulfilled:

- (a) The tripping of the overspeed governor for testing purposes is effected by means located in the controller.
- (b) The overspeed governor is accessible for inspection and maintenance from the roof of the car.
- (c) The overspeed governor returns after tripping automatically into the normal position, as the car, counterweight or balancing weight is moved in the upward direction. The electrical parts shall be returned to the normal position by manual means located in the controller, which shall not influence the normal function of the overspeed governor.

6.2 EXTENT OF PLATFORM OR FLOORING

6.2.1 Liftwell area 9 m² or less

Where the cross-sectional area of the liftwell is not more than 9 m², the platform or flooring shall fill the entire liftwell.

6.2.2 Liftwell area exceeding 9 m²

Where the cross-sectional area of the liftwell is more than 9 m² or the platform is external to the liftwell, the platform flooring shall extend not less than 600 mm beyond the general contour of the sheaves or equipment and to the entrance to the liftwell at or above the level of the flooring. It shall be guarded on all sides by handrails, midrails, and 150 mm high toeboards, or shall have other equivalent protection (see Clause 5.10).

6.3 MEANS OF ACCESS

Suitable means of access shall be provided to platforms and floorings, complying wherever possible with the relevant requirements of Section 5.

Where access is provided from within a machine room to a secondary floor, a fixed rung type ladder complying with AS 1657 may be used, provided that the following conditions apply:

- (a) Structural difficulties prevent the use of a stairway.
- (b) The vertical height between the floors is not more than 2800 mm.
- (c) The ladder is inclined at an angle to the horizontal not less than 65 degrees nor more than 75°.
- (d) Any obstructions adjacent to the front face of the ladder are not less than—
 - (i) 960 mm, where the ladder is inclined 65° to the horizontal;
 - (ii) 760 mm, where the ladder is inclined 75° to the horizontal; or
 - (iii) 65° and 75°, proportional to Items (i) and (ii) above, where the ladder is inclined at an angle to the horizontal between.
- (e) A clear space not less than 600 mm exists between the foot of the ladder and any equipment.
- (f) Where equipment is installed in close proximity to the foot of the ladder, the emergency stop switch for such equipment is located adjacent to the foot of the ladder.
- (g) Every stop switch is located in a readily accessible position.

Where major equipment, such as motor-generator sets and floor selectors, is installed in this secondary floor space, a machinery hatch complying with Clause 5.9 shall be provided in the machine room floor or the secondary floor, together with suitable lifting means to facilitate the removal of the equipment during maintenance, replacement, or repair.

6.4 LIGHTING

Each lift shall be provided at least with one luminaire at each platform and each secondary floor. Luminaires shall have integral protection equivalent to that of the bulkhead type and shall be rated not less than 75 W if incandescent or 20 W if fluorescent. The switch for such luminaires shall be at the point of entry to the platform or secondary floor.

6.5 PLATFORMS AND SECONDARY FLOORS

Platforms and secondary floors shall be capable of sustaining a live load of not less than 6 kPa over the whole area and also any load that may be imposed by the equipment carried thereon, or by reaction from such equipment during the purpose of normal operation and dismantling or repair.

Any grid-type construction material shall comply with the requirements of AS 1657 and, where it will not reject a 6 mm diameter ball, an additional mesh that will reject a 6 mm diameter ball shall be superimposed on and substantially attached to the underside of the grid.

6.6 CEILING HEIGHT OF PLATFORMS, SECONDARY FLOORS, AND SHEAVE ROOMS

Platforms, secondary floors, and sheave rooms containing sheaves or auxiliary equipment shall have ceiling heights determined as follows:

- (a) With major equipment where equipment such as speed governors, motor generators, selector or floor controllers are installed, not less than 2000 mm, and the underside of any projecting beams, not less than 1500 mm.
- (b) Without speed governor, not less than 1700 mm, and to the underside of any projecting beams, not less than 1400 mm.

Where major equipment such as a motor generator, selector, or floor controller is located in a secondary floor space, where necessary a ceiling height not less than 2000 mm shall be provided for adequate servicing of such equipment.

Where access of 2000 mm high $\times$ 600 mm wide is available on at least one side of the sheave room space, and the governor is not more than 600 mm from such access way, the clearance may be reduced to a minimum of 1700 mm.

6.7 STOP SWITCH

A stop switch complying with Clause 29.14 shall be provided in a convenient position, adjacent to sheaves that are located in a sheave room or are accessible from a platform.

SECTION 7 MACHINES

7.1 TYPES

Driving machines shall be of the traction type. However, drum machines may be used subject to the following conditions:

- (a) They shall not be provided with counterweights.
- (b) The rated speed of the lift shall be not more than 0.65 m/s.
- (c) The lift travel shall be not more than 30 m.

7.2 ASSUMED LOADINGS

Lift machine members in bending, shear, tension, or compression shall be capable of sustaining twice the actual computed static load with rated load in the lift car.

Members subject to torsion shall be capable of sustaining twice the actual static out-of-balance load with rated load in the lift car.

7.3 FACTORS OF SAFETY

The factors of safety for the design of driving machines, based on the loadings specified in Clause 7.2, shall be not less than —

- (a) for steel, based on yield strength with an elongation not less than 14% in a gauge length of 50 mm..... 2;
- (b) for steel, based on yield strength with an elongation less than 14% in a gauge length of 50 mm 2.5;
- (c) for ductile metals other than steel (i.e. those with an elongation not less than 14% in a gauge length of 50 mm), based on yield strength..... 2.5;
- (d) for grey cast iron in compression, based on tensile strength..... 5;
- (e) for grey cast iron in tension or bending, based on tensile strength..... 6.

Materials of gear teeth shall comply with the strength requirements specified in Clause 7.8.2.

NOTE: The above factors of safety provide for the abnormal and infrequent stresses resulting from safety gear and buffer engagement, which are included in the loadings specified in Clause 7.2. Components designed with these factors of safety are normally considered to have adequate reserve strength to prevent failure due to fatigue.

7.4 TRACTION SHEAVES AND DRUMS

7.4.1 Materials

Sheaves and drums shall be of steel or cast iron.

The grooves of sheaves may be lined with other materials. However, in the event of lining failure, the rope traction shall comply with Clause 7.14.

7.4.2 Grooving

Sheaves and drums shall have machined rope grooves and shall be provided with suitable flanges in compliance with Clause 19.1.

7.4.3 Diameter

The diameters of sheaves and drums shall comply with the requirements of Clause 19.2.

7.4.4 Overhung sheaves

Where sheaves are overhung, there shall be—

- (a) effective means to retain the sheave on the shaft, independent of a reliance on the fit on the shaft;
- (b) effective means to prevent the sheave or any rope from carrying away, in the event of breakage of the shaft or of any rope leaving the sheave; and
- (c) effective means to prevent the sheave moving more than two rope diameters in the direction of the load, in the event of failure of the shaft.

7.4.5 Guarding

Any nip and/or shear points formed by ropes and/or sheaves shall be guarded.

7.5 BOLTS TRANSMITTING TORQUE

Bolts or other means, used to transmit torque between the driving sheave and the gearing and their support, shall be tightly fitted without play. Set screws or threaded portions of bolts or screws shall not be used to transmit torque.

7.6 THREADS FOR STUDS OR SCREWS IN TENSION

Where internally threaded components other than nuts, support studs or screws loaded in tension, the length of thread in engagement shall be not less than the following:

- (a) In steel, the diameter of the screw or stud.
- (b) In cast iron, 1.5 times the diameter of the screw or stud.
- (c) In other materials permitted by this Standard, such length of thread in engagement as will ensure the failure of the screw or stud before failure of the threaded part of the internally threaded component.

7.7 SHAFTS

7.7.1 Strength

The torsional, bending, or shear stress in any shaft, each taken separately and not in combination, shall afford a factor of safety not less than the relevant value specified in Clause 7.3.

7.7.2 Fillets

Where shafts are stepped, that is, where there is a change in diameter, fillets shall be provided to minimize fatigue effects from any excessive concentration of stress in the shaft.

Where a shaft is stepped to afford an abutting face for a ball or roller bearing, the fillet provided shall be the largest practicable that is able to accommodate the radius of the inner bearing race.

Fillets shall be smooth and free from machining marks.

Where it is established that a sufficient reduction of stress concentration cannot be achieved by means of fillets alone, an increased factor of safety for the small diameter portion of the shaft or another means shall be considered.

NOTE: In the application of this Clause, due regard should be given to practical experience, particularly for those shafts having torsional stresses in combination with alternating bending stress.

7.7.3 Keys and keyways

Keys and keyways shall conform to the dimensions and fits laid down for parallel keys in BS 46.1. However, where the dimensions specified in BS 46.1 are not applicable to any particular design, keys and keyways may be made to other dimensions, provided that such keys are not mechanically inferior to those that would be used under BS 46.1 for the transmitted forces.

Keys shall be fitted so that they cannot work loose in service. The lengths of the key and the boss of any member transmitting torque shall be adequate for the stresses involved.

Taper keys and taper pins for transmitting torque shall not be used in a lift machine.

Keyways shall be arranged to stop short of any change in diameter of shaft so as to avoid any further concentration of stress.

7.7.4 Fit

The fit of shaft in a member rotating with it shall be an interference fit in accordance with AS 1654.1 and AS 1654.2.

7.8 GEARS

7.8.1 Material

Worms and worm gears of cast iron shall not be used in lift machines.

7.8.2 Design

Gears in lift machines shall be designed in strength for not less than twice the actual static out-of-balance load on the machine in accordance with AS 2938.

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

7.8.3 Gear-case oil level

Means shall be provided to allow the oil level in gear cases to be readily ascertained.

7.9 BEARINGS

Bearings shall be of the ball, roller, sleeve, or other replaceable type. Ball bearings and roller bearings shall be in dustproof housings and provision shall be made for effective lubrication.

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

7.10 BRAKES

Every lift machine shall be provided with a braking system complying with the following:

- (a) The brake shall be mechanically applied and electrically held off.
- (b) During normal operation, the brake shall not be released unless power is applied to the lift motor.
- (c) (i) The brake shall remain effective in the event of any—
 - (A) single fault (including any electrical, mechanical or other type of fault);
 - (B) residual magnetism; or
 - (C) interruption of power supply to the lift motor.

- (ii) While the car is supporting its rated load and travelling downwards at rated speed, and while the car is empty and travelling upwards at rated speed, the lift shall be capable of being slowed down and stopped by the emergency application of the brake.
- (iii) Where a lift has a rated speed of 1.0 m/s or less, it shall be capable of either stopping or slowing down to a speed of not more than 20% of rated speed, in the event of any single failure of the braking system.
- (d) Toggles shall not be used for the normal operation of the brake.
- (e) Where springs are used to apply brake shoes, the springs shall be in compression and adequately guided and supported. In the event of failure of any one spring, the braking effect shall not be reduced by more than 55%.
- (f) Frictional devices shall not be interposed between the brake drum and the traction sheave or winding drum.
- (g) Brake linings shall be—
 - (i) of material not deemed combustible when tested in accordance with AS 1530.1; and
 - (ii) secured to the brake shoe so that normal wear will not weaken their fixings.
- (h) Where dynamic braking is provided, the mechanical brake shall be capable of stopping and holding the lift car with 125% of its rated load, from a test speed between 5% and 10% of rated speed.
 Where dynamic braking is not provided, each brake shoe or each independent brake shall be capable of stopping and holding 105% of rated load from a test speed of full rated speed.
 The braking system provided shall be such that a single fault or failure in the braking system will not prevent the application of braking force when required. To achieve this, one of the following shall apply:
 - (i) Two independent brake systems shall be installed on each lift.
 - (ii) One brake system comprising two independent braking devices within the one system that do not rely on or prevent each other from applying braking force when required.
- (i) After the brake has been adjusted in accordance Item (h) above, means shall be provided to indicate the minimum brake spring setting in the machine room or on the brake.
- (j) The braking system shall have not less than two independent brake shoes or two independent disc callipers, or one brake shoe plus one disc calliper.

7.11 FLAT-BELT AND CHAIN DRIVES

Flat-belt-driven or chain-driven machines shall not be used.

7.12 V-BELT DRIVES

7.12.1 Speed

Where V-belt-driven geared machines are used, the rated speed of the car shall be not more than 1.75 m/s.

7.12.2 Electrical protection

A switch shall be fitted to the speed governor of lifts having a V-belt-driven machine, except where the travel is not more than 5.5 m and the machine has a single start worm. The switch shall stop the lift in the event of the car speed exceeding 120% of the rated speed in either direction of travel.

7.12.3 Number of belts

Every V-belt drive shall have not less than three V-belts.

7.12.4 V-belts and pulleys

V-belts and pulleys shall comply with AS 2784, and the power correction factor shall be not more than 0.5.

7.12.5 Guards

V-belts and pulleys shall be effectively guarded against accidental contact. Such guards shall be easily removed for inspection of the belts and pulleys.

7.12.6 Type of belts

The symbol indicating the cross-section and the nominal inside length of the belts shall be permanently indicated in a conspicuous position adjacent to the drive.

7.13 MAXIMUM SPEED

The maximum speed of a lift machine shall be not more than 110% of its rated speed under normal working conditions.

7.14 ROPE TRACTION

The following conditions shall apply with respect to rope traction:

- (a) The driving sheave grooves of traction-driven machines shall provide adequate traction to the hoisting ropes. Such traction shall—
 - (i) allow a normal stop of the car, loaded with 125% rated load, from full speed at the lowest landing with negligible rope slip; and
 - (ii) allow a normal stop of the empty car running up at full speed at the top landing without rope slip.
- (b) The tractive effect between the driving sheave and the suspension ropes shall not be sufficient to enable the empty car or the counterweight to be lifted after the opposite member has landed and compressed its buffer.

Where lockdown compensation is not used, the necessary loss of traction under the above conditions may be demonstrated by driving the machine at slow speed to produce rope slip after the car and counterweight have been landed on their respective buffers.

Where lockdown compensation is used, no test is necessary.

7.15 EMERGENCY HAND WINDING

Machine rooms shall be provided with a suitable emergency brake release device for each type of machine in the room. The device shall ensure the immediate reapplication of the brake as soon as hand pressure is released. Where driving machines are provided with emergency hand-winding facilities and with brake release means, the hand-winding means shall be either of the smooth disc type or interlocked so as to interrupt the control circuit in one of the following ways:

- (a) By mounting the device on the machine.
- (b) By removing some part of the machine, to allow the device to be mounted.

7.16 ROPE BRAKES

Where rope brakes are installed for operation on traction lift ropes, they shall comply with Appendix G.

SECTION 8 TOP AND BOTTOM CLEARANCES FOR CAR AND COUNTERWEIGHTS

8.1 BELOW THE CAR

When the car rests on its stops or fully compressed buffers, the vertical clearances below the car (see Figures 8.1(A) and 8.1(B)) shall be as follows:

- (a) *Mechanical clearance* The mechanical clearance between any fitting attached to the car and the floor of the pit shall be not less than 50 mm.
- (b) *Person clearance* Between the pit floor and the buffer striker plate, the underside of the auxiliary safety plank of Type D safety gear (see Clause 33.2.5), the guards of underslung car sheaves, or the lowest mechanical part, equipment, or device installed beneath the car platform, the person clearance shall be not less than 600 mm. This clearance shall be maintained over the whole car area, except for—
 - (i) guide shoes or rollers and safety gear components;
 - (ii) platform guards or other equipment located within 300 mm, measured horizontally, from the sill line of any lowest floor entrance;
 - (iii) cams, side braces, their end attachments, or other items located within 150 mm horizontally from the perimeter of the car platform; and
 - (iv) at compensation or tape sheaves, buffer supports and their steady brackets.

A minimum crouching or standing space for person clearance shall be provided adjacent to and on one side of the underbeam of the car. Such space shall be not less than 1370 mm long $\times$ 450 mm wide $\times$ 600 mm high; however, where a length of 1370 mm is not available, the space shall be not less than 600 mm long $\times$ 500 mm wide $\times$ 1290 mm high. Where the attachment of travelling cables unavoidably occurs in this person clearance space, the height shall be measured from the lowest part of the cable support.

The standing/crouching area shall be clearly and permanently designated with an outline on the pit floor with 50 mm wide yellow lines, and the words, 'PERSON CLEARANCE' shall be marked inside the outline.

8.2 CAR BUFFER

When the car floor is level with the bottom landing, the car buffer clearance for all types of buffers shall be a minimum of 150 mm and a maximum of 600 mm.

8.3 CAR AT TOP LANDING

8.3.1 Top-of-car mechanical clearance

Where not more than 300 mm horizontally inside the perimeter of the car roof, the vertical top-of-car mechanical clearances between overhead obstructions and any equipment mounted on the top of the car, other than guide shoes or rollers, when the car platform is level with the top landing, shall be not less than C (see Figure 8.3.1), where—

- $C = D + 600$ mm, for drum machines
- $= m + d + Y + 300$ mm, for traction machines and for sheaves mounted on top of the lift car
- $D =$ the overtravel to the fixed stop (not less than 250 mm nor more than 460 mm, see Clause 9.2)
- $m =$ the maximum counterweight buffer clearance specified by Clause 8.4

d = the stroke of the counterweight buffer that is provided

Y = an allowance for car jump (see Note)

= $(S - S_2)$ where $S > S_2$

= 0 where $S \geq S_2$

S = buffer stroke in accordance with Table 9.5.2 for spring buffers or Table 9.6.2 for oil buffers

S_2 = half the stroke of the counterweight buffer that is provided

NOTE: Y may be omitted where oil buffers are used and provision is made to prevent jump of the car at counterweight buffer engagement, e.g. by locking down the compensator sheave.

8.3.2 Top-of-car person clearance

Except for guide shoes, rollers, and overhead diverter sheaves under conditions prescribed by Clause 8.3.3, the vertical top-of-car person clearances to any overhead obstructions situated within 300 mm inside the perimeter of the lift car, when the car platform is level with the top landing, shall be not less than A and B below (see Figure 8.3.1):

A measured to the crosshead, where—

$A = D + 900$ mm, for drum machines; and

= $m + d + Y + 600$ mm, for traction machines.

B measured to any area on the car roof where a person can stand, where—

$B = D + 1000$ mm, for drum machines; and

= $m + d + Y + 1000$, for traction machines.

where

D = the overtravel to the fixed stop (not less than 250 mm nor more than 460 mm, see Clause 9.2)

m = the maximum allowable counterweight buffer clearance specified by Clause 8.4

d = the stroke for the counterweight buffer that is provided

Y = an allowance for car jump (see Note)

= $(S - S_2)$ where $S > S_2$

= 0 where $S \leq S_2$

where

S = buffer stroke in accordance with Table 9.5.2 for spring buffers or Table 9.6.2 for oil buffers

S_2 = half the stroke of the counterweight buffer that is provided

NOTE: Y may be omitted where oil buffers are used and provision is made to prevent jump of the car at counterweight buffer engagement, e.g. by locking down the compensator sheave.

Where there is a projection below the ceiling of the well, e.g. a beam or a sheave not covered by Clause 8.3.3, and the projection is more than 500 mm horizontally from the nearest part of the crosshead, a clearance having a value not less than A as shown in Figure 8.3.2(A) or (B) between that projection and the roof of the car (A_2) shall be maintained as well as the clearance specified above.

8.3.3 Top-of-car clearance for overhead diverter sheaves

Where within 500 mm horizontally of the nearest part of the crosshead the nearest overhead obstruction is the rim of an overhead diverter sheave, the vertical top-of-car person

clearance between the lower edge of the sheave rim and the crosshead shall be not less than A (see Clause 8.3.2); however, where all the following conditions are fulfilled (see Figure 8.3.3), this clearance shall be not less than $(A - 2x)$, where x is the distance measured horizontally between the sheave rim and the nearest part of the crosshead:

- (a) The angle between the sheave shaft and the crosshead is not more than 10° .
- (b) The shaft or bearings do not protrude more than 175 mm from the side of the diverter sheave.
- (c) The vertical clearance between the lower edge of the sheave rim and the car top is not less than A when the car platform is level with the top landing.

8.4 COUNTERWEIGHT BUFFER CLEARANCE

The minimum designed counterweight buffer clearance shall be not less than 150 mm.

A sign shall be located in the pit in the vicinity of the counterweight, stating the maximum designed counterweight buffer clearances in lettering not less than 20 mm high.

8.5 ABOVE THE COUNTERWEIGHT

When the car floor is level with the bottom terminal landing, the clearance between the highest portion of the counterweight, e.g. the frame, guide shoes, or counterweight sheave, and the nearest obstruction directly above it, when the car is level with the bottom terminal landing, shall be not less than f (see Figure 8.5), where—

$$f = h + i + j + Y_1$$

h = car buffer clearance (see Clause 8.2)

i = stroke of car buffer that is provided

j = 150 mm for traction machine

Y_1 = an allowance for counterweight jump (see Note)

$$= S - S_1$$

where

S = buffer stroke in accordance with Table 9.5.2 for spring buffers or Table 9.6.2 for oil buffers

S_1 = half the stroke of the car buffer that is provided

NOTE: Y_1 may be omitted where oil buffers are used and provision is made to prevent jump of the car at counterweight buffer engagement, e.g. by locking down the compensator sheave.

8.6 BELOW THE COUNTERWEIGHT

When the counterweight rests on its stops or fully compressed buffer, the vertical clearances between any fitting attached to the counterweight and the floor of the pit shall be not less than 50 mm.

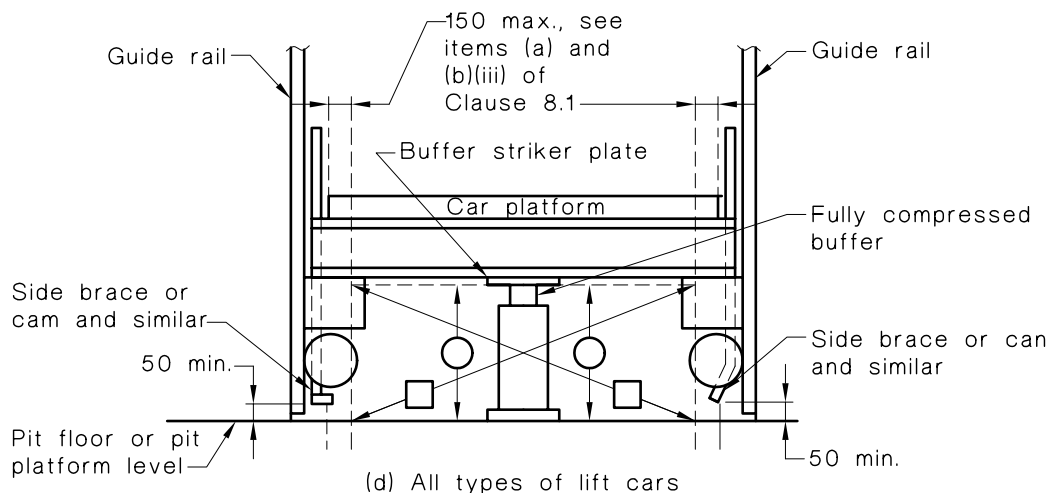
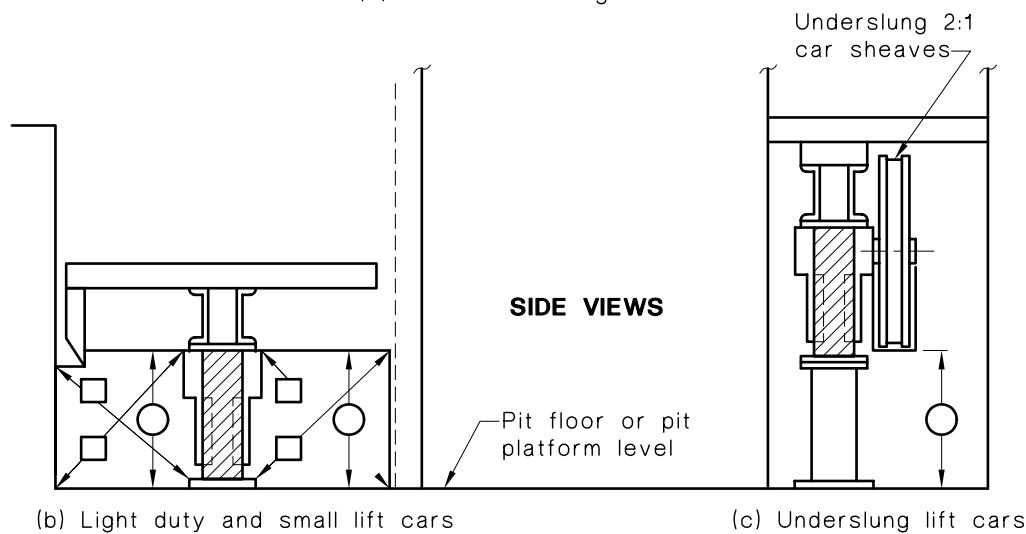
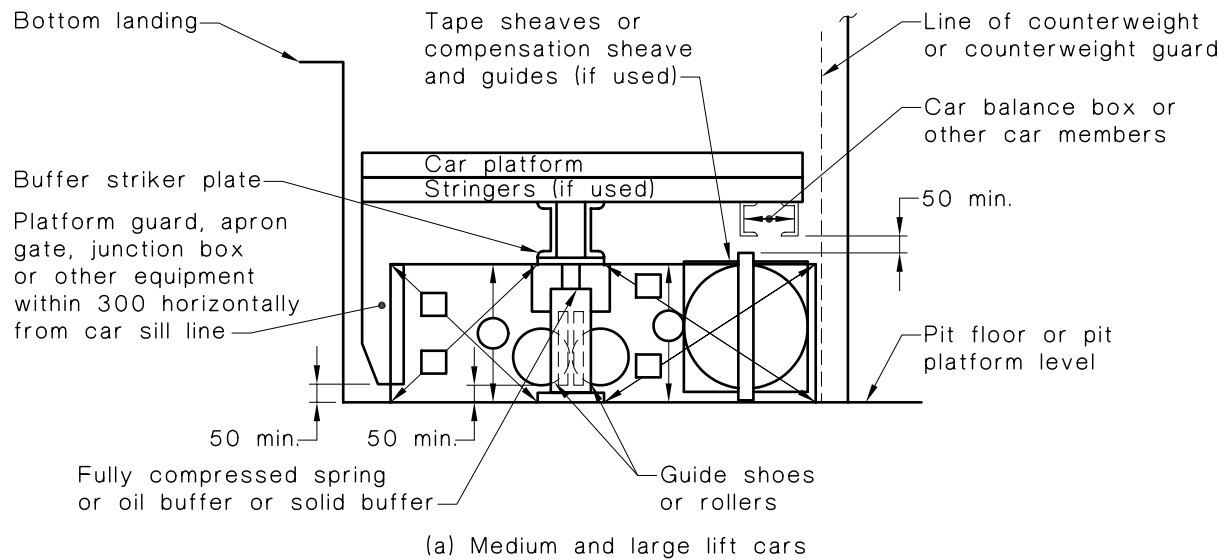
8.7 FLYING COUNTERWEIGHT

8.7.1 Flying counterweight buffer clearance

The flying counterweight buffer clearance shall be as specified for counterweights in Clause 8.4.

8.7.2 Clearance at top of flying counterweight

The clearance at the top of the flying counterweight shall be as specified in Clause 8.5, when the car floor is level with the bottom terminal landing.



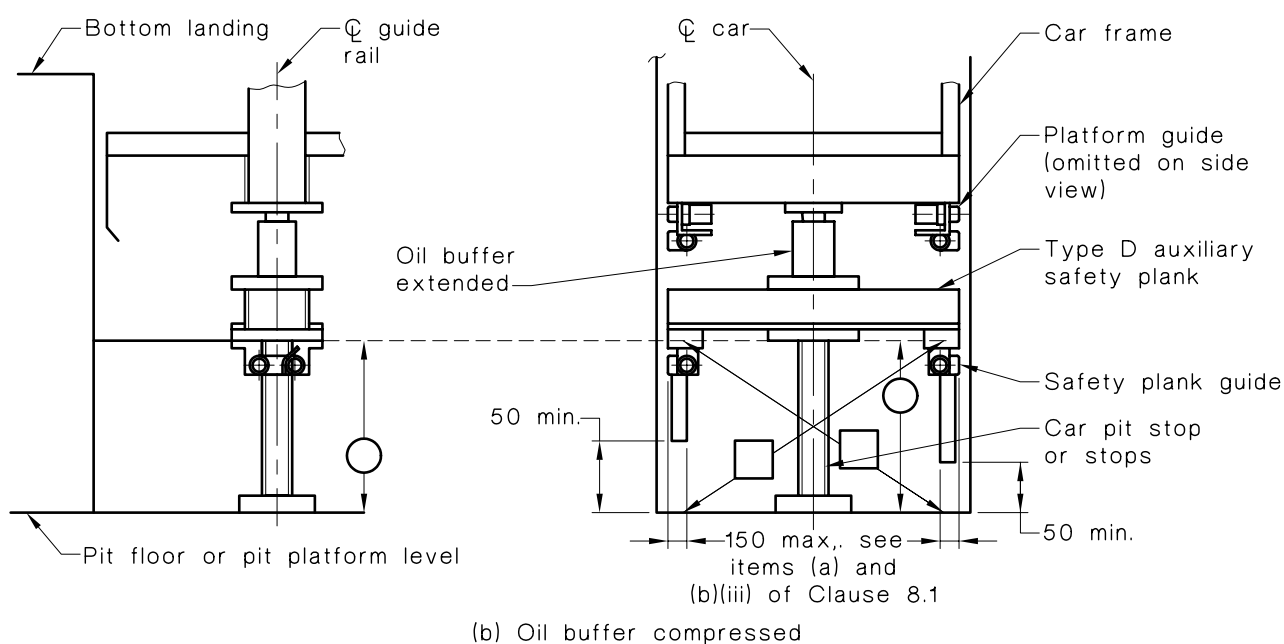
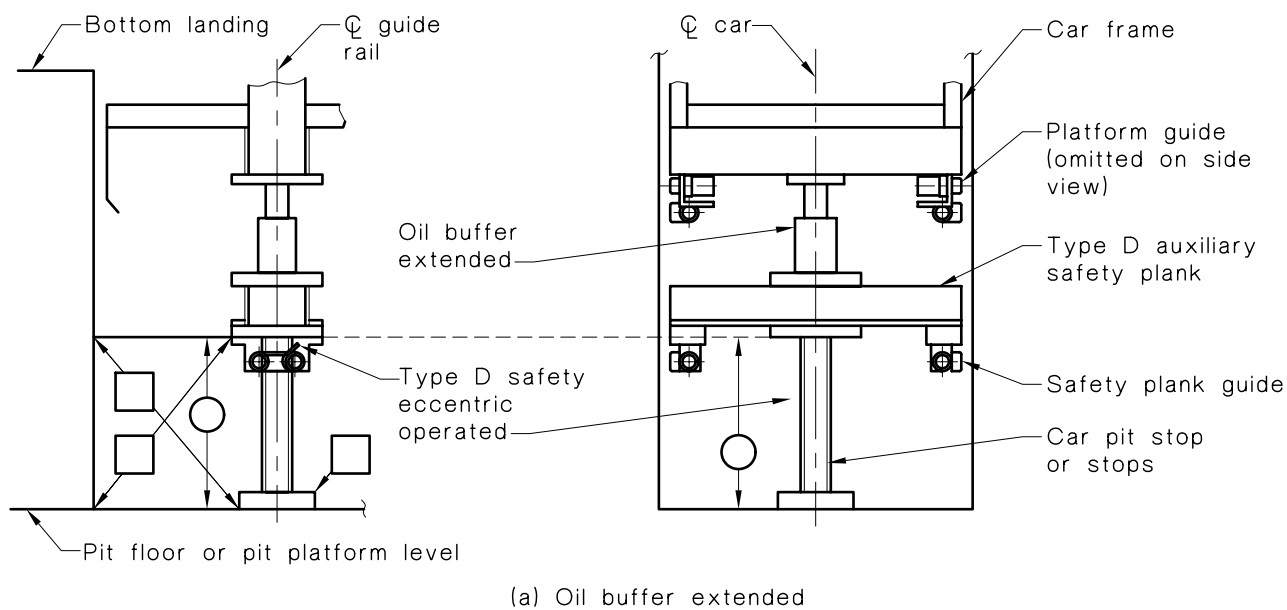
LEGEND FOR MAN CLEARANCES SPECIFIED BY CLAUSE 8.1(b):

□ Area

○ Height

DIMENSIONS IN MILLIMETRES

FIGURE 8.1(A) CLEARANCES BELOW THE CAR—TYPES A, B AND C SAFETY GEAR



LEGEND FOR MAN CLEARANCES SPECIFIED BY CLAUSE 8.1(b):



Area



Height

DIMENSIONS IN MILLIMETRES

FIGURE 8.1(B) CLEARANCES BELOW THE CAR—TYPE D SAFETY GEAR

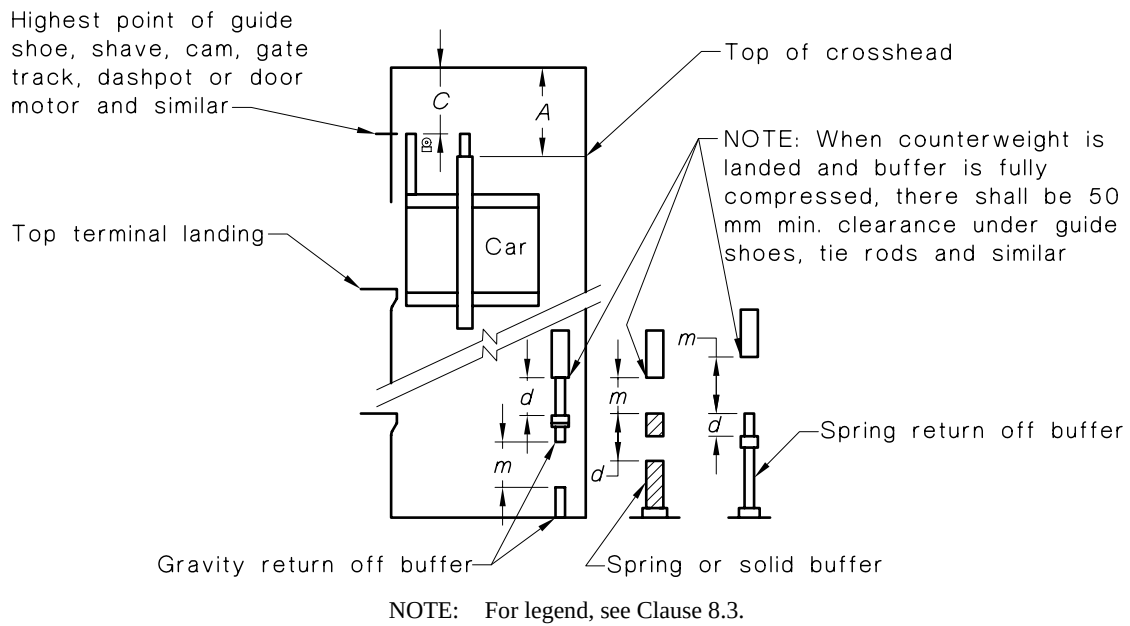


FIGURE 8.3.1 CLEARANCES ABOVE THE CAR FOR ROPE-SUSPENDED LIFTS, AND BELOW THE COUNTERWEIGHT

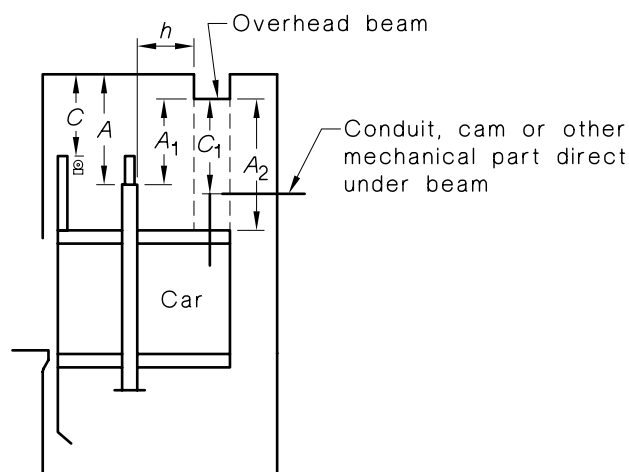
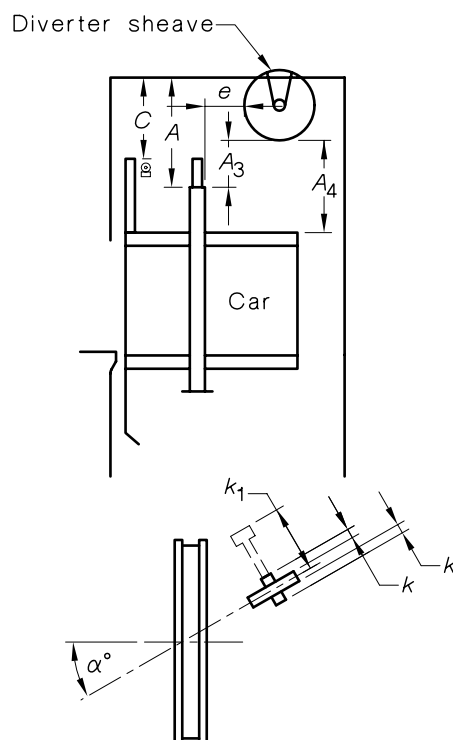


FIGURE 8.3.2 CLEARANCES ABOVE THE CAR WHERE OVERHEAD BEAM PROTRUDES BELOW LIFTWELL CEILING

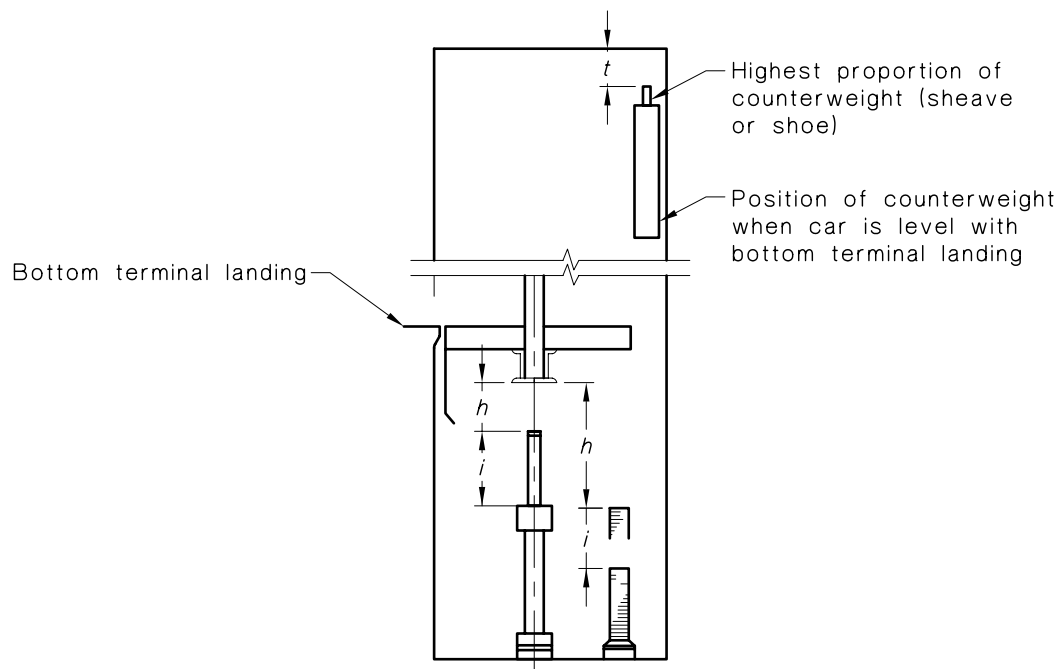


NOTE: For legend, see Clause 8.3.

LEGEND TO FIGURES 8.3.2 AND 8.3.3 (see also Clause 8.3):

- n = distance measured horizontally between overhead beam and crosshead
 where n is 500 mm or less, A_1 shall be not less than A and C_1 shall be not less than C
 where n is greater than 500 mm, A_1 may be ignored, but A_2 shall be not less than A and C_1 shall be not less than C
- A_1 = distance measured vertically between lowest part of overhead beam and top of crosshead
- A_2 = distance measured vertically between lowest point of beam and car roof
- C_1 = mechanical clearance measured vertically between underside of beam and conduit, cam or other car member mounted directly under the beam
- e = distance measured horizontally between rim of diverter sheave and nearest part of crosshead
 where e is 500 mm or less, A_3 may be reduced by 20 mm for each 10 mm of e and A_4 shall be not less than A , provided that—
 - (a) α is not more than 10 degrees; and
 - (b) k is not more than 175 mm
 where α is more than 10 degrees; A_3 shall be not less than A
 where k is more than 175 mm, refer to Legend for k_1 below
 where e is more than 500 mm, A_3 may be ignored but A_4 shall be not less than A
- A_3 = distance measured vertically from lower edge of sheave to top of crosshead
- A_4 = distance measured vertically from lower edge of sheave to roof of car
- α = angle that sheave axis is out of parallel with crosshead
- k = distance that sheave bearing brackets or shaft protrudes from side face of sheave
- k_1 = where k exceeds 175 mm, the vertical clearances for the shaft or brackets are to be established as for overhead beams (see Clause 8.3.2)

FIGURE 8.3.3 CLEARANCES ABOVE THE CAR WHERE OVERHEAD DIVERTER SHEAVE PROTRUDES BELOW LIFTWELL CEILING



NOTE: For Legend, see Clause 8.5

FIGURE 8.5 CLEARANCES ABOVE THE COUNTERWEIGHT

SECTION 9 BUFFERS AND STOPS

9.1 PROVISION

For the purpose of stopping the lift in the pit, stops and buffers shall be provided for cars and counterweights of lifts in accordance with Table 9.1.

TABLE 9.1
TYPES OF STOPS AND BUFFERS

Rated speed of car or counterweight m/s	Minimum buffer requirement
≤ 0.4	Solid buffers, or impact-absorbing stops
> 0.4, ≤ 1.0	Spring buffers, or elastomer buffers, or oil buffers
> 1.0	Oil buffers

9.2 OVERHEAD STOPS FOR DRUM-DRIVE LIFTS

For drum-drive lifts, overtravel of the lift car above the top landing shall be limited to not less than 250 mm nor more than 460 mm by contact of the car crosshead with structural overhead stops, which shall be equally spaced either side of the car hitch or 2:1 car sheave. These stops shall prevent contact of the lift car with any other overhead obstruction and, in the event of use, the lift car shall be maintained level and shall not leave the car guides.

The stops shall be of an impact-absorbing type capable of absorbing the energy in the mechanical system at rated speed, with power applied and within the stroke of the stop, without permanent deformation of the equipment.

9.3 LOCATION

Buffers and stops shall be located in the pit symmetrically about the vertical centre-line of the car frame or the counterweight frame within a tolerance of 50 mm.

9.4 SOLID BUFFERS

Solid buffers shall be of wood or other suitable resilient material and of sufficient strength to withstand without failure the impact of the car with rated load or of the counterweight, descending at a speed of 0.9 m/s. The material shall resist deterioration or shall be treated to resist deterioration.

9.5 SPRING BUFFERS

9.5.1 Load rating

Spring buffers for cars shall be at or near the fully compressed state when supporting a static load not less than 2 times nor more than 3 times the sum of the rated load plus the weight of the car.

Spring buffers for counterweights shall be at or near the fully compressed state, when supporting a static load not less than 2 times nor more than 3 times the mass of the counterweight.

9.5.2 Stroke

The stroke of the buffer spring as marked on the buffer rating plate (see Clause 9.5.3) shall be equal to or greater than that shown in Table 9.5.2.

9.5.3 Rating plate

Every spring buffer shall have a permanently attached metal plate marked in a legible and permanent manner to show its stroke and load rating.

TABLE 9.5.2
MINIMUM STROKE OF
SPRING BUFFERS

Rated car speed m/s	Minimum stroke mm
≤ 0.5	38
$> 0.5 \leq 0.75$	63
$> 0.75 \leq 1.0$	100

9.6 OIL BUFFERS

9.6.1 Load rating

The load rating of oil buffers shall be in accordance with the following:

- For car buffers, the mass of the car with rated load and the mass of the empty car shall each be not greater than the maximum nor less than the minimum values of the car buffer load rating.
- For counterweight buffers, the mass of the counterweight shall be not greater than the maximum nor less than the minimum values of the counterweight buffer load rating.

Where a lift is provided with lockdown rope compensation, the rating of the buffer shall allow for the force required to decelerate the total moving lift masses at an average rate of 9.8 m/s^2 . For this reason, the maximum and minimum buffer ratings may exceed the calculated values for the car plus load or the empty car respectively.

9.6.2 Stroke

The minimum stroke of oil buffers shall be based on the following:

- The average retardation shall be 9.8 m/s^2 when the car or counterweight strikes the buffer at 115% of rated speed. Table 9.6.2 indicates the minimum buffer strokes (gravity stopping distances) for speeds equal to 115% of the most usual rated speeds.
- Where a terminal speed-checking and stopping device complying with Clause 31.4 is installed so as to limit the speed at which the car or counterweight can strike its buffer, the buffer stroke shall be based on not less than 115% of such reduced striking speed on an average retardation not exceeding 9.8 m/s^2 . In no case shall the stroke used be less than 33.3% of the stroke required in Item (a) above, subject to a minimum of 422 mm.

9.6.3 Retardation

The maximum retardation developed shall not exceed 24.5 m/s^2 for more than 0.04 s for any mass of car or car plus load within the range of not more than the maximum nor less than the minimum values of the buffer load ratings, when the buffer is struck at an initial speed of not more than—

- for buffers complying with Clause 9.6.2(a), 115% of the rated speed of the buffer;

- (b) for buffers complying with Clause 9.6.2(b), 115% of the predetermined reduced speed of the buffer.

9.6.4 Factor of safety for oil buffer parts

The factor of safety of parts of oil buffers, based on the yield point for compression members and on the tensile strength and elongation for other parts, at gravity retardation with the maximum load for which the buffer is designed, shall be not less than the following:

- (a) For materials having an elongation not less than 20% in a gauge length of 50 mm ... 3.
 (b) For materials having an elongation not less than 15% but less than 20% in a gauge length of 50 mm.....3.5.
 (c) For materials having an elongation not less than 10% but less than 15% in a gauge length of 50 mm..... 4.
 (d) For materials having an elongation less than 10% in a gauge length of 50 mm 5.
 (e) For cast iron 10.

TABLE 9.6.2
MINIMUM STROKE OF OIL BUFFERS

Rated speed m/s	115% of rated speed m/s	Minimum stroke mm
1.00	1.15	67
1.125	1.29	85
1.25	1.44	105
1.50	1.73	152
1.75	2.01	207
2.00	2.30	270
2.25	2.59	342
2.50	2.88	422
3.00	3.45	607*
3.50	4.03	827*
4.00	4.60	1 080*
4.50	5.18	1 366*
5.00	5.75	1 687*
5.50	6.33	2 041*
6.00	6.90	2 429*
6.50	7.48	2 851*
7.00	8.05	3 306*
7.50	8.63	3 795*
8.00	9.20	4 318*
8.50	9.78	4 875*
9.00	10.35	5 465*
9.50	10.93	6 090*
10.00	11.50	6 747*

* For rated speeds in excess of 2.5 m/s, the buffer may have a reduced stroke as allowed by Clause 9.6.2(b).

9.6.5 Slenderness ratio for members of oil buffers

The slenderness ratio (ratio of length to radius of gyration) for members of oil buffers under compression as columns shall be not more than 80.

9.6.6 Plunger-return requirements

Oil buffers shall be designed so that—

- (a) the buffer plunger of return-type oil buffers shall return to its fully extended position within 90 s when released after full compression; and
- (b) while supporting a 9 kg mass, the plunger of spring-return type oil buffers shall return to the fully extended position within 30 s when released after being depressed 50 mm.

A switch wired into the control circuit of the lift shall be provided on each oil buffer to prevent lift movement should the buffer plunger not be within 13 mm of its normal operating position.

9.6.7 Buffer oil specification

Oils used in oil buffers shall have a pour point not more than -10°C as defined by ASTM D 97 and a viscosity index not less than 75 as defined by ASTM D 2270.

9.6.8 Means of determining oil level

Oil buffers shall be provided with means for determining that the oil level is within the maximum and minimum allowable limits. Glass sight gauges shall not be used.

9.6.9 Rating plate

Every installed oil buffer shall have securely attached thereto a metal plate, marked by the manufacturer in a legible and permanent manner, bearing the following information:

- (a) The maximum and minimum load rating, in kilograms.
- (b) The maximum striking speeds for which the buffer may be used in compliance with this Standard.
- (c) The make and grade of oil to be used.
- (d) The buffer stroke in millimetres.

9.6.10 Approval of oil buffers

Approval shall be based on the following:

- (a) The buffer shall be approved on the basis of the type tests specified in AS 1735.10, which shall be made or witnessed by an approved testing laboratory. Tests shall be made on the buffer with the longest stroke for each type or design, with the maximum and minimum load for each porting submitted.

The firm or person installing the buffer shall retain an authentic copy of the test certificate complying with the requirements of AS 1735.10.

- (b) A buffer tested in accordance with the test requirements of a prior edition of this Standard shall be acceptable without being retested, on submittal by the firm or person installing the buffer of the test certificate stating that the buffer, when tested, complied with the specified test requirements of that prior edition of this Standard.

The approval shall include buffers of the same type or design having an equal or shorter stroke with oil porting for any load range within the maximum and minimum loads for which the buffer has been tested.

- (c) Buffers of the approved type or design and having a stroke greater than the minimum required by Clause 9.6.2 may be used and the maximum and minimum load ratings increased provided that the maximum retardation of the buffers used will comply with the requirements of Clause 9.6.3. The forces to which the buffers are subjected shall not exceed those developed in the laboratory tests.

9.6.11 Changes in design

Changes in design of oil buffers, which affect their strength or performance or other major changes, shall not be made unless approved by the testing laboratory.

Minor changes, which do not affect the strength or performance of oil buffers, shall not be made unless approved by either the manufacturer or the testing laboratory.

9.7 ELASTOMER BUFFERS

9.7.1 Load rating

The mass of the car with rated load shall be equal to or less than the maximum load rating of the buffer. The mass of the empty car shall be equal to or greater than the minimum load rating of the buffer.

9.7.2 Stroke

The stroke of the buffer shall be in accordance with Table 9.7.2; however, the maximum stroke shall be not greater than 65% of the freestanding height of the buffer.

9.7.3 Rating plate

Every buffer shall have a metal plate permanently attached as close as practicable to the buffer, marked in a legible and permanent manner, to show its stroke and load rating.

9.7.4 Retardation

The retardation shall not be more than 9.8 m/s^2 when the car strikes the buffer.

SECTION 10 PITS

10.1 PROVISION

A pit shall be provided for every power lift.

10.2 FLOORS

Pit floors shall be substantially level, except for unavoidable projections into the pit of portions of structural footings.

10.3 GUARDS BETWEEN ADJACENT PITS (see Clause 20.3)

Where the difference in level of adjacent pit floors exceeds 600 mm, a substantial guard of material not deemed combustible when tested in accordance with AS 1530.1, such as 1.6 mm thick sheet steel or 50 mm × 3.15 mm diameter crimped wire mesh, shall be installed to separate such pits. Guards shall extend not less than 1800 mm above the higher pit floor and may be provided with an access door subject to the following conditions:

- (a) The doorway shall be not less than 1800 mm high.
- (b) The door shall be self-closing and any hinged types shall be self-latching.
- (c) The full height of the door shall not be obstructed by either of the adjacent cars while they are resting on the fully compressed buffer.
- (d) A ladder shall be provided between the two pit levels.

10.4 ACCESS LADDERS

Unless a pit access door complying with Clause 12.21.3 is provided, each lift shall be provided with a pit access ladder, which shall comply with the following requirements:

- (a) The relevant requirements of AS 1657, except that—
 - (i) clearances behind the back edges of rungs of ladders shall be not less than 100 mm;
 - (ii) the width between stiles shall be not less than 350 mm; however, this width may be reduced to not less than 300 mm where structural difficulties exist; and
 - (iii) the minimum strength requirements for the ladder shall comply with AS/NZS 1892.1.
- (b) The ladder shall be of a material not deemed combustible when tested in accordance with AS 1530.1.
- (c) Rungs shall extend to the height of the top of the stiles.
- (d) The ladder shall be accessible from the bottom landing of the lift.
- (e) Where practicable, the ladder shall be located on a side of the liftwell which is adjacent to the wall containing the landing door giving access to the ladder. Where so located, the following requirements apply:
 - (i) The horizontal distance between a ladder stile and the inside edge of the landing door jamb shall be not more than 1000 mm. Where the reach distance from the pit ladder to the outer edge of the door jamb exceeds 1200 mm, or the doorjamb surface does not provide a suitable handhold a suitable handhold shall be provided on or adjacent to the doorjamb and within 1200 reach distance of the pit ladder.

- (ii) Either the ladder shall extend not less than 1150 mm above the sill line, or hand grips shall be mounted above the centre-line of the ladder or above both sides of the ladder to a height above the sill line of not less than 1150 mm.
- (iii) A rung shall be positioned approximately at the level of the lowest landing door sill.
- (f) Where it is not practicable to mount a ladder on a side of the liftwell that is adjacent to the wall containing the landing door, such as where the ladder position cannot comply with Item (e)(i) above, the ladder shall be located on the front of the liftwell. Where so located, the following requirements apply:
 - (i) The horizontal distance between a ladder stile and the inside edge of the landing door jamb shall be not more than 750 mm.
 - (ii) The ladder shall extend not less than 1150 mm above the sill line, but may be further extended to provide an easy reach to door locks and the like.
 - (iii) Ladder rungs shall be positioned so as to obtain one rung not less than 125 mm nor more than 175 mm below the sill line and one rung not less than 75 mm nor more than 125 mm above the sill line.
 - (iv) Ladder stiles shall be designed so as to discourage their use as hand grips.
 - (v) The landing door sill extension shall be cut back to the inside line of the open landing door at least, to reduce interference with hands when the rungs are gripped.
 - (vi) There shall be a clearance of not less than 40 mm between the rungs and the landing door when open.
 - (vii) The clearance between the stile and the landing door shall not be less than 6 mm.
 - (viii) The ladder shall not reduce the minimum clearances permitted by Clause 15.1.2.

10.5 PIT LIGHTING

For pit lighting see Clause 11.3.

10.6 PIT STOP SWITCH

Every lift shall be provided with the following relevant pit stop switches, which shall comply with Clause 29.14:

- (a) A stop switch shall be located in the liftwell, approximately 1000 mm above the lowest landing served, within easy reach from the pit ladder, and within easy reach while standing adjacent to the nearest edge of the landing-door opening with the car away from the landing.
- (b) A stop switch shall be located in the pit near the pit ladder, accessible from the pit area when the car is on its fully compressed buffer.
- (c) A stop switch shall be located in the pit adjacent to the access door.
- (d) Where the lift is in a multiple liftwell and an access door in another pit is provided, an additional stop switch shall be located in the pit adjacent to the nearest point of access to that pit.
- (e) The wiring of the pit stop switches shall be so arranged that the bypassing of any other safety device at the controller shall not render the pit stop switches inoperative.